ATP 3-90.97

Mountain Warfare and Cold Weather Operations

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This publication supersedes FM 3-97.6, dated 28 November 2000 and ATTP 3-97.11, dated 28 January 2011.

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Mountain Warfare and Cold Weather Operations

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Preface

The purpose of ATP 3-90.97 is the Army's doctrinal publication for operations in mountain warfare and cold weather operations. It provides doctrinal guidance and direction for how United States (U.S.) forces conduct mountain and cold weather operations and is to arm leaders and Soldiers with the information necessary to operate in mountain and cold weather environments. The information contained in this manual applies to all Soldiers, regardless of rank or job specialty. This manual is designed to work in conjunction with and complement Training Circular on military mountaineering (TC) 3-97.61 and Army Tactics and Techniques Publication (ATTP) 3-21.50. This manual will enable leaders and Soldiers to understand mountain and cold weather environments, their effects on military weapons and equipment, impacts these environments have on personnel, and most importantly, how units employ the elements of combat power in mountain and cold weather environments.

The principal audience for this publication is all members of the profession of arms. Commanders and staffs of Army headquarters serving as joint task force or multinational headquarters should also refer to applicable joint or multinational doctrine concerning the range of military operations and joint or multinational forces. Trainers and educators throughout the Army will also use this publication.

This publication provides the conceptual framework for conventional forces to conduct mountain and cold weather operations across the range of military operations. It addresses mountain and cold weather operations at operational and tactical levels. See ATTP 3-21.50 for lower level information.

Commanders, staffs, and subordinates ensure that their decisions and actions comply with applicable United States, international, and in some cases host-nation laws and regulations. Commanders at all levels ensure that their Soldiers operate in accordance with the law of war and the rules of engagement. (See FM 27-10.)

This publication uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. Terms for which this publication is the proponent publication (the authority) are italicized in the text and are marked with an asterisk (*) in the glossary. Terms and definitions for which this publication is the proponent publication are boldfaced in the text. For other definitions shown in the text, the term is italicized and the number of the proponent publication follows the definition.

ATP 3-90.97 applies to the Active Army, Army National Guard/Army National Guard of the United States and United States Army Reserve unless otherwise stated.

The proponent of publication is the United States Army Combined Arms Center. The preparing agency is the Combined Arms Doctrine Directorate, United States Army Combined Arms Center. Send comments and recommendations on DA Form 2028 (Recommended Changes to Publications and Blank Forms) to Commander, United States Army Combined Arms Center and Fort Leavenworth, ATTN: ATZL-MCD, 300 McPherson Avenue, Fort Leavenworth, KS 66027-2337; by e-mail to usarmy.leavenworth.mccoe.mbx.cadd-org-mailbox@mail.mil; or submit an electronic DA Form 2028.

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Introduction

When conducting military operations in mountains or cold weather environments, leaders and Soldiers must plan to fight two enemies: the environment and the opposing force. Despite the difficulties that mountain and cold weather pose, there are armies that have and can conduct large-scale, sustained operations in mountain and cold environments. In contrast, few U.S. military units or personnel have trained extensively in mountain and cold weather operations. For those trained in how to operate in mountain and cold weather environments effectively, they will not only survive but prosper when their training is used as a combat multiplier. Mountain and cold weather can be extremely intimidating, however, Soldiers, can fight and win in these environments with proper preparation and training. Preparation includes understanding the environment and its effects on Soldiers and equipment and ensuring that U.S. forces have the proper clothing and equipment to accomplish their tasks. Although the military's equipment is among the best in the world for use in mountain and cold weather, training must include knowing how to use that equipment and how to adapt operations. Mountains and cold weather present unique challenges for the sustainment forces. Realistic and challenging training can prepare Soldiers for the rigors of mountain and cold weather warfare, allowing them the opportunity to develop the discipline and confidence that operating in the mountains or cold demands.

While Soldiers can train on some base skills and knowledge in the classroom or through self-study, experiential-based training in the terrain and weather are the only way to develop the skill set required to operate successfully. These environments place high demands upon troops, leaders, and equipment. Training requires the use of specialized clothing, equipment, and procedures to combat the effects of complex, compartmentalized mountainous terrain, cold weather, and high altitudes. Units develop robust training programs to prepare Soldiers for this environment. Soldiers train at the Northern Warfare Training Center in Fort Wainwright, Alaska and the Army Mountain Warfare School in Camp Ethan Allen, Vermont. Additionally, limited training opportunities may exist at the Marine Corps Mountain Warfare Training Center (MCMWTC) in Bridgeport, California for individual Soldiers and Army units up to a brigade in both mountain and cold weather warfare.

The FM 3-97.6 chapters of 1. Intelligence, 2. Command and Control, 3. Firepower and Protection of the Force, 4. Maneuver, 5. Logistics and Combat Service Support have been replaced with the following ATP 3-90.97 ten chapters:

Chapter 1 addresses the severe environmental conditions associated with the mountain and cold region environments and their effect on units and individuals and discusses mountain and cold region terrain and weather characteristics that impact military operations.

Chapter 2 discusses specific effects of mountainous environments on intelligence operations by concentrating on two areas of the intelligence process; plan and direct, and collect. These activities are most impacted by mountainous environments, such as when the environment limits communication.

Chapter 3 addresses operations in mountains and their characteristics. Considerations for the size of units, formations, and detailed planning are addressed. Additionally, risk management considerations are introduced.

Chapter 4 focuses on how complex and compartmentalized terrain, the time of year, weather conditions, and an adversary's actions influence movement and maneuver in the mountains.

Chapter 5 looks at considerations for conducting engineering operations in mountain and cold region environments. Specific challenges for engineers in this environment and planning considerations to cope with them are discussed.

Chapter 6 covers a broad spectrum of planning considerations for sustainment in support of operations conducted in mountains and cold regions.

Chapter 7 covers the functions of military aviation in support of mountain operations. The unique considerations and limitations associated with military aviation in mountain operations, and how to minimize their effects, are addressed.

Chapter 8 addresses considerations for indirect fires in mountain operations. While the basic tactical principles for artillery remain valid in mountains, they are subject to the limitations imposed by the terrain and weather addressed in this chapter. Considerations for targeting, mortars, and air support are also discussed.

Chapter 9 covers the unique challenges that the mountainous environment poses when trying to employ communications equipment.

Chapter 10 focuses on training for mountain and cold region operations, both individually and collectively. Training standards, programs, and expectations are discussed. Specific training venues and standards are addressed to ensure that the Army maintains a high level of interoperability and to enhance units' warfighting capability in these challenging environments.

Chapter 1

The Environment

PRESENT IMPERATIVE FOR MOUNTAIN DOCTRINE

1-1. History illustrates the need for the Army to focus on mountain doctrine and training when conducting expeditionary operations in mountainous environments. While a mountainous environment is challenging, expeditionary forces operate effectively with proper training, equipment, and organization. The tactics, techniques, and procedures (TTP) used for mountain and cold weather operations must be trained in actual mountainous terrain at representative high elevations and cold.

1-2. According to the Marine Corps Intelligence Activity, MCIA-1586-001-05, Marine Corps Midrange Threat Estimate 2005-2015, there are 20 states of interest in the world, located within an arc of instability that ranges from the Caribbean through Africa, South and Central Asia, and to North Korea. According to the World Factbook maintained by the Central Intelligence Agency (CIA), 16 of the 20 states of interest have regions with elevations equal to or greater than 2,438 meters (8,000 feet) (see Table 1-1). The current and projected threats in many of these countries center on small and irregular forces operating in rugged, compartmentalized terrain. These forces are expected to use the inherent advantages that mountainous terrain and weather offer in order to negate U.S. technological advantages in information collection and firepower. Therefore, the ability to fight both large- and small-scale contingencies against conventional and irregular, non-state actors is paramount.

Table 1-1. States of Interest

Country	Highest Elevation	Location
Afghanistan	7,485 m	Noshak
Albania	2,764 m	Maja e Korabit (Golem Korab)
Bangladesh	1,230 m	Keokradong
China	8,850 m	Mount Everest
Columbia	5,775 m	Pico Cristobal Colon
Ethiopia	4,533 m	Ras Dejen
Georgia	5,201 m	Mt'a Shkhara
Haiti	2,680 m	Chaine de la Selle
Indonesia	4,884 m	Puncak Jaya
Iran	5,671 m	Kuh-e Damavand
Iraq	3,611 m	Cheekha Dar
Liberia	1,380 m	Mount Wuteve
Mauritania	915 m	Kediet Ijill
Nigeria	2,419 m	Chappal Waddi
North Korea	2,744 m	Paektu-san
Pakistan	8,611 m	K2 (Mt. Godwin-Austen)
Philippines	2,954 m	Mount Apo
Saudi Arabia	3,133 m	Jabal Sawda'
Syria	2,814 m	Mount Hermon
Uzbekistan	4,301 m	Adelunga Toghi

MOUNTAINOUS ENVIRONMENT

1-3. The principal mountain ranges of the world lie along the broad belts shown in Figure 1-1. Called cordillera (after the Spanish word for rope), these ranges encircle the Pacific basin and then lead westward across Eurasia into North Africa. Secondarily and though no less rugged, chains of mountains lie along the Atlantic margins of the Americas and Europe.

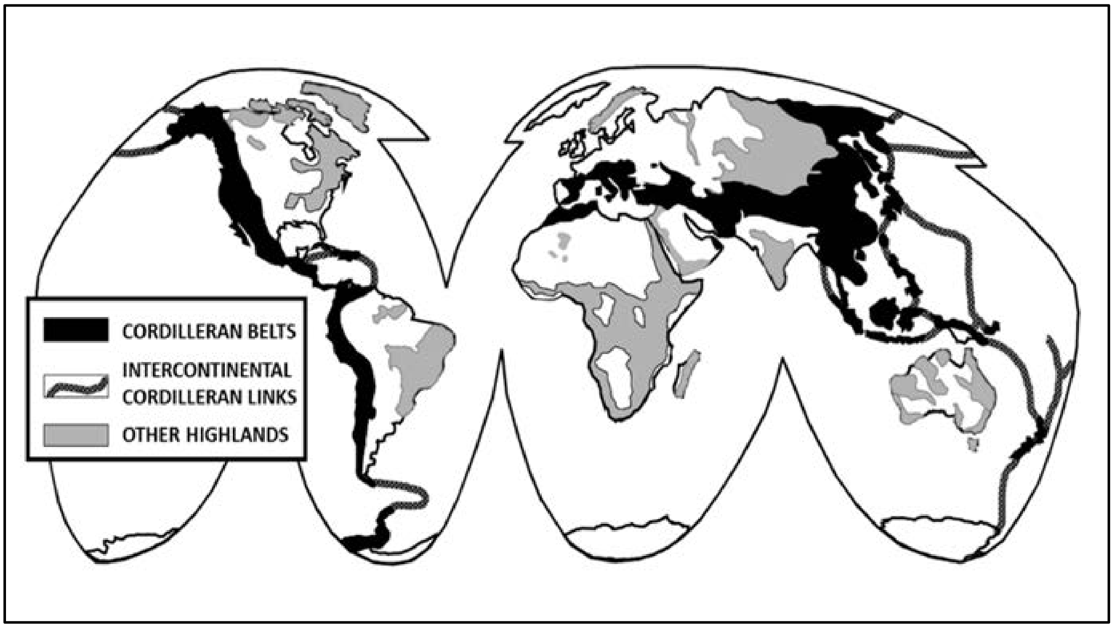

Figure 1-1. Mountain Regions of the World

1-4. Different mountain chains have different types of climates. Some chains are located in dry desert regions with temperatures ranging from extreme heat in the summer to extreme cold in the winter. In tropical regions, small to medium mountains are covered in lush jungles with deep ravines that flood during the rainy season. Temperatures in these areas typically remain warm and humid all year. Many of the mountains in Central America and many mountainous regions in Africa and South America that are located close to the equator have these characteristics. Conversely, high mountains in temperate climates have sparse vegetation at elevations above 3,505 meters (11,500 feet) and temperatures drop below freezing in winter. Some mountainous regions have a variety of environments, such as in Afghanistan where units have encountered several different mountainous environments within the same area of operations.

MOUNTAINOUS TERRAIN

1-5. Mountains may rise abruptly from the plains to form a giant barrier or ascend gradually as a series of parallel ridges extending unbroken for great distances. Mountains may have isolated peaks, rounded crests, eroded ridges, and high plains and be cut by valleys, gorges, and deep ravines. High rocky crags with glaciated peaks and year-round snow cover exist in mountain ranges at most latitudes along the western portion of the Americas and in Asia. Regardless of their appearance, rugged terrain is common among all types of mountains.

1-6. Mountain slopes generally vary between 15 and 45 degrees. Cliffs and other rocky precipices may be near vertical or even overhanging. Aside from obvious rock formations and other local vegetation characteristics, actual slope surfaces are relatively firm earth or grass. Grassy slopes may include grassy clumps known as tussocks; short alpine grasses; or tundra, which is more common at higher elevations and latitudes. Many slopes will be scattered with rocky debris deposited from the higher peaks and ridges. Extensive rock or boulder fields are known as talus. Slopes covered with smaller rocks, usually fist-sized or smaller, are called scree fields. Slopes covered in talus are often an easy ascent route. On the other hand, climbing a scree slope is difficult because the small rocks tend to loosen easily and give way.

1-7. In winter and at higher elevations throughout the year, snow covers slopes, creating an environment with its own distinct effects. Some snow conditions aid travel by covering rough terrain with a consistent surface. Deep snow, however, impedes movement and requires troops to be well trained in using snowshoes, skis, and over-the-snow vehicles. Steep, snow-covered terrain presents the risk of snow avalanches as well. Snow can pose a serious threat to troops not properly trained and equipped for movement under such conditions. Avalanches have taken the lives of more troops engaged in mountain warfare than all other terrain hazards combined.

1-8. Commanders operating in the arctic and subarctic mountain regions and the upper elevations of the world's high mountains, are confronted with vast glaciated areas. Valleys in these areas are buried under massive glaciers and present additional hazards such as hidden crevasses and ice and snow avalanches. The mountain slopes of these peaks are glaciated and their surfaces are composed of varying combinations of rock, snow, and ice. Although glaciers have their own peculiar hazards requiring special training and equipment, dismounted movement over valley glaciers may be the safest route through these areas.

1-9. Different rock types, soil composition, and slope types affect how forces are employed. For example, granite produces fewer rock falls but its jagged edges make pulling rope and raising equipment more difficult. Granite is abrasive and increases the danger of ropes or accessory cords being cut. Sedimentary rock, such as limestone, produces significant numbers of caves. An in-depth analysis of individual factors that affect operations in mountainous environments is in TC 3-97.61.

1-10. See Appendix A for a discussion of altitude and environmental hazards in mountains. This appendix provides detailed information on environmental threats unique to mountains and cold regions.

GLACIERS

1-11. Glaciers are rivers of ice and rocks that slowly move down mountains. They are formed when the rate of snowfall or other types of precipitation exceeds the rate of melting in summer months. After accumulations over hundreds of years, the snow compresses into ice that can range from ten to several hundred feet thick. Glaciers can be small and only cover a portion of a mountain or they can be massive with a series of glaciers covering a mountain range. Dismounted movement across glaciers is dangerous due to icy conditions, landslides, ice falls, and deep crevasses that often crisscross glaciers. Troops should reference TC 3-97.61 for movement considerations over glaciers. Glaciers are a good supply of water for units on patrol. Units purify water and reduce the need for aerial or ground resupply.

COLD ENVIRONMENT

1-12. For military purposes, cold regions are defined as any region where cold temperatures, unique terrain, and snowfall have a significant effect on military operations for one month or more each year. About one quarter of the earth's land mass may be termed as severely cold. In Figure 1-2, this area is indicated by the area above line A in the Northern Hemisphere and below line A in the Southern Hemisphere. In these areas, mean annual air temperatures stay below freezing, maximum snow depths exceed 60 centimeters, and ice covers lakes and rivers for more than 180 days each year. Another quarter of the earth is termed moderately cold. In Figure 1-3, this area fits between lines A and B (including most of the United States and Eurasia). Its mean temperatures during the coldest month are below freezing.

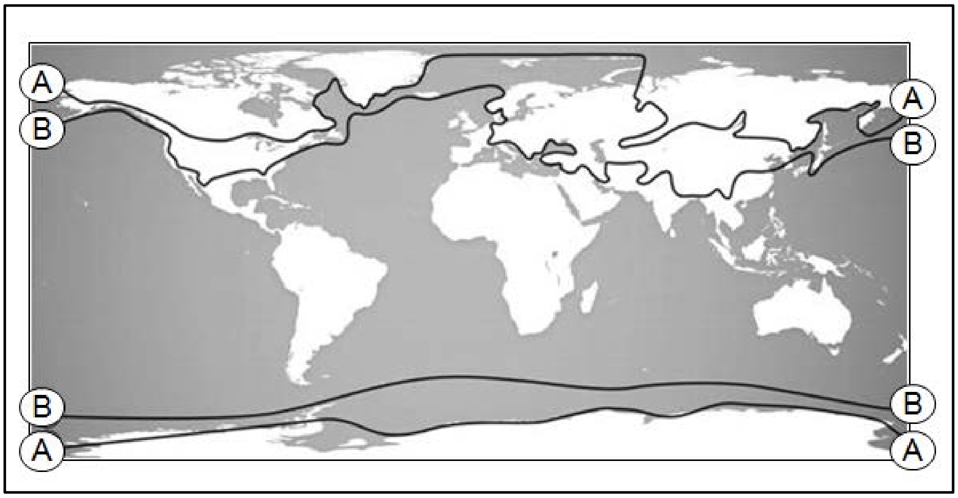

Figure 1-2. Cold Regions of the World

1-13. Military forces use more than one classification system to break down cold regions into sub-regions. This discussion is loosely derived from the Bailey's ecoregions geographical classification system (see Army Regulation (AR) 70-38 for more detailed information). Cold regions are further broken down into the arctic, subarctic, and temperate sub-regions. These are simplifications of biomes. This classification system considers climate, latitude and terrain features recognizable across the globe. All three sub-regions include mountains, which significantly complicate operations in cold regions. All mountain areas that receive snowfall are considered cold regions.

Arctic Region

1-14. The southern limit of the Arctic region is located at the Arctic Circle (latitude 66º 32' N). Above this latitude the sun never sets on the summer solstice and the sun never rises during the winter solstice. Located in the northern continental fringes of North America, Iceland, coastal Greenland, and the Arctic coast of Eurasia, this region has long, severe winters and short, cool summers. The mean monthly temperature of the warmest month is between 32° F and 50° F (0° C and 10° C). Annual precipitation is less than eight inches (200 millimeters), but low rates of evaporation make the climate humid. Vegetation consists of low-growing grasses, lichens, mosses, and brush with treeless plains. Soils are developed and have a permanently frozen sub-layer (permafrost) that seasonally thaws at the surface. Surface and subsurface drainage is poor and creates muddy summertime conditions. The Arctic predominately consists of coastal plains, low-interior and high-interior plains, and lesser areas of low and high-relief mountains. Most development and infrastructure of military interest centers around ports and areas with valuable natural resources (such as oil and natural gas). Few roads or towns exist.

Subarctic Region

1-15. The subarctic is the area between 50º north latitude and the Arctic Circle. At least one month of the year has a mean monthly temperature above 50° F (10° C). Precipitation falls mostly in the summer months. Vegetation consists primarily of needle-leaf forests and open woodlands. Soils are acidic, seasonally frozen, and contain discontinuous permafrost. Numerous lakes, ponds, peat bogs, and swamps exist because of poor subsurface drainage. The subarctic consists of coastal plains, high-relief and low-relief mountains, lesser areas of low-interior and high-interior plains, and extensive areas of rock and non-cohesive sand. There is typically more infrastructure and developed areas than the arctic region, but vast undeveloped areas with few roads dominate. The largest temperature range in the world exists here. Snow cover exists for at least six months in the lowlands; surrounding mountains can have perennial snow cover.

Temperate Region

1-16. Temperate areas vary greatly and include maritime and continental zones, heavily forested areas, mountain ranges, deserts, and plains areas. The effects of cold on military operations in this region are generally short term but these effects can be catastrophic for unprepared units.

Mountain Influenced Cold Region

1-17. Variations in climate that exist in cold regions result from mountainous terrain. Mountain terrain can cause a vertical change in weather called a zonation and may cause differences in weather on the windward and leeward side of the mountain. Mountains can complicate operations in cold regions. Leaders treat all mountains and mountainous regions that receive a predictable amount of snowfall as a cold region. Many tasks needed to operate successfully in cold regions apply to mountain regions but operating in mountainous terrain requires specialized training beyond the scope of this manual. Factors such as slope, soil composition, and surface configuration differentiates mountain operations from other mountain and cold weather operations. The most significant factor to affect individual performance is altitude. Performance starts to degrade after personnel ascend to elevations over 5,000 feet (1,500 meters).

INFLUENCE OF OCEANS AND LAND MASSES

1-18. In addition to the influence of mountain regions on climate, large bodies of water (maritime zones) and inland areas (continental zones) have the greatest overall effect on the climate of an area.

Maritime Zone

1-19. A maritime zone is influenced by large bodies of water, be it an ocean or large lake. It typically moderates temperatures throughout the year with cool wet summers and milder winters with heavy precipitation. During the winter months, maritime zones typically experience cold-wet conditions. Temperatures hover near freezing, and freeze-thaw cycles typically occur throughout the winter. Wet snow, sleet, and rain are also common conditions. This effect diminishes with the latitude.

Continental Zones

1-20. Continental zones are inland areas. The climate is influenced by large land masses. These zones are typically drier than maritime zones. Extreme cold temperatures in winter and warm to hot temperatures in summer are the norm. Continental zones generally experience cold-dry conditions.

TERRAIN CHARACTERISTICS

1-21. Characteristics of terrain affect cold regions. These terrains characteristics include icecaps, boreal forests, tundra, permafrost, muskeg, glaciers, rivers, and overflow ice.

Icecaps

1-22. In the high northern latitudes, the icecap includes the large ice sheets such as those found in Greenland, Antarctica, and on small islands. Mean annual temperatures are below freezing, with low amounts of annual precipitation occurring as snow and landscapes generally devoid of vegetation and soils. Most of the development and infrastructure of military interest centers on ports and areas with valuable natural resources (such as oil and natural gas). Few roads or towns exist.

Boreal Forests

1-23. Thick boreal forests, also known as taiga, are vast areas where evergreen spruce and firs are the dominant plant life. The taiga is the northernmost area where trees can exist. Boreal forests grow primarily in the subarctic region and are located in the arctic and temperate regions as well. The extent of these forests diminishes the further one moves north (see Figure 1-3). The tree line (with respect to elevation) is generally low. Transitions to treeless areas occur at elevations as low as 2,000 feet (610 meters). Treeless areas are generally characterized as tundra.

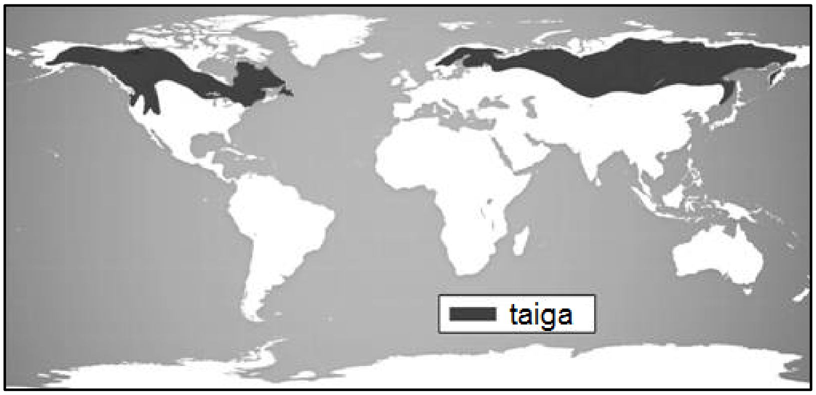

Figure 1-3. Extent of Boreal Forests (Taiga)

TUNDRA

1-24. The tundra is an area where tree growth is hindered due to low temperatures and a short growing season. Tundra is the most prevalent terrain feature north of the subarctic. Tundra consists of various grasses and mosses. Vegetation develops into clumps with standing pools of water between clumps. These are known as tussocks and make mounted and dismounted movement extremely difficult during the summer and during freeze-thaw periods. The tundra can swallow vehicles as they sink into the swampy ground. Movement is easier in the winter when the ground is frozen. Even with the frozen ground of winter, vehicular movement is generally restricted to roads. Movement on tundra can quickly turn into a vehicle recovery operation. Drainage in these areas is typically poor due to the permanently frozen ground that exists under the tundra. This is known as permafrost.

PERMAFROST

1-25. Permafrost is permanently frozen ground that occurs when the ground temperature is 32° F (0° C) or colder for two or more years. It is continuous in the arctic region but sporadic in the subarctic and nonexistent in temperate regions. The thickness of permafrost varies from a few feet to over a thousand feet in depth. Disturbance of the tundra increases the thawing of permafrost. In areas where permafrost is present, Soldiers will have to build fighting positions above ground unless they have engineer support. Frozen ground prevents the draining of water, contributing to the formation of muskeg.

MUSKEG

1-26. Muskeg is a type of bog or wetland found in poorly drained areas underlain with permafrost. Muskeg develops in areas with abundant rainfall and cool summers. Trapped by underlying permafrost, water moves little or not at all. Acid from slowly rotting plants accumulates in stagnant water and lowers soil ph. Due to the acidic soil, only a few specialized plants grow in this environment. Personnel can quickly spot this terrain when black spruce (mainly in the subarctic), sphagnum moss, and sedges grow in abundance. Muskeg can hinder or facilitate mobility depending on the season and temperature. Sedges replace grasses, which prefer warmer, dryer conditions. Usually the ground is soft and spongy, or it can be a vast shallow swamp. Again, movement is difficult in the summer but gets easier in the winter when the ground is frozen. These areas are often difficult to detect in early or late winter when the ground is only partially frozen. Vehicles that attempt to move through muskegs at this time often get trapped.

GLACIERS

1-27. Glaciers are rivers of ice and snow that develop with the seasonal accumulation of snow in valleys where the summer temperature stays low enough to prevent complete snow melt. The accumulated snow eventually turns to ice through compression forces. The flow or movement of glaciers is caused by gravity. Glaciers glide over a layer of melt-water between the underside of the glacier and the surface of the earth. Glaciers and polar icecaps cover 10 percent of the earth's surface. Alaska contains two percent of the total glaciers. Typically, glaciers occur in mountainous regions of the subarctic and temperate areas. Glaciers are the highway into the mountains and can be safer and easier to negotiate than the surrounding ridges and peaks. However, glaciers are dangerous if Soldiers are not familiar with the unique terrain found in this environment. Soldiers require specialized training and equipment to traverse and negotiate over and around crevasses and ice falls.

RIVERS

1-28. Rivers found in cold regions can either aid movements or be an obstacle depending on the time of year and mission. Subarctic rivers are usually glacier-fed with many braided channels and swift currents. Glacier-fed rivers change course frequently, making river navigation difficult and rendering map data suspect. If shallow-draught boats are available, rivers are lines of communication (LOCs) in summer. Once firmly frozen, rivers may offer routes for both mounted and dismounted movement. During spring and early winter (when the rivers experience break-up and freeze-up), rivers become impassable. Some rivers, especially in temperate areas, may not freeze solidly enough to allow for winter movement.

OVERFLOW ICE

1-29. Overflow ice occurs when a layer of ice ruptures and water underneath it flows up through the surface. Two conditions must exist for overflow ice to occur. First, temperatures must be below freezing. As a water source freezes, it does so from the top down. Second, subsurface water must be under pressure. If the water under the layer of ice is under pressure (for example where a spring continues to flow into the area), the water forces its way through ice and flow on top of it. Overflow ice can occur throughout the winter despite extremely cold temperatures. Ice can rupture and refreeze many times, forming layer upon layer of ice. Overflow ice is difficult to detect and creates a significant obstacle along roadways. Despite extremely cold temperatures, Soldiers and equipment may become immersed in water. Layers of ice may build up as a result of overflow throughout the winter and can persist on rivers well into summer, creating another obstacle to movement.

TERRAIN ANALYSIS

1-30. As in all tactical operations, terrain analysis involves observation and fields of fire, avenues of approach, key terrain, obstacles, cover and concealment. Successful mountain and cold weather operations require that commanders and staffs understand the terrain characteristics and hazards.

OBSERVATION AND FIELDS OF FIRE

1-31. In the arctic region, conditions resemble a desert environment with respect to observation and fields of fire. Generally, the terrain is open with little high vegetation and allows for unrestricted visibility though there is still complex terrain. In areas with boreal forests, visibility is limited, especially in old growth spruce and fir forests. This condition is limited in the arctic region but extensive in the subarctic region. Snow and light conditions impact observation and fields of fire. Winds create ground blizzards, restricting operations for long periods. Long periods of darkness and twilight restrict observation. Whiteouts and gray-outs are further hindrances to visibility. Conversely, moonlit nights over snow-covered terrain provide observation and fields of fire. The looming phenomena in extreme cold conditions can make range estimation difficult. Featureless tundra creates the same effect in the summer and winter. Long periods of daylight in the summer months reduce or eliminate the option of conducting operations under limited visibility.

AVENUES OF APPROACH

1-32. Avenues of approach depend mainly on manmade roads and trails. When the ice is thick enough, units can use waterways cleared of snow or construct ice roads. Units use specialized tracked vehicles such as bulldozers to open otherwise restricted and severely restricted terrain. Soldiers properly trained and equipped with skis or snowshoes effectively move cross-country. Those without the equipment or training will need to remain close to roads and trails. Units can use river networks to move personnel and supplies quickly over long distances in the summer months.

KEY TERRAIN

1-33. The important terrain features in the cold regions are major road networks, LOCs, and any developed or urban areas. For small units, shelter adds to combat effectiveness. Increased logistics requirements necessitate access to developed areas on a larger scale than most planners anticipate. In extreme cold regions, battles to control this key terrain are common. Passes, the high ground that can control a key pass and river networks, are also key terrain. Seemingly insignificant trails will quickly become key terrain. In areas dominated by boreal forests these small informal trails are fairly common outside population centers and usually will not show up on topographic maps. Current aerial imagery will become critical.

OBSTACLES

1-34. The challenges that snow and ice present to wheeled, tracked, and individual movement are numerous. Often, units require extensive engineer efforts to keep roads open. Combat engineers are the most valuable and necessary resource for large-scale military operations conducted in cold regions. Lack of roads require units to construct roads and trails. Limited frost-free days make this a time-consuming and difficult prospect. Other options used to overcome these obstacles include constructing ice roads and winter trails or using frozen waterways. Chinook winds that bring a thaw bring military operations to a halt as roads flood and turn to impassable mud. The break-up period in spring slows military operations to a crawl. For cross-country movement, snow presents a significant obstacle to Soldiers not trained in the use of skis or snowshoes. Cross-country movement during the summer months is equally difficult. Thick forests, swampy tundra, and muskeg restrict vehicle movement to roads and trails. Off road, individual movement is slow and arduous.

COVER AND CONCEALMENT

1-35. Inter-visibility lines are the only means of cover or concealment in the arctic and subarctic environments. In the boreal forests, concealment is excellent. Small diameter spruce and fir trees provide limited cover from small arms fire but under indirect fires, these small trees will create additional flying debris. Where the ground is frozen, snow and ice can be used to create effective fighting positions.

COLD WEATHER CHARACTERISTICS

1-36. The Army groups cold temperatures using categories. The temperature categories are:

- Wet cold, +39° F to +20° F (4° C to -7° C).
- Dry cold, +19° F to -4° F (-7° C to -20° C).
- Intense cold, -5° F to -2° F (-20° C to -32° C).
- Extreme cold, -25° F to -40° F (-32° C to -40° C).
- Hazardous cold, -40° F (-40° C) and below.

1-37. Wet cold conditions occur when wet snow and rain often accompany wet cold conditions. This type of environment is more dangerous to troops and equipment than the colder, dry cold environments because the ground becomes slushy and muddy and clothing and equipment becomes perpetually wet and damp. Because water conducts heat 25 times faster than air, core body temperatures drop if troops are wet and the wind is blowing. Troops become casualties due to weather if not properly equipped, trained, and led. Wet cold environments combined with wind is dangerous because of the wind's effect on the body's perceived temperature. Wet cold leads to hypothermia, frost bite, and trench foot. Wet cold conditions are not only found in mountain environments but in many other environments during seasonal transition periods. Under wet cold conditions, the ground alternates between freezing and thawing because the temperatures fluctuate above and below the freezing point. This makes planning problematic. For example, areas that are trafficable when frozen could become severely restricted if the ground thaws.

1-38. Dry cold conditions are easier to live in than wet cold conditions. Like in wet cold conditions, proper equipment, training and leadership are critical to successful operations. Wind chill is a complicating factor in this type of cold. The dry cold environment is the easiest of the four cold weather categories to survive in because of low humidity and the ground remains frozen. As a result, people and equipment are not subject to the effects of the thawing and freezing cycle, and precipitation is generally in the form of dry snow.

1-39. Intense cold exists from -5° F to -25° F (-20° C to -32° C) and can affect the mind as much as the body. Simple tasks take longer and require more effort than in warmer temperatures and the quality of work degrades as attention-to-detail diminishes. Clothing becomes more bulky to compensate for the cold so troops lose dexterity. Commanders consider these factors when planning operations and assigning tasks.

1-40. Extreme cold occurs from -25° F (-32° C to -40° C) and the challenge of survival becomes paramount. During extreme cold conditions, it is easy for individuals to prioritize physical comfort above all else. Personnel withdraw into themselves and adopt a cocoon-like existence. Leaders expect and plan for weapons, vehicles and munitions failures in this environment. As in other categories, leadership, training and specialized equipment is critical to the ability to operate successfully.

1-41. In hazardous cold conditions, commanders and planners assume greater risk if they engage in operations when the temperature falls below -40° F (-40° C). Units are extensively trained before undertaking an operation in these temperature extremes.

1-42. For military purposes, snow is categorized as light, moderate, or heavy. Each classification affects visibility and ground movement due to accumulation:

- Light snow-visibility is equal to or greater than 5/8 mile (or 1,000 meters) in falling snow. A trace to one inch (2.5 centimeters) per hour accumulates.
- Moderate snow-visibility is 5/16 mile to half a statute mile (or 500–900 meters) in falling snow. One to three inches (2.5 to 7.6 centimeters) per hour accumulates.
- Heavy snow-visibility is cut to less than ¼ statute miles (or 400 meters) in falling snow. Three or more inches per hour accumulates.

1-43. Units use snow and snowdrifts to their advantage on the battlefield. Snow fills in ditches and vehicle tracks. On rolling ground, snow tends to flatten the terrain. The wind builds up snowdrifts and can change the contour of the ground a great deal. Leaders must continually study snow-covered terrain and utilize every feature. On the downwind side of every obstacle, tree, house, and bush, a hollow always exists. This hollow provides an observation point or firing position. The wind, particularly in open areas, may form long wavy snowdrifts that are almost natural snow trenches. When deep enough, Soldiers use them as an approach to the objective.

1-44. Rivers found in cold regions may aid movements or be major obstacles depending on the time of year and mission. Subarctic rivers are usually glacier-fed with many braided channels and swift currents. Glacier-fed rivers change course frequently, making river navigation difficult and rendering map data suspect. If units have shallow-draught boats available, rivers may provide valuable lines of communication in summer. During spring and early winter, rivers often become impassable due to freezing or thawing ice flows. Once firmly frozen, rivers may offer routes for both mounted and dismounted movement. However, leaders must consider trafficability and overflow ice (see Paragraph 1-18) for both mounted and dismounted forces. Some rivers, especially in temperate areas, may not freeze solidly enough to allow for winter movement. If the ice is not thick enough, units find themselves immobilized. Soldiers consider that certain swampy areas do not freeze solidly during the coldest periods of winter. Often, these swampy areas are covered with snow, concealing the water underneath. Soldiers should avoid and bypass suspected areas without attempting to cross.

1-45. Weather information is hard to obtain in cold regions. Observatories make generalized forecasts for large, unpopulated areas that may or may not be accurate. A call for moderate weather conditions in the forecast may not be relevant to the particular area of operations and local conditions overwhelm forces that are unprepared. For specific information on weather observation and forecasting, refer to TC 3-97.61. Unique weather phenomena can affect military operations in mountain and cold weather environments include:

- Ice fog.
- Blizzard.
- Whiteout.
- Gray-out.
- Temperature inversion.

- Looming.
- Chinook winds.
- Aurora borealis.
- Light data.

ICE FOG

1-46. Ice fog occurs when three things exist: temperatures of -30° F (-34° C) or colder, a vapor source, and still air conditions. Moisture from heat sources that use combustion crystallize in the air forming a fog of very small ice particles. Firing a weapon creates heat. The resulting ice fog pinpoints the weapon's position with a lasting signature. Soldiers require alternate firing positions for both target acquisition as well as cover and concealment. Stationary running vehicles, large generators, and field kitchens can produce localized ice fog. This creates a signature around them noticeable for miles.

1-47. An open lead in a river can produce a small cloud. This can also serve as a warning to anyone traveling on the river that open water may be present.

1-48. When viewed from a height, a valley shrouded in ice fog may indicate the presence of a temperature inversion.

BLIZZARD

1-49. A blizzard consists of the following conditions for three or more hours:

- Sustained winds or frequent gusts to 35 miles (56 kilometers) per hour or greater.
- Considerable falling, blowing, or falling and blowing snow.
- Reduced visibility to a quarter of a mile or less.

1-50. Ground blizzards involve winds moving snow that is already on the ground. This hazard is common in the arctic and subarctic. This phenomenon can last for days.

WHITEOUT

1-51. A whiteout occurs when sunlight is diffused through an unbroken cloud layer onto an unbroken snow surface. The horizon effectively disappears. Individuals experience a loss of depth perception and an inability to distinguish irregularities in terrain. Whiteout is often referred to as flat light. Travel under whiteout conditions is difficult and dangerous. Units should restrict or cease movement until the condition clears.

GRAY-OUT

1-52. A gray-out occurs over a snow-covered surface during twilight or when the sun is close to the horizon. The result is an overall grayness to surroundings causing a loss of depth perception. During gray-out, the horizon is indistinguishable which makes travel difficult and dangerous.

TEMPERATURE INVERSIONS

1-53. Normally as elevation increases, temperature decreases. In mountainous areas, the general rule is for every 1,000 feet of elevation gained, the temperature decreases 3° F to 5° F. When cold, calm, clear conditions exist, temperature inversions are the exception to this rule. This reversal of normal cooling with elevation is called a temperature inversion. Temperature inversions occur when the mountain air is cooled by snow, ice, and heat loss through thermal radiation. The cooler air settles into valleys and low areas. The inversion continues until the sun warms the surface of the earth or a moderate wind causes a mixing of the warm and cold air layers. Temperature differences can be as much as 20 degrees higher on hills or mountainsides that are just a few hundred feet from the valley floor.

Looming

1-54. Looming is an optical illusion. Objects appear closer and taller than they actually are. This condition exists in cold still air and can make range estimation inaccurate.

Chinook Winds

1-55. Chinook winds are warm dry winds that occur in the lee of high mountain ranges. In a few short hours, these winds produce complete thaws in cold regions that typically do not see a thaw until the spring or summer months. The conditions mimic the spring break-up period typical of cold regions. Mud and flooding on roads and trails make them impassable. Frozen rivers and lakes partially thaw, making them unreliable as transportation routes.

Aurora Borealis

1-56. The aurora borealis is caused by charged particles produced by the sun, deflected by the earth's magnetic field, and drawn towards the poles. These charged particles create a light show in the sky and are most visible on cold clear nights. The aurora borealis occurs throughout the year. It has been reported as far south as Mexico City. It disrupts amplitude modulation communications but enhances frequency modulation communications. In the Southern Hemisphere the aurora borealis is known as Aurora Australis.

Light Data

1-57. During winter, especially in the arctic and subarctic, night operations are the norm. On clear, cold, windless, moonlit nights, personnel can see exceptionally well over open snow-covered terrain. During the winter months, twilight provides some visibility even though the sun has set. However, in a snow-covered forest (taiga), it becomes extremely dark.

1-58. Sunrise, sunset, and the amount of useable light available for operations becomes relative to where Soldiers are located. Leaders and Soldiers use the information contained in Figure 1-4 to approximate the number of daylight hours available for a given part of the year. Light data depends on latitude and time of year. Soldiers should realize that sunrise and sunset times swing dramatically in the arctic and subarctic. For example, as the seasons change into spring and summer in Anchorage, Alaska, each day grows approximately six minutes longer. This effect reverses itself after the summer solstice. At its most extreme, 24 hours of darkness or 24 hours of light occur, depending on the time of year.

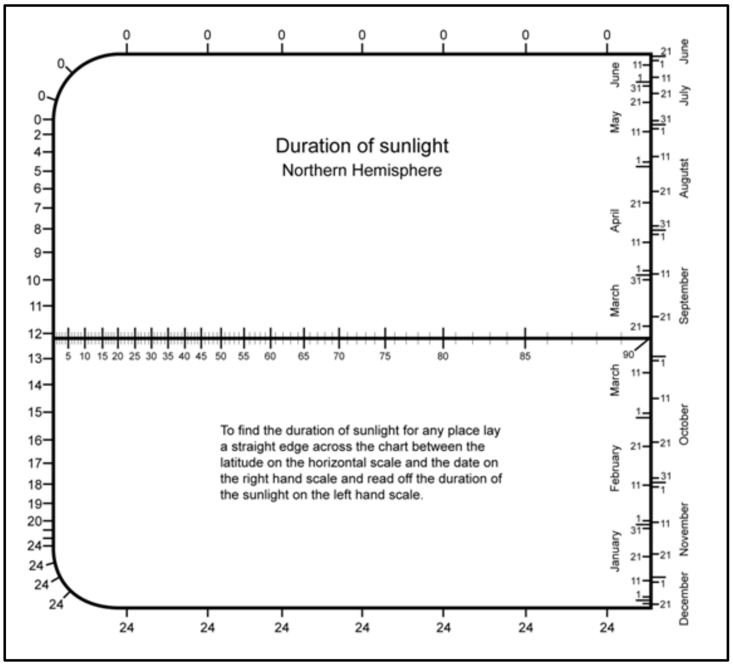

Figure 1-4. Daylight Chart

MOUNTAIN CLASSIFICATIONS

1-59. Mountain environments are difficult to classify. Soil composition, surface configuration, elevation, latitude, and climatic patterns determine the specific characteristics of each major mountain range. When alerted to the potential requirement to conduct mountain operations, commanders analyze each characteristic for the specific mountain region where their forces operate. Generally, however, mountains are classified or described according to their elevation. For military purposes, mountains are classified according to operational terrain levels and dismounted mobility and skill requirements.

ELEVATION

1-60. Mountains are commonly classified according to elevation, which is the height of the immediate terrain in reference to sea level. Descriptors from the conditions for joint tasks are—

- Very high, greater than 3,048 meters (10,000 feet).
- High, 1,829 to 3,048 meters (6,000 to 10,000 feet).
- Moderately high, 914 to 1,829 meters (3,000 to 6,000 feet).
- Moderately low, 305 to 914 meters (1,000 to 3,000 feet).
- Low, 152 to 305 meters (500 to 1000 feet).
- Very low, less than 152 meters (500 feet).

1-61. In general, low mountains have an elevation of 152 to 914 meters (500 to 3,000 feet) with summits usually below the timberline. High mountains exceed 1,829 meters (6,000 feet) and are characterized by barren alpine zones above the timberline. Glaciers and perennial snow cover are common in high mountains and usually present commanders with more obstacles and hazards to movement than do low mountains.

1-62. Mountain operations are generally carried out at three different operational terrain levels (see Table 1-2).

Table 1-2. Operational Terrain Classifications

Level	*Description*
I	Bottoms of valleys and main lines of communication
II	Ridges, slopes, and passes that overlook valleys
III	Dominant terrain of the summit region

1-63. Level I terrain is located at the bottom of valleys and along the main LOCs. At this level, armored forces operate, but maneuver space is restricted. Infantry and armored forces are normally combined since vital LOCs usually follow the valley highways, roads, and trails.

1-64. Level II terrain lies between valleys and shoulders of mountains, and generally consists of narrow roads and trails—secondary LOCs—that cross this ridge system. Therefore, enemy positions on level III terrain dominate and influence the lower level II terrain. Similarly, units expend the energy to occupy level II terrain because it dominates level I terrain and influences operations dramatically.

1-65. Level III terrain includes the dominant terrain of summit regions. Mobility in Level III terrain is usually the most difficult to achieve and maintain. Level III terrain, however, provides opportunities for well-trained units to attack the enemy from the flanks and rear. At this terrain level, acclimatized troops with advanced mountaineering training infiltrate to attack LOCs, logistic bases, air defense sites, and command infrastructures.

DISMOUNTED MOBILITY CLASSIFICATION

1-66. When conducting mountain operations, commanders clearly understand the effect the operational terrain level has on dismounted movement. Therefore, in addition to the general mobility classifications contained in ATP 2-01.3/*MCRP* 2-3A,—unrestricted, restricted, severely restricted—mountainous terrain may be categorized into five classes based on the type of individual movement skill required (see Table 1-3). Operations conducted in the first two classes require little to no mountaineering skills but operations in the other three require a higher level of mountaineering skills for safe and efficient movement. Commanders plan and prepare for mountain operations largely based on this type of terrain analysis, particularly noting that class 4 terrain kills more people than any other class because the risk the terrain poses is less obvious than class 5 terrain.

Table 1-3. Dismounted Mobility Classifications

Class	*Terrain*	*Mobility Requirements*	*Skill Level Required*
1	Gentler slopes/trails	Walking techniques	Unskilled (with some assistance) and basic mountaineers
2	Steeper/rugged terrain	Some use of hands	
3	Easy climbing	Fixed ropes where exposed	Basic mountaineers (with assistance from assault climbers)
4	Steep/exposed climbing	Fixed ropes required	
5	Near vertical	Technical climbing required	Assault climbers

WEATHER

1-67. In general, mountain climates tend to be cooler wetter versions of the climates of the surrounding lowlands. Most mountainous regions exhibit at least two different climatic zones: a zone at low elevations and another at elevations nearer the summit regions. In some areas, an almost endless variety of local climates exist within a given mountainous region. Conditions change markedly with elevation, latitude, and exposure to atmospheric winds and air masses. The climatic patterns of two ranges located at the same latitude and in the same proximity may differ radically due to all of these individual factors. These different patterns of weather are known as micro-climatization.

1-68. Major mountain ranges force air masses and storm systems to drop significant amounts of rain and snow on the windward side of the range. As air masses pass over mountains, the leeward slopes receive far less precipitation than the windward slopes. It is not uncommon for the climate on the windward side of a mountain range to be humid and the climate on the leeward side arid. This phenomenon affects both coastal and inland mountains. The deepest winter snow packs are on the windward side of mountain ranges. As a result, vegetation and forest characteristics are different between these two areas. Prevailing winds and storm patterns determine the severity of these effects.

1-69. Mountain weather can be erratic, varying from calm to strong winds and from relative warmth to extreme cold within a short time or a minor shift in locality. The severity and variance of the weather require troops to be prepared for alternating periods of heat and cold, as well as conditions ranging from dry to extremely wet. At higher elevations, noticeable temperature differences exist between sunny and shady areas or between areas exposed to wind and those protected from it. This greatly increases every Soldier's clothing load and a unit's overall logistical requirements. For a more detailed listing of mountain weather considerations, see Appendix B.

1-70. Normally located within a G-2/S-2 and designated as a special staff officer, the United States Air Force Staff Weather Officer provides and coordinates weather support and services. AR 115-10/AFI 15-157 (IP) and AR 5-25 provide additional guidance.

Climate Influences

1-71. Like most other landforms, oceans influence mountain climates. Mountain ranges in close proximity to oceans and other large bodies of water usually exhibit a maritime climate. Maritime climates produce milder temperatures and larger amounts of rain and snow. Their winters produce heavy snowfalls, while their summer temperatures rarely get excessively hot.

1-72. Mountains farther inland display a more continental climate. Winters in this type of climate are cold while summers are hot. Annual rainfall and snowfall in these inland areas are far less than in a maritime climate and may be quite scarce for long periods. Relatively shallow snow packs are normal during a continental climate's winter season.

Temperature

1-73. Normally, troops encounter a temperature drop of three to five° F per 305-meter (1,000-foot) gain in elevation. At high elevations, there may be differences of 40 to 50° F between the temperature in the sun and that in the shade, which is similar in magnitude to the day-to-night temperature fluctuations experienced in some deserts. Besides permitting rapid heating, the clear air at high altitudes results in rapid cooling at night. Much of the chilled air drains downward so that the differences between day and night temperatures are greater in valleys.

Wind

1-74. Wind in a mountainous environment has the following characteristics:

- In high mountains, the ridges and passes are seldom calm, while strong winds in protected valleys are rare.
- Normally, wind velocity increases with altitude and is intensified by mountainous terrain.
- Valley breezes commonly blow up-slope in the morning and down-slope in the evening.
- Wind speed increases when winds are forced over ridges and peaks (orographic uplift) or when they funnel through narrowing mountain valleys, passes, and canyons (venturi effect).
- Wind blows with great force on an exposed mountainside or summit.
- As wind speed doubles, its force on an object nearly quadruples.

1-75. Mountain winds cause rapid temperature changes and may result in blowing snow, sand, or debris that can impair movement and observation. Commanders should routinely consider the combined cooling effect of ambient temperature and wind (wind chill) experienced by their troops (see Figure 1-5).

Cooling power of wind expressed as an equivalent chill temperature (under calm conditions)												
ESTIMATED WIND SPEED (IN MPH)	**ACTUAL THERMOMETER READING (F)**											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	EQUIVALENT TEMPERATURES (F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-124
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-21	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
Winds greater than 40 MPH have little additional effect.	LITTLE DANGER (for properly clothed person) Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh.			GREAT DANGER				
	Trench foot and immersion foot may occur at any point on this chart.											

Figure 1-5. Wind Chill Chart

1-76. At higher elevations, air is considerably dryer than air at sea level. Due to this increased dryness, troops must increase their fluid intake by approximately a third. In this environment, equipment will not rust as quickly and organic matter will decompose more slowly.

PRECIPITATION

1-77. The rapid rise of air masses over mountains creates distinct local weather patterns. A mountainous environment has the following effect on precipitation:

- Precipitation increases with elevation and occurs more often on the windward side than on the leeward side of ranges.
- Maximum cloudiness and precipitation generally occur near 1,829 meters (6,000 feet) elevation in the middle latitudes and at lower levels in the higher latitudes.
- Usually, a heavily wooded belt marks the zone of maximum precipitation.

1-78. Common types of mountain precipitation include rain and snow, thunderstorms, and traveling storms.

Rain and Snow

1-79. Both rain and snow are common in mountainous regions. Rain presents the same challenges as at lower elevations, snow affects all operations. Depending on the region, snow occurs at any time during the year at elevations above 1,521 meters (5,000 feet). Heavy snowfall increases avalanche hazards and can force changes to previously selected movement routes. In certain regions, the intensity of snowfall delays operations for months. Dry, flat riverbeds may appear as locations for assembly areas and support activities. However, rains and thawing snow and ice may create flash floods many miles downstream from the rain or snow's location.

Thunderstorms

1-80. Although thunderstorms are local and usually last only a short time, they can impede mountain operations. Interior ranges with continental climates are more conducive to thunderstorms than coastal ranges with maritime climates. In alpine zones, snow and wind squalls accompany thunderstorms. Ridges and peaks become focal points for lightning strikes, which occur most often in the summer. Although statistics do not show lightning to be a major mountaineering hazard, troops should take care to avoid summits and ridges, water, antennas, and contact with metal objects.

Traveling Storms

1-81. Storms caused by widespread atmospheric disturbances involve strong winds and heavy precipitation and are the most severe weather condition that occurs in the mountains. If troops encounter a traveling storm in alpine zones during winter, there will be low temperatures, high winds, and blinding snow. These conditions persist longer than in the surrounding low lying areas.

FOG

1-82. The effects of fog in mountains are the same as in other terrain but because of the topography, fog occurs more frequently in the mountains. The high incidence of fog makes it a significant planning consideration because it restricts visibility and observation. This complicates reconnaissance and surveillance. Fog, however, facilitates covert operations, such as infiltration. Routes in areas with a high occurrence of fog may need to be marked and charted to facilitate passage.

Chapter 2
Intelligence

PLAN AND DIRECT

2-1. The initial generation of intelligence knowledge about the operational environment occurs far in advance of detailed planning and orders production. This intelligence helps focus information collection once a mission is received. Intelligence planning is also an inherent part of the Army design methodology and the military decision making process (MDMP). Intelligence analysts must prepare detailed planning products for the commander and staff for orders production and the conduct of operations (see ATP 2-01 for more details).

2-2. The plan and direct step also includes activities that identify key information requirements and develops the means for satisfying those requirements. The Intelligence Directorate/Section (G-2/S-2) collaborates with the Operations Directorate/Section (G-3/S-3) to produce a synchronized and integrated information collection plan focused on answering commander's critical information requirements (CCIR) and other requirements. The CCIR and other requirements drive the information collection effort. Intelligence planning and directing comprises a broad range of detailed tasks to include:

- Initial intelligence knowledge about the operational environment such as research, intelligence reach, and analysis.
- Generating intelligence knowledge.
- Preparing intelligence preparation of the battlefield/battlespace (IPB) products and overlays.
- Developing the initial intelligence estimate or briefings.
- Establishing the intelligence architecture and testing access to the intelligence enterprise.
- Establishing effective analytic collaboration.
- Establishing liaisons.
- Establishing intelligence team cohesiveness.
- Establishing reporting procedures.
- Establishing formats and standards for products.
- Planning refinements, briefings, standard operating procedure (SOP) reviews, and rehearsals as wells as coordinating with various elements and organizations.
- Planning requirements and assessing collection.
- Assisting the G-3/S-3 with updating the information collection plan.
- Assessing continuously.
- Providing intelligence portions of the orders.
- Establishing other troop leading procedures or coordination in accordance with the mission variables mission, enemy, terrain and weather, troops and support available, time available, and civil considerations or METT-TC.

2-3. Planning and directing information requirements and the information collection plan is critical to intelligence operations in the restrictive terrain of mountainous environments and the harsh conditions of cold weather environments.

- A mountain environment is generally categorized as an area where altitude, relief, and weather significantly degrade normal military activities. Mountainous terrain exists in the jungle, temperate, and arctic regions of the world.
- A cold weather environment is characterized by low temperatures, fog, freezing rain, snow, ice, frozen conditions, and a series of freeze and thaw cycles.

2-4. Information collection planning in mountainous areas must take into consideration an increased reliance on aerial collection assets and degraded target acquisition and early warning and collection capabilities of intelligence systems. Such degradation increases the importance of emplacement and utilization of information collection assets. Military intelligence Soldiers may have to use man-portable equipment to execute intelligence operations and this requirement needs to be planned for by the staff while developing the information collection plan.

COLLECT

2-5. The collect step of the intelligence process is synchronized to provide critical information at key times throughout the phases of an operation and during the transition from one operation to another. A successful information collection effort results in the timely collection and reporting of relevant and accurate information which supports the production of intelligence.

2-6. It is critical for the staff to use well developed procedures and flexible planning to track emerging targets, adapt to changing operational requirements, and meet the requirement for combat assessment.

2-7. Key staff considerations for information collection in a mountain or cold weather environment are:

- Terrain trafficability and the ability to move cross-country which affects personnel movements, ground reconnaissance patrols, and the ability to employ mechanized forces.
- Rockslides are threats to movements and mobility and are most common after rains or periods of thaws.
- Forces are likely to be deployed at key terrain such as passes, road junctions, built-up areas, or adjacent high ground. However, enemy elements can bypass these defensive positions and attack from the flank or rear.
- Mountainous terrain may provide concealment.
- Aerial elements can mitigate terrain limitations but must deal with weather challenges and the potential for localized weather conditions.
- Higher elevations are frequently shrouded by rain, snow, sleet, and fog.
- Interrupted line of sight affects ground surveillance systems.
- Electronic surveillance can be reduced by using terrain masking, relay and retransmission to thwart direction finding, and electronic attack activities against communications sites.
- Line-of-bearing data may be used in conjunction with aerial assets for more reliable direction finding results, weather permitting (see FM 2-0).

2-8. The ability to live and fight in extreme cold weather environments is essential. Additional considerations for cold weather environment include:

- Changes to mobility corridors, avenues of approach, and trafficability due to freezes or thaws.
- Antenna icing can reduce range, increase noise, alter frequency, or simply collapse the antenna.
- Radar signal scattering due to ice, fog, and airborne snow.
- Thickened oil and lubricants which can cause mechanical problems in generators and vehicles.
- Decreased battery life and performance.
- Significantly degraded visibility due to snow and fog.
- Avalanches due to instability of snowpack, threatens troops and hinders mobility.
- Wind chill factors and potential human problems due to frostbite and immersion foot.

2-9. Initial information collection plans in mountainous or cold environments should utilize aerial or overhead collection platforms. These platforms use radar systems to detect manmade objects. If the weather is permitting, the initial information collection plan could include the use of electro-optical platforms.

2-10. Subsequent use of ground assets can verify the data gathered by overhead and electro-optical platforms and can capitalize on the limited or reduced capabilities of some types of overhead platforms in these environments.

2-11. In harsh mountainous terrain or cold weather environments, time is a greater planning factor for troop movements. Rates of march may be reduced due to terrain or weather conditions and must be planned for accordingly.

2-12. Once the information is collected, it is processed into a format that enables analysts to extract essential information. Processing involves converting, evaluating, analyzing, interpreting, and synthesizing raw collected data and information.

PRODUCE

2-13. Production is the development of intelligence through the analysis of collected information and existing intelligence. Analysts create intelligence products, conclusions, or projections regarding threats and relevant aspects of the operational environment to known or anticipated requirements (see FM 2-0 and ATP 2-19.4 for more information on intelligence production).

2-14. Intelligence products must be timely, relevant, accurate, predictive, and tailored to facilitate situational understanding and support decision making. Analysis is important to ensure the focus, prioritization, and synchronization of a unit's intelligence production effort is in accordance with the priority intelligence requirements (PIR) and other requirements.

DISSEMINATE

2-15. Commanders must receive combat information and intelligence products in time and in an appropriate format to facilitate situational understanding and support decision making. Dissemination while deliberate, should also be timely as it is critical to the success of operations.

2-16. The commander and staff must establish and support a seamless architecture to effectively disseminate information and intelligence. This can be challenging in mountainous environments as units and commanders may be spread out over large areas of terrain and operating in smaller elements.

2-17. There are numerous methods and techniques for disseminating information and intelligence. Information may be presented verbally, in writing, interactively, or in a graphic format. Dissemination methods and techniques include:

- Direct dissemination; person-to-person, by voice communications, or electronic means.
- Direct electronic dissemination, a messaging program.
- Instant messaging.
- Web posting, with notification procedures for users.
- Printing or putting information on compact disk and sending it.

2-18. Disseminating intelligence simultaneously to multiple recipients is one of the most effective, efficient, and timely methods and can be accomplished through various means. The G-2/S-2 must plan for methods and techniques to disseminate information and intelligence when normal methods and techniques are unavailable.

ANALYZE AND ASSESS

2-19. Analyze and assess are two activities that shape and continually occur throughout the intelligence process.

ANALYZE

2-20. Analysis assists commanders, staffs, and intelligence leaders in framing and solving the problem. Leaders at all levels conduct analysis to support situational understanding and decision making.

2-21. Analysis in requirements management is critical to ensuring information requirements receive the appropriate priority for collection. The G-2/S-2 staff analyzes each requirement to determine—

- The requirements feasibility and whether it supports the commander's guidance.
- The best method of satisfying the requirement (for example, which unit or capability and where to position that capability based limiting environmental factors).
- If the collected information satisfies the requirement.

2-22. Analysis is used in situation development to determine the significance of collected information and its significance relative to predicted threat courses of action, PIR, and other requirements.

ASSESS

2-23. Assessment is the continuous monitoring and evaluation of the current situation particularly that of significant threat activities and changes in the operational environment. Friendly actions, threat actions, civil considerations, and events in the area of interest interact to form a dynamic operational environment.

2-24. The G-2/S-2 staff continuously produces assessments based on operations, the information collection effort, the threat situation, and the status of relevant aspects of the operational environment. These assessments are critical to—

- Ensure PIRs are answered.
- Ensure intelligence requirements are met.
- Redirect collections assets to support changing requirements.
- Ensure operations run effectively and efficiently.
- Ensure proper use of information and intelligence.
- Identify threat efforts at deception and denial.

2-25. The G-2/S-2 staff continuously assesses the effectiveness of the information collection effort. This type of assessment requires sound judgment and a thorough knowledge of friendly military operations, characteristics of the area of interest, and the threat situation, doctrine, patterns, and projected courses of action.

ANALYTIC CONSIDERATIONS

2-26. Mountain populations exhibit certain traits that impact operations. While this varies based on location of the operation, case studies show generalizations that distinguish mountain populations from other populations. These variations include the following traits:

- Independent.
- Enhanced loyalty to their group.
- Homogeneous.
- Tribal/clannish.
- Increased emphasis on religion.
- Less economically developed than more accessible areas.
- Lacking formal education.
- Adherence to a strict social code.
- Different norms to determine economic status.
- Less infrastructure.
- Decreased access to information.
- Less emphasis on centralized governance.

2-27. While individual mountain populations are homogeneous because of compartmentalized terrain, the districts, provinces, or states where they reside are heterogeneous. Clans or tribes from one valley differs from those in the next. The operational impact is that small unit leaders are forced to conduct functions that are normally done at the battalion level and higher. As a result, assets are pushed to lower levels to compensate for this operational need. For example, the company intelligence support team will, in most cases, pull information from human environment/civil consideration databases.

2-28. A company intelligence support team (COIST) provides an analytical, production, and dissemination capability at the company level, providing the commander with options to exploit enemy vulnerabilities. The COIST analysis focuses on the company area of operations, with the ability to report and populate the battalion and brigade combat team (BCT) intelligence databases and the common operational picture. For further information on the company intelligence support team, see ATP 2-19.4.

2-29. Intelligence planners in a mountainous environment select teams of analysts who examine and share information provided by different field elements. Much like journalists, these analysts collect information from the grass roots level and incorporate that information at their command level. For example, they integrate information collected by civil affairs elements, provincial reconstruction teams, liaison officers (LNOs), female engagement teams (FET), military information support operations teams, human terrain teams, and infantry battalions into a shared database.

2-30. Leaders and planners put time and energy into selecting the best, most extroverted, and most eager analysts to serve in the fusion cells. The highly complex mountainous environment requires an adaptive way of thinking and operating, such as vetting a single source from one tribal valley compartment against the adjacent terrain/tribal compartment. These efforts facilitate stability operations by allowing the commander to better respond to the needs of the populace.

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Chapter 3

Operations

PLANNING CONSIDERATIONS

3-1. Forces plan for and operate for extended periods of time. Commanders and planners use the information in this chapter with ATTP 3-21.50. Due to the challenging human and physical environment and an elusive, adaptive, and complex enemy, operational (Army) forces must—

- Operate independent of forward operating bases (FOBs).
- Avoid an over reliance on armored and Stryker assets.
- Balance protection requirements with the need to operate and live among the population.

3-2. Operating and maneuvering in a mountainous environment requires centralized planning and decentralized execution. The dispersion of forces is useful when conducting offensive, defensive, and stability operations in the mountains. Decentralization enables greater flexibility and responsiveness across the operational area. In mountainous environments, battalion-size units may reorganize in order to increase the number of available maneuver elements. For example, forming four maneuver elements from the battalions' three table of organization and equipment (TOE) rifle companies, enhances the battalion's ability to cover more terrain.

3-3. Task organization is useful in a compartmentalized mountainous environment. Organizing existing units into smaller maneuver elements to compensate for environmental challenges requires additional time for personnel to train together, rehearse battle drills and SOPs, and build cohesiveness and trust. It requires more detailed planning and rehearsals. Maneuver commanders and planners know potential equipment constraints, reduction in unit cohesion, and mission command issues. Equipment issues arise since existing units are fragmented to create additional units. Unit cohesion suffers as personnel from existing units are split and reintegrated to create new units. Mission Command suffers significant impact due to the increased complications of having more moving pieces in the area of operations and relying on junior officers and noncommissioned officers (NCOs) to lead new units. Mountain leaders plan and lead the most distant or critical elements (level III master mountaineers, see Chapter 10).

3-4. The principles of patrolling do not change in a mountainous or cold weather environment (see FM 3-21.8 and ATTP 3-21.50). The method of movement may be impeded if crampons (spiked plate worn on boots for aid in climbing), snowshoes, or skis are required.

MISSION COMMAND CONSIDERATIONS

3-5. Compartmentalized terrain, expansive areas of operations, and severe environmental conditions limit communications systems and challenge mission command efforts. Large operational areas and the need to employ small unit tactics require commanders to decentralize and disperse their forces. Commanders rely on decentralized execution enabled by centralized planning, mission orders, and clear commander's intent. Risk management integration is critical at each level of command in all phases of mountain operations to identify and mitigate hazards to enhance mission success. The following considerations apply to mission command during mountain operations:

- Warning orders that allow subordinates ample time to prepare and plan for operations.
- Mission orders that empower subordinates and promote freedom of action.
- Commander's intent that clearly articulates the purpose, key tasks, and desired end state.
- Command relationships that are clearly understood and facilitate the exercise of initiative by subordinates (unity of command where possible, unity of effort where it is not).
- SOPs that are adopted, understood, and applied across the command.

- Mobile reserves or reaction forces that are trained to move quickly across rough compartmentalized terrain with tailored loads.

LEADERSHIP

3-6. Troops must have confidence in their leaders to ease anxiety in combat. This confidence diminishes unless leaders demonstrate the ability to lead in any environment. Superficial knowledge of mountain warfare and ignorance or underestimation of mountain hazards and environmental effects result in mission failure and the unnecessary loss of life.

3-7. Effective leadership combines sound judgment with a thorough understanding of the characteristics of the operational environment. Commanders first develop flexible and adaptable leadership throughout the chain of command. To fight effectively, they must be able to understand and exploit opportunities offered by the mountainous environment and minimize its effect on operations of personnel, equipment, and weapons. The keys to meeting this challenge are proper training and operational experience in the mountains. This requires leaders to understand the need for specialized clothing, equipment, and training. Commanders recognize the importance of small unit leaders to prevent environmental injuries and illnesses. Commanders manage risk to mission and risk to Soldiers by assessing the environmental hazards daily from subordinate leaders' updates.

COMMAND POSTS

3-8. Significant environmental impacts must be considered and mitigated to ensure the command post remains functional despite cold temperatures, high winds, and the effects of altitude.

Displacement

3-9. Displacing the command post takes more time due to the effects of the environment and the terrain itself. Displacement exercises are critical. Future command post locations must be identified quickly and reconnoitered to ensure they function effectively.

3-10. Headquarters configure command posts with redundant and overlapping capabilities, assuming sufficient equipment and personnel exist. Each element has a primary and secondary command and control responsibility. For example, the main command post has primary responsibility for logistics operations and movement control while the forward command post has responsibility for maneuvering forces and coordinating fire support. The main command post has the secondary responsibility of monitoring those tactical communications nets associated with maneuvering forces and coordinating fires support so that it can assume command in the event that the forward command post is compromised or needs to displace. By task organizing headquarters and assigning primary and alternate responsibilities to each element, commanders can exercise mission command while displacing command posts.

3-11. Normally, the commander will maintain a forward command element for the best situational awareness of the battlefield. During displacement, the commander passes control to the main command post until the forward command post re-establishes reliable communications.

Watch Personnel

3-12. A mountainous environment saps strength and energy from the troops so command posts need a three-watch system under harsh, mountain conditions. Headquarters personnel augmentation is essential to provide extra watch-standers, to assist command post displacements and to provide more depth for security personnel. In many cases, command posts will need their own defense, especially when conducting displacement operations. Units rehearse using different command post configurations to include setup, operations, and displacement from fixed facilities, tents, and mobile forms.

THE OFFENSE

3-13. Offensive actions in the mountains vary based on mountain restrictions. Conventional mountain operations occur to gain control of key or decisive terrain. Key terrain includes LOCs, mountain passes, ridges, and chokepoints. Troops attack from higher elevations to lower elevations to conserve energy, increase movement speed, and observe fields of fire. Frontal attacks against defended heights or through deep snow have little chance of success. Troops attack along the flanks and to the rear of the enemy. Consequently, flanking attacks and envelopments are the preferred form of maneuver.

3-14. A well-trained force uses mobility skills to mitigate the effects of the mountainous or snow covered terrain. This achieves surprise by infiltrating and attacking the enemy's rear or attacking during periods of limited visibility such as night, rain, or snow. Soldiers use helicopters and technical mountaineering skills to conduct decisive operations throughout the area of operations.

3-15. The mountainous terrain increases the threat to concentrated formations. Usually, it is difficult to coordinate all forces by time and location to rapidly support each other and achieve massed effects. The compartmented terrain separates adjacent units, which precludes mutual support and affects supporting distances. Therefore, it is critical for commanders to anticipate the concentration of forces and fires before the battle begins to achieve effective synchronization.

3-16. The length of the preparatory phase is longer in a mountainous environment. Offensive action against a well-defended enemy must be based on thorough reconnaissance and orderly preparation. Commanders take advantage of the weaknesses found in the enemy's defenses when planning. Commanders may require a large number of reconnaissance assets and additional time to determine the strength of enemy positions and to identify favorable routes to and beyond the objective.

3-17. Difficult approach routes are marked and prepared for safe passage. Easily traversed slopes, broad hills, plateaus, and valley floors, as well as mountainous terrain with well-developed road and transportation nets, create opportunities for the force to deploy in breadth. High ranges with ridges and crests leading to the objective require organization with extended LOCs. Units have overwatch when moving in the mountains. Traveling overwatch is the preferred technique when preparing for the offense.

3-18. If combat operations occur during snow storms or high winds, leaders keep compact formations, execute simple plans with reasonable objectives, provide detailed instructions, and use positive means of identification. Close reconnaissance and attack are possible under the concealment afforded by such conditions. If Soldiers have little or no experience operating in mountain and cold weather environments, leaders should not engage in offensive actions during inclement weather. Commanders should use compact formations to facilitate the exercise of mission command if a mission must happen.

3-19. In trackless mountainous terrain, company-sized teams conduct attacks. If the area assigned to a battalion permits, multiple companies can approach the objective separately on multiple routes, never moving without overwatch on adjacent high ground. In restrictive terrain, adequate maneuver space is not always available and several units use the same approach. It may even be necessary to conduct shaping operations to seize terrain that dominates movement routes.

3-20. After seizing an objective, units consolidate and reorganize. Assaulting troops may be fatigued and overheated from the exertion of the attack. Leaders make provisions to prevent personnel from becoming cold or heat casualties. Commanders and staffs must integrate exploitation forces into offensive plans. Once dislodged from defensive positions, enemy forces are at the mercy of the extreme cold and difficult terrain found in mountain and cold weather environments. This provides an excellent opportunity for follow-on forces to continue the offensive and compel the enemy to surrender or be destroyed.

OFFENSIVE TASKS

3-21. The types of offensive tasks are movement to contact, attack, and exploitation and pursuit. They are addressed in the following subparagraphs. For more information about offensive tasks, reference Army Doctrine Reference Publication (ADRP) 3-90.

MOVEMENT TO CONTACT

3-22. Units conducting movement to contact in the mountains are more vulnerable to attack and ambush. Limited mobility and dependence on restrictive LOCs limit deployment of the force from movement formations. Plans and movement formations should be based on maintaining flexibility and providing continuous security. As mobility decreases, units use a smaller force to establish contact. If mobility conditions vary because of differences in snow depth or mud conditions, commanders may need to adjust the location for deployment into attack formation. Search and attack operations by elements skilled in mountain and cold weather operations may help deny large areas to the enemy and collect information.

3-23. During a movement to contact, the advance guard advances in column, moving continuously or by bounds until it makes contact. While requiring less physical exertion, movement along the topographical crest of a ridgeline increases the possibility of enemy observation and should normally be avoided. Given adequate concealment, this exposure may be reduced by moving along the military crest. Ridgelines and crests can often provide a tactical advantage to the force that controls them by allowing rapid movement from one terrain compartment to another and affording excellent observation. In all cases, commanders must address the control or clearance of ridgelines that dominate their planned avenues of approach.

3-24. The main body should never be committed to canalizing terrain before forward elements have advanced far enough to ensure that the main body will not become encircled. This is a critical factor when employing a mix of infantry and armored forces that have sharp differences in operational tempo. Sustainment units must be readily available to sustain the combat elements. Major terrain features may physically separate maneuver units moving as part of a larger force. Continuous reconnaissance to the front as well as flank security is essential to prevent the enemy from infiltrating the gaps between units.

3-25. As the enemy situation becomes better known, commanders may shorten the distance between elements to decrease reaction time or they may begin to deploy in preparation for the attack. Lateral movement between adjacent columns is frequently difficult or impossible but every attempt should be made to maintain at least visual contact. Connecting files or mountain pickets are effective for lateral connection. Commanders must emphasize the use of checkpoint reporting, contact patrols, and phased operations to coordinate and control the movement of the overall force. Control measures should not be so numerous as to impede operations and stifle initiative. Proper control ensures that units and fires are mutually supporting, objectives are correctly identified, and units are in position to attack. Permanent occupation of key terrain is unrealistic and therefore, engagements occur repeatedly on the same pieces of terrain. Commanders should plan to control those historic points whenever operating within their vicinity. Fixing and finishing the enemy is often accomplished by direct and indirect fire, respectively, in mountainous terrain.

ATTACK

3-26. Speed, flexibility, and surprise which are normally advantages enjoyed by the attacker, are limited by restrictive terrain and the defender’s increased ability to see and acquire targets at greater distances. These limitations make it difficult for units above the company team level to conduct hasty attacks against prepared positions. Additional time should be allocated to conduct deliberate planning for fire support coordination, route selection, and command, control, and support coordination.

3-27. As the temperature drops, terrain-oriented objectives become more likely than force-oriented objectives since mobility worsens and the enemy seeks sheltered defensive positions. Units may significantly impair the enemy’s will and unit cohesion if they coordinate their attack as an operation in depth. Units can disrupt the enemy’s ability for sustainment in cold regions by attacking LOCs or support facilities.

3-28. Although the enemy’s defense may be more concentrated due to requirements for shelter and individual sustainability, this may be offset by maneuver limitations on the attacker as well as degradation of fire support assets. If the enemy’s proficiency at preparing a mountain/cold weather defense is greater than the friendly forces’ proficiency at conducting a mountain/cold weather attack, delays in preparing for a deliberate attack may favor the enemy.

Planning an Attack

3-29. When planning and conducting attacks, commanders should recognize that the enemy will generally seek to control the valleys and trail networks, including adjacent slopes and high ground. The enemy will attempt to engage the attacker in the valleys and low ground with flanking fires and artillery, often in a direct fire mode. Commanders must analyze the terrain to determine not only how the enemy will organize his defensive positions but also how the terrain might contribute to the enemy’s ability to counterattack. As friendly forces attempt to deploy for the attack, the enemy while using his advance knowledge of the terrain and prepared routes, may maneuver forces to counterattack from the flank or rear.

3-30. In snow covered terrain, concentration of forces may prove extremely difficult due to mobility restrictions and periods of limited visibility. Surprise may be more difficult to achieve when snow is present. The enemy can easily see moving objects on the snow and hear Soldiers moving because of better sound transmission in cold air. Additionally, the enemy may occupy specific locations so the only way surprise can be achieved is during periods of limited visibility. If ample over the snow transportation exists, suddenly increasing the tempo of an initially slow attack through the snow may surprise the enemy.

Terrain

3-31. All terrain features that can be occupied by even a small enemy force should be secured. In many instances, overwatch positions may not be readily available within the range or capability of organic weapons. Infiltration, technical climbing, and extensive breaching may be required to position weapons to support the assault. On many occasions, artillery support, especially in high mountains, may not be available. Commanders must identify fire support requirements and allocate fires based on the ability to support as well as on available ammunition. Because resupply may be limited and extremely difficult, they may need to place restrictions on the amount of ammunition expended on specific targets. Dominating terrain may give a commander great situational awareness while being beyond the range of fires.

Weather

3-32. Effectively using weather conditions increases opportunities for audacity in conducting attacks. This includes exploiting blizzards, falling snow, fog, low cloud cover, and natural night illumination. Leaders can imaginatively use what appear to be weather obstacles and turn them into major advantages. However, conducting offensive operations during severe weather conditions restricts the use of aviation support, increases reconnaissance problems (such as sensor degradation), and may reduce the length of reconnaissance patrols. Commanders weigh this advantage against losing control of their units. They use detailed plans to mitigate this risk. If commanders decide to attack during blizzards or a blowing snow storm, the unit should attack downwind or at a slight angle to force the enemy to face the full force of the storm.

Obstacles

3-33. Breaching obstacles and preparing bypass routes that allow the assault force to attack an enemy defensive position must be an integral part of the commander’s plan. In rugged terrain, manmade obstacles that are covered by fire create a particularly dangerous and formidable barrier. Control of breaching operations, in this type of terrain, is more difficult than in open terrain and mobility support is extensive if the obstacle cannot be reduced. Assaults in mountainous terrain almost always involve preparing routes that allow the assault force to rapidly move over difficult natural obstacles and into the objectives.

Raid and Ambush

3-34. The restrictive terrain of mountainous areas also affords increased opportunities to conduct raids and ambushes. These operations should take advantage of limited visibility and terrain that the enemy may consider impassable. In steep terrain, movement time increases significantly and only light equipment can be taken. The force should use special climbing techniques to negotiate the difficult routes during limited visibility. Commanders must carefully consider the routes and methods used for extraction to ensure that the combat force does not become isolated after executing the mission. They can ensure a successful operation by avoiding detection through proper movement techniques and by skillfully using natural cover and concealment. It may be necessary to reposition some indirect fire support assets to cover dead space or use attack helicopters and close air support (CAS). The ambush or raid commander must know in advance if supporting fires cannot cover his routes to and from the objective.

Demonstrations and Feints

3-35. Because maneuver space is usually limited or confined and restricts the number of avenues of approach for heavier forces, deception plays an important part in the mountain battle. Commanders should plan systematic measures of deception to mislead the enemy regarding friendly intentions, capabilities, and objectives.

Exploitation and Pursuit

3-36. In a mountainous/cold weather environment, exploitation and pursuit operations must be conducted discriminately. Air assault and attack helicopter units can be used to augment exploitation and pursuit operations. The exploiting commander must compensate for the ground mobility restrictions imposed by terrain and weather. Speed can be achieved best by isolating enemy positions with the smallest force possible. Engineer support should be well forward with the necessary equipment to allow combat troops to maintain momentum and avoid delay by enemy or natural obstacles such as snow removal or compaction. The commander must be careful to prevent overextending either the exploiting force or its sustaining logistics. A withdrawing force is capable of establishing numerous delaying positions and firing positions on heights that allow it to quickly dissipate the combat power of the exploiting force. Consideration must be given to shelter and heat during even moderate times of rest in cold weather. Audacity must be tempered with good judgment if the cold weather presents a significant risk for injury on a broad scale. Conversely, if friendly forces can sustain a pursuit in cold regions, the enemy may be annihilated from the combined effects of combat and the environment.

FORMS OF MANEUVER

3-37. The forms of maneuver are common to all environments, so only such considerations for mountain and or cold weather operations are addressed in the following subparagraphs. While frequently used in combination, each form of maneuver attacks the enemy in a different way and some pose different challenges to the commander when attacking in the mountains.

Frontal Attack

3-38. The frontal attack is an offensive maneuver in which the main action is directed against the front of the enemy forces. It is used to rapidly overrun or destroy a weak enemy force or fix a force in place to support a flanking attack or envelopment. Aviation forces and supporting arms should be used to create gaps in the enemy's front or to prevent or delay enemy reinforcements from reaching the front lines. The frontal attack is generally the least preferred form of maneuver because it strikes the enemy where he is the strongest. Frontal attacks in hilly or mountainous areas, even when supported by heavy direct and indirect fires, have a limited chance of success. Mountainous terrain adds to the relative combat power of the defender, requiring that the ratio of attacking forces exceeds three to one, such as in military operations on urban terrain.

Envelopments and Turning Movements

3-39. Envelopments and turning movements are used extensively in mountain operations. These techniques are a superior form of maneuver used by the attacker to bypass the enemy's principal defensive positions. These forms of maneuver seek to avoid the enemy's strength and attack where the enemy is weakest or unprepared. The enemy's defensive positions may be bypassed using ground, air, or vertical envelopment. When conducting dismounted movements, the corridors through which the maneuver elements travel are key considerations. Commanders should place considerable emphasis on the use of mountain pickets to act as connecting files and overwatch as maneuver forces move across the valley floor in order to achieve surprise. The enemy also may neglect these security measures if road bound and lacking mobility over the snow for flank security. The ability of forces to successfully execute flanking attacks, envelopments, and turning movements is enhanced by employing organizational mountaineers, airborne insertions, and air assaults.

Infiltration

3-40. Infiltration is frequently used in the mountains. The difficult terrain and recurring periods of limited visibility allow for undetected movement. Infiltration in a mountainous environment shapes the battlefield by moving undetected through or into an area occupied by enemy forces to occupy a position of advantage in the enemy rear while exposing only small elements to enemy defensive fires, securing key terrain in support of decisive operations, or disrupting enemy sustainment operations. Infiltration is normally conducted using one of three techniques of movement: in small groups along one axis, movement in one group, or movement in small groups along several routes at the same time. Regardless of the technique used, units conduct tactical movement and employ noise and light discipline while leveraging existing/available natural concealment to reduce the chance of enemy contact.

3-41. Infiltration may be particularly useful during cold weather. This especially applies if the enemy's defensive area is relatively great and if inclement weather impairs enemy counter reconnaissance and surveillance assets. Highly mobile units such as ski-mobile personnel or units equipped with over-snow vehicles may be used against deeper objectives while larger and less mobile units attack more immediate key objectives.

Movement in Small Groups Along One Axis

3-42. With movement in small groups along one axis, all members of the force use the best route. Small groups are harder to detect, easier to control, and do not compromise the total force if detected. This technique is time consuming, requires an increased number of guides and lead climbing teams, and requires an assembly area or linkup point prior to conducting the decisive action. If detected, the risk to follow on groups being ambushed is greater.

Movement in One Group Along One Axis

3-43. The enemy can more easily detect movement of one large group along a single axis of advance. If the force is detected, the overall mission may be endangered. This technique, however, does not require reassembling the force prior to going into the attack. Since everyone uses the same route, navigation is easier and the requirement for guides and lead climbing teams is reduced. A large force can fight out of a dangerous situation more easily than a small one. This technique also minimizes coordination problems among infiltrating units.

Movement in Small Groups Along Multiple Axes

3-44. When conducting operations in the mountains, movement in small groups along several axes avoids putting the total force in danger and makes them less likely to be seen. It forces the enemy to react in many locations and makes it harder to determine the size of the force or its mission. The challenges associated with this technique include reassembly of the force, mission command, sustainment, and the need for more specialized training, equipment, and personnel.

3-45. When conducting operations in the non-mountainous cold regions, movement in small groups along several axes creates a huge signature in the snow with multiple trails going in the same direction. This may enable the enemy to not only identify where forces are headed but also where likely logistical nodes are to support those operations.

Penetration

3-46. Mountainous terrain normally makes penetrations extremely dangerous due to the difficulty of concentrating overwhelming combat power at the area of penetration. Due to mobility restrictions, it is also difficult to develop and maintain the momentum required to move through the point of penetration. The area of penetration is vulnerable to flank attack, especially in mountainous terrain. A penetration may be useful when attacking an enemy that is widely dispersed or overextended in his defense. Flank defensive positions must be eliminated before the initial breach of enemy positions. Successful penetrations require surprise, security, and covered and concealed terrain at selected breach points.

THE DEFENSE

3-47. The purpose of the defense is to create conditions for a counteroffensive that allows Army forces to regain the initiative. Other reasons for conducting defensive actions include: retaining decisive terrain or denying a vital area to the enemy, attriting or fixing the enemy as a prelude to offensive actions, surprise action by the enemy, and increasing the enemy's vulnerability by forcing the enemy commander to concentrate subordinate forces. This section will focus on the defense and defensive tasks as they apply to mountainous terrain and cold regions. For more information about the defense and defensive tasks, reference ADRP 3-90.

3-48. The immediate objective of a mountainous defense is to deny the enemy access to key terrain that helps him conduct further operations. Therefore, it is necessary to defend in terrain that restricts and contains the enemy as well as to control the high ground that dominates this terrain. The terrain provides the defender with cover, concealment, and camouflage that can deceive the enemy regarding the strength and disposition of friendly forces. The defender should know the terrain, control the heights, fortify positions, site weapons in advance, stockpile supplies, and prepare lateral trail networks to allow for mobility.

3-49. Special techniques are required to construct fighting positions in snow. In general, to construct fighting positions above ground proves more efficient due to the frozen ground. However, the time of year and amount of frozen ground present determine what type of fighting position to construct and the degree to which it is located above ground or below ground. ATP 3-37.34 describes the proper method for constructing mountain and cold weather fighting positions.

3-50. Restrictive terrain inherent to mountainous areas is one of the primary advantages of the defender because it interferes with the attacker's synchronization, canalizes his movement, and impedes his ability to maneuver. To capitalize on this advantage, commanders should carefully analyze the vertical and horizontal components of terrain from both friendly and enemy viewpoints.

3-51. While a screening force is usually considered to be the preferred form of security in rugged terrain, all forms of security operations (screen, guard, and cover) may be employed. The following points should be considered when conducting security operations:

- Forces available for security operations.
- Ability to maintain a mobility advantage.
- Size of the security area and the number of avenues of approach.
- Likelihood of enemy action.
- Size of the expected enemy force.
- Amount of early warning and reaction time needed.

3-52. A screening force provides early warning to the protected force and is usually an economy-of-force measure. The compartmented nature of mountainous terrain can lead to gaps and exposed flanks. The rugged terrain also restricts movement of both friendly and enemy forces. In these instances, commanders may choose to use minimum combat power to observe, identify, and report enemy actions at these locations and engage and destroy enemy reconnaissance within the screening force's capability. The screening force can avoid being decisively engaged by withdrawing into restrictive terrain.

3-53. In mountainous terrain, the screening force should adjust to the enemy advance and continue to screen as far forward as possible, even though elements of the force may have to withdraw. Retention of selected forward positions may allow surveillance and targeting forward of the area of operations, upsetting the enemy's coordination. By allowing the enemy to bypass advance positions, the screening force can facilitate a counterattack by providing observation of and access to the flanks and rear of the attacking forces.

3-54. If a significant enemy force is expected, or a significant amount of time and space is required, commanders may employ a guard or covering force. Security forces that can maintain a mobility advantage over the enemy can effectively delay and counterattack the enemy force. The appropriate use of a guard or covering force provides greater depth in the security area.

3-55. Defending forces must prevent enemy infiltration by carefully positioning observation posts and conducting continuous patrols and ambushes. Reconnaissance patrols may rely heavily on technical climbing skills. Ground surveillance radar and ground sensors can be used to add greater depth to the defense.

3-56. Defensive positions along ridges or on dominating heights should include both forward and reverse slopes to add greater depth and security. Fighting positions and observation posts should be echeloned vertically, as well as in depth. When defending a mountain valley, forces should establish fighting positions that are located on adjacent heights and in depth to permit covering the valley with interlocking fires.

Defensive positions must be anchored to restrictive terrain or adjacent defensive forces to prevent enemy infiltration or envelopment. In wooded terrain, defensive positions may be organized on the forward edge of the woods as well as on commanding heights. Obstacles should be widely employed to slow or stop enemy movement.

3-57. Mountain warfare demands that forces defend aggressively. Defending units must infiltrate enemy units and attack headquarters, supply lines, and rear areas. Small patrols and observation posts should be deployed well forward to direct artillery and attack aircraft fire on targets of opportunity and to conduct anti-armor and personnel ambushes. Operations should be conducted to force the enemy to deploy additional assets and also to disrupt preparations.

3-58. Commanders may need to rely on their reserve as the principal means of restoring a defense's integrity or exploiting opportunities through offensive action. Reserves should be mobile enough to react to enemy action in any portion of the perimeter. Large centrally placed reserve forces are normally unable to intervene in time unless the terrain permits mounted movement or sufficient helicopter lift assets are committed or rapidly available to the reserve. Less mobile reserves are positioned to block the most dangerous avenues of approach and assigned on-order positions on other critical avenues. Sharply compartmented terrain may require the creation of more than one reserve. Because of the difficulties of movement, small reserves may be located near primary defensive positions, ready for immediate counterattack. This type of small responsive counterattack may be much more effective than a large-scale major counterattack.

3-59. To minimize the vulnerability of sustaining operations, sustainment resources must be dispersed, redundant, and as far from enemy approaches as possible. Because of limited space available in rear areas, the commander must be careful in selecting and locating positions for sustainment unit activities. These positions are likely to be confined to small valleys. A perimeter defense is planned for each operating base within the defensive area. Defensive positions should be selected on the dominating high ground. Sensors, observation posts, and radars are used to cover avenues of approach and gaps between positions. More information on perimeter defense is available in ATTP 3-21.50 and ADRP 3-90.

3-60. There are three basic defensive tasks: mobile defense, area defense, and retrograde.

MOBILE DEFENSE

3-61. In a mobile defense, the defender withholds a large portion of available forces for use as a striking force in a counterattack. Mobile defenses require enough depth to let enemy forces advance into a position that exposes them to counterattack. The defense separates attacking forces from their support and disrupts the enemy's command and control. As enemy forces extend themselves in the defended area and lose momentum and organization, the defender surprises and overwhelms them with a powerful counterattack. The counterattack focuses on destroying the attacking force by permitting the enemy to advance into a position that exposes him to counterattack and envelopment. The commander commits the minimum possible combat power to his fixing force that conducts shaping operations in order to control the depth and breadth of the enemy's advance. The fixing force also retains the terrain required to facilitate the striking force's decisive counterattack.

3-62. A mobile defense relies heavily on the defender's ability to maintain a mobility advantage. This mobility advantage may result from or be enhanced by countermobility actions directed against the enemy force. In the mobile defense plan, the commander seeks to ensure that the force along with its reserves and the striking force, can move freely around the battlefield while restricting the enemy's mobility, slowing enemy momentum, and guiding or forcing the enemy into areas favorable for engagement. Mountainous terrain favors the defender because of its many chokepoints and fire sacks. Chokepoints have limiting terrain on two sides and fire sacks have limiting terrain on three sides.

AREA DEFENSE

3-63. A position/area defense focuses on retaining terrain by absorbing the enemy into a series of interlocked mutually supporting positions. Mobility restrictions and the requirement to control key terrain favor position/area defenses. Defending forces are relied upon to maintain their positions and to control the terrain between them. This defense uses battle positions, strong-points, obstacles, and barriers to slow, canalize, and defeat the enemy attack. Position/area defenses rely on security forces, continuous reconnaissance and combat patrols, and numerous observation posts for depth and early warning. The natural canalization effect of mountainous terrain offers tremendous advantages in the defense.

3-64. In a position/area defense, the commander positions the bulk of combat power in static defensive positions with small mobile reserves. The commander depends on static forces to defend their positions and on the reserves to blunt and contain penetrations, to counterattack, and to exploit opportunities presented by the enemy. Helicopters may be used to deploy reserves but their use depends on the availability of suitable secure landing zones (LZs) and favorable weather conditions. Commanders must prevent the enemy from concentrating overwhelming combat power against isolated sections of their defense.

REVERSE SLOPE DEFENSE

3-65. Reverse slope defenses (see Figure 3-1) are well-suited to mountain operations. Reverse slope defenses seek to reduce the effects of massed indirect fire from mortar, artillery, and close air support or CAS and draw the battle into the small arms range. The overall goal of the reverse slope defense is to make the enemy commit his forces against the forward slope of the defense, causing his forces to attack in an uncoordinated fashion across the exposed topographical crest.

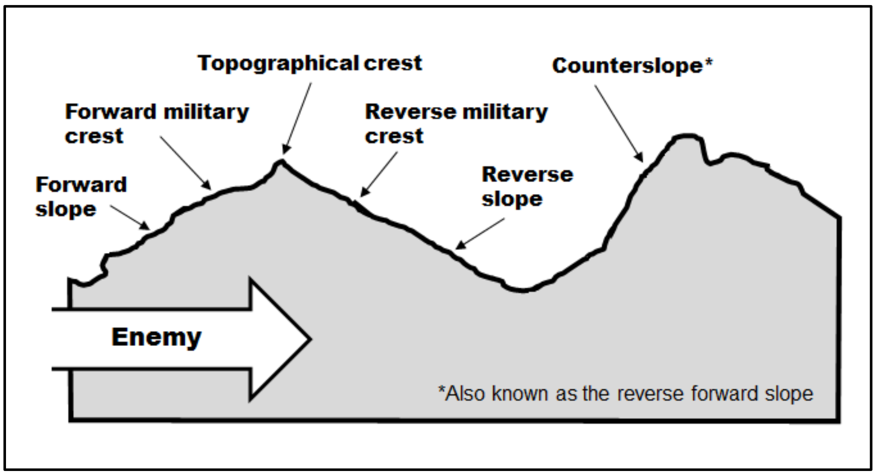

Figure 3-1. Reverse Slope Defense

All or parts of the defending force may use reverse slope techniques. In many instances, mountainous terrain favors a defense that employs both forward and reverse slope positions to permit fires on enemy approaches around and over the crest and on the forward slope of adjacent terrain features. Key factors to this type of defense are–

- Mutually supporting covered and concealed positions.
- Numerous natural and manmade obstacles.
- The ability to bring fire from all available weapons onto the crest.
- A strong and mobile counterattack force.

RETROGRADE

3-66. The reverse slope defense is organized so that the main defensive positions are masked from enemy observation and direct fire by the topographical crest. It extends rearward from the crest only to the maximum effective range of small arms fire. Observation and fires are maintained over the entire forward slope as long as possible to continue to destroy advancing enemy forces and prevent them from effectively massing for a final assault. A successful reverse slope defense is based on denying the topographical crest to the enemy, either by fire or by physical occupation. Although the crest may not be occupied in strength, control of the crest by fire is essential for success.

STABILITY OPERATIONS

3-67. Cultural understanding is fundamental to planning stability operations in the mountains. Although challenging in the mountains, commanders can develop situational understanding by circulating throughout their operational areas as often as possible, making observations, and communicating with the local populace and other actors operating in the area. These activities will aid forces in overcoming local suspicion of outsiders and establishing the personal bonds of trust with local leaders. Soldiers should reference ADRP 3-07 when conducting stability operations.

CIVIL CONSIDERATIONS

3-68. Generally, civilian population centers will be located at the lower elevations, Level I terrain, close to sources of water and along major LOCs. Dislocated civilians may increase congestion on the already limited road and trail networks normally found in mountainous environments, further complicating maneuver and sustainment operations.

3-69. Commanders must also consider the impact of operations on the often limited civilian resources available in the mountains. The wisdom of using local resources to lighten in theater supply requirements must be balanced with the impact on civilians and their local economy. While the purchase of goods and services from the local economy is generally welcomed, it may serve to inflate prices and make it impossible for local civilians to purchase their own scarce and needed supplies.

3-70. In mountainous regions, commanders often encounter a populace of diverse political and ethnic orientation that may support, oppose, or be ambivalent to U.S. operations or the presence of U.S. forces. Depending on friendly force objectives, commanders may use civil affairs operations, foreign humanitarian assistance, and military information support operations to influence perceptions and attitudes of the indigenous population and institutions. Commanders may also use public affairs to inform internal and external publics and fulfill the Army's obligation to keep the American people and the Army informed about the Army's mission and goals. Even if commanders choose not to commit resources to enlist civilian sympathy and support, they must still adjust their operations to minimize damage and loss of life to innocent civilians. Homogeneous mountain communities are susceptible to greater influence from external forces/factors than the more heterogeneous communities found in less compartmented terrain.

3-71. Due to the restrictive nature of the terrain, mountain communities may quickly become safe havens and bases of support for enemy activity. Where combat typically focuses on the defeat or destruction of an enemy force, the focus of stability operations is the populace.

OPERATIONAL ADVANTAGES AND DISADVANTAGES

3-72. The forms of maneuver and offensive tasks will not change for mountainous/cold weather environments but there are unique elements that must be considered before conducting offensive operations. Like all other environments, one of the primary advantages of conducting offensive operations is that the attacker can choose when and how he will attack. This point is emphasized even further in the mountains if there are many avenues of approach to an objective, ground LOCs the defender has to rely upon for sustainment, and the difficulty the defender faces in constructing defensive positions.

3-73. Despite these offensive advantages, the aggressor is usually at a disadvantage in the mountains because the mountainous terrain favors defensive operations. The primary advantage to the defender in mountainous terrain is the ability to choose defensive positions that will canalize offensive forces, denying the attacking force the ability to maneuver effectively. If the defender controls the heights, observation will preclude the attacking force from achieving surprise. Both observation and canalization will give the defender the opportunity to mass fires in order to defeat or destroy the enemy. However, if the attacking force is highly trained and able to negotiate the complicated mountainous terrain, the advantages the defender gained will be nullified.

3-74. Conducting stability operations in mountain population centers establishes conditions that enabling for the efforts of the other U.S. instruments of national power and international organizations. By providing the requisite security and control to stabilize an operational area, those efforts build a foundation for transitioning to the host nation's civilian control. Military forces operating in this environment seek to establish or restore basic sustainable civil functions and to protect them until a host nation or other civil authority is capable of providing these services for the local populace. In many cases, the restrictive terrain and cultural barriers found in isolated mountain communities may delay the host nation from fulfilling their role. Military forces may be called upon to significantly increase their role to include providing the basic civil functions of government. This slow development process of government reconstruction and stabilization may become frustrating and difficult to manage as units and commanders cycle through deployments. Integrating the planning efforts of all the agencies and organizations involved in a stability operation is essential to long-term peace.

Chapter 4

Maneuver and Movement

AIR MOVEMENT

4-1. Aviation is advantageous to operations in a mountainous environment. Assault support aircraft are essential to rapid movement of forces and equipment in the mountains. However, commanders are mindful of the effects of weather and elevation on the employment of assault support aircraft. Assault support aircraft provides the commander with maneuver capabilities, enabling him or her to concentrate combat power quickly and decisively. However, any operation that depends primarily on continuous aviation support to succeed is extremely risky. High elevations and rapidly changing weather, common to mountainous regions, are restrictive to aviation operations and make availability of aviation support unpredictable. Higher altitudes restrict helicopter lift capabilities and decrease aircraft payloads. Commanders must be familiar with the conditions that limit the effectiveness of aviation during mountain operations. A more detailed discussion can be found in Chapter 7.

MOUNTED MOVEMENT

4-2. Armored and Stryker operations in complex and compartmentalized terrain are hampered by terrain, infrastructure, and weather. Narrow roads and movement corridors will limit vehicle traffic to predictable patterns. While simplifying traffic control, maneuvering and recovering vehicles will be problematic.

4-3. Terrain and weather limit the type of vehicles that travel on certain roads, especially during inclement weather conditions. Roads that are wide enough for high mobility multi-purpose wheeled vehicle (HMMWVs) may not support larger wheeled vehicles mine resistant ambush protected (MRAP) or armored vehicles (tanks, armored personnel carriers, or amphibious assault vehicles). Fuel consumption for vehicles also increases due to the effects of road slope and grade.

4-4. Precipitation (snow and rain) hampers the mobility of both armored and Stryker assets. Roads close to rivers can flood during the spring when snowpack starts to melt at higher elevations. The seasonal impact on vehicle movement must always be considered when planning convoys in complex terrain.

4-5. Generally, mountainous terrain above the valley floor limits movement of wheeled vehicles and is too restricted for tracked vehicles. Trafficable terrain, such as roads and trails, tend to contour along rugged terrain features which makes mounted movement vulnerable to ambushes and attack aircraft. Recovery vehicles accompany mounted forces in mountainous terrain to remove disabled vehicles from the limited and narrow road networks. See Chapter 6 for vehicle recovery information.

4-6. The M973 Small Unit Support Vehicle (SUSV) is specifically designed to carry troops and equipment cross country under most snow conditions. The planning considerations for operating the SUSV are much the same as they are for dismounted travel. Leaders should ensure that—

- There are at least two vehicles travelling together and that the crews are well versed in recovery.
- Fuel is topped off and additional cans are carried.
- Basic issue item(s) (BII) is present and serviceable. Recovery equipment such as winches, tow cables, and snatch blocks are essential. Wheeled vehicles MUST have tire chains.
- The route, number of personnel, and time of departure are understood and logged with command center.
- Passengers have adequate equipment to sustain overnight as a minimum.
- Leaders have navigational equipment, maps, compasses, overlays and imagery, and global positioning system (GPS) receivers.

4-7. Tanks and other armored vehicles, such as infantry fighting vehicles, are limited to movement in valleys and existing trail networks at lower elevations. Even at lower elevations, roads and trails require extensive engineer work to allow tracked vehicle usage. In mountain operations, there is an operational need for an up-armored over-the-snow vehicle similar to the SUSV.

4-8. Due to terrain limitations, tracked vehicles rarely accompany dismounted infantry in the assault. Tanks, infantry fighting vehicles, and cavalry fighting vehicles assist forces conducting dismounted movement by occupying support-by- fire positions and by using their firepower to isolate objectives. If employed above Level I terrain, armored vehicles decentralize and operate as smaller units but should be complemented by dismounted forces. Armored vehicles are more vulnerable in mountainous terrain because they are susceptible to attack from higher elevations and unable to elevate their weapon systems sufficiently in order to return fire.

4-9. The lower atmospheric pressure at higher elevations increases the evaporation of water in batteries and vehicle cooling systems and impairs cylinder breathing. Consequently, vehicles expend more fuel and lubricant and experience engine power reductions by four to six percent for every 1,000-meter increase in elevation above sea level. As a result, mileage and load carrying capacity is reduced during operations. Consequently, the need for fuel and oil increases approximately 30 to 40 percent.

DRIVING

4-10. Inexperienced drivers are not permitted to drive in mountainous environments until they have adequate training. Ensure that rollover battle drills are rehearsed as roads tend to have very steep drop offs. During pre-deployment training, drivers should conduct rough terrain driving to prepare them for the rigors of driving in complex compartmentalized terrain. Drivers must become skilled at driving in reverse on narrow mountain passes because if the road only allows for one way traffic and drivers encounter oncoming traffic, then one of the parties will have to back up to a spot that will allow passage.

CONVOY PLANNING

4-11. To facilitate convoy planning, planners should conduct a physical network analysis. The physical network analysis encompasses roads, bridges, obstacles, population centers, and potential danger areas. Due to the complex nature of mountainous terrain, assets other than maps and dated imagery should be used. Roads that appear viable on maps may be impassable during certain times of the year. Additional convoy planning considerations include—

- Type and maximum number of vehicles that the road network can support, including each route’s throughput.
- Requirement for new road construction or road improvements.
- Classification of bridges.
- Likely locations for vehicle rollovers.
- Rapid analysis of existing roads for bottlenecks, deployment areas, passing places, and turnarounds for various vehicles. There is a requirement for early location and marking of bottlenecks, deployment areas, passing places, and turnarounds for various types of transport. Alternative routes must be identified and allocated.
- Selection, whenever possible, of at least two routes; one for vehicle traffic and the other for troops on foot, animal transport, and dislocated civilians. If possible, additional separate routes for wheeled and tracked vehicles should also be allocated, particularly if the latter are likely to damage the surface.
- Classification of routes as one- or two-way and development of schedules for the use of one-way routes.
- Placement of signs, if the tactical situation permits, for both day and night moves on difficult and dangerous routes.
- Good communications, especially between start and finish points, on congested portions of the route and at any passing points.
- Dedicated organization to rapidly clear obstacles caused by enemy action, the elements, or broken-down vehicles.

- Plans for route clearance operations on commonly used routes.

4-12. Most mountainous areas of the world have unimproved roads that are not suitable for heavy tactical vehicles. In such areas, existing roads and trails are few and primitive and cross-country movement is particularly challenging. Highways usually run along features that have steep slopes on either side, making them vulnerable to attack. Rivers become major obstacles because of rapid currents, broken banks, rocky bottoms, and the lack of bridges. Landslides and avalanches, natural as well as manmade, also pose serious obstacles to vehicle movement. In late winter or early spring, mud becomes a big issue and roads become flooded as snow begins to melt. The runoff from melting snows in the spring and torrential rains in the summer or fall washes away roads and floods low ground. In the face of numerous dangers, all vehicles have survival equipment for all troops.

BREAKING TRAILS FOR MOUNTED MOVEMENT

4-13. When conducting mounted movement across snow covered terrain that lacks existing trails, leaders may employ the following procedures to break new trails:

- The lead vehicle will set the initial track staying concealed as much as possible.
- The second vehicle will offset their track to flatten out the trail. This keeps a hard ridge from forming in the center of the trail that can high-center other vehicles.
- Following vehicles will also offset as much as practicable to widen the trail. This also serves to harden the snow thus easing the passage of other vehicles.
- A series of tripods can be set up quickly to mark the trace of a trail through open areas. They should be spaced so that from one tripod, the next in line can be easily seen.

4-14. Trail maintenance is a critical task in order to maintain LOCs. A significant snowfall or wind event can totally obliterate any trace of a trail. A well maintained and marked trail is far easier to reopen than breaking a new one.

MINES AND IMPROVISED EXPLOSIVE DEVICES

4-15. Limited ingress and egress routes in mountain valleys and villages aid in the enemy's ability to ambush and attack mounted convoys. The complexity of the terrain surrounding navigable roads coupled with the ability of the enemy to use this terrain to employ mines or improvised explosive devices (IEDs) can have a devastating effect on ground forces. When conducting convoy and route clearance operations, a detailed assessment of the road, terrain, and enemy threat must take place to determine potential mine/IED locations. Likely locations of mines/IEDs include chokepoints, compartmented terrain, and restricted roads. Using host nation route clearance units is recommended, if available. Additionally, commanders can mitigate enemy obstacle emplacement (reseeding mines) by providing overwatch (pickets) to the main supply route (MSR), alternate supply route or critical ground LOCs areas, such as bridges or tunnels. More information pertaining to route clearance and obstacle reduction is found in ATP 3-90.4/*MCWP* 3-17.8 and ATP 3-34.20/*MCRP* 3-17.2D.

DISMOUNTED MOVEMENT

4-16. Dismounted movement is slow and requires skilled mountaineering teams to secure the advance. For example, movement in Level II terrain dictates that elements secure the high ground in Level III terrain. As with any type of movement, proper movement techniques and formations and constant security to avoid unplanned enemy contact are some of the keys to successful dismounted movement.

ROUTE PLANNING

4-17. A tool available to commanders during the planning process is the time/distance formula, which assumes acclimatized forces. The following considerations help planners determine time requirements for movements:

- Altitude at which forces will be operating.
- Amount of time a unit has to acclimate to the environment.

- Weight each individual will be required to carry.
- Fitness level of the unit.
- Size of the unit.
- Altitude gain or loss.

4-18. Foot marches in the mountains are measured in time and elevation rather than just distance. For a map reconnaissance, map distance plus one-third is a good estimate of actual ground distance covered. One hour is planned for each three kilometers (about two miles) of distance. An additional hour is added for each 305 meters (1,000 feet) of ascent or each 610 meters (2,000 feet) of descent. The shortest man in the unit needs to be placed in the front of the formation due to his shortened gait, allowing the unit to maintain a uniform march rate.

4-19. If dismounted troops deploy into column (wedge) formation outside the file formation, the unit will move more slowly. With no one breaking the trail, all personnel must now move through undisturbed snow. In temperate regions, column formation is ideal since it maximizes fields of fire and supports the exercise of mission command. However, when operating in a snow-covered environment, the ideal formation is the file formation. Leaders only deploy into column formation if enemy contact is imminent because the rate of movement is so constrained. Table 4-1 shows dismounted movement rates of march in the mountains. This is just a rough guide. As slope angle increases, the amount of time is likely to exponentially increase as well.

Table 4-1. Rates of March for Unit Movement

Movement Mode	***Unbroken Trail***	***Broken Trail***
On foot, no ski or snowshoe Less than 1 foot of snow	1.5 to 3 kph	2 to 3 kph
On foot, no ski or snowshoe More than 1 foot of snow	0.5 to 1 kph	2 to 3 kph
Snowshoe	1.5 to 3 kph	3 to 4 kph
Skiing	1.5 to 5 kph	5 to 6 kph
Skijoring	NA	8 to 24 kph (for safety, 15 kph is the highest recommended speed)
Legend kph – kilometers per hour NA – not applicable		
Time/distance formula: Add one hour for every 305 meters (1,000 feet) of ascent and one hour for every 610 meters (2,000 feet) of descent.		

4-20. Commanders cannot permit straggling or deviations from the selected route. Every aspect of march discipline keeps a column closed. To prevent an accordion effect, unit members allow enough distance between themselves to climb without causing the following individual to change pace. In mountainous terrain, a slow steady pace is preferred to more rapid movement with frequent halts.

4-21. Commanders incorporate scheduled rest halts in movement plans based on distance and availability of covered and concealed positions. As a general rule, units should stop and rest for five minutes after 25 minutes moving. If possible, commanders should not conduct rest halts during steep ascents or descents. At the start of a march, everyone dresses lightly so that they begin the march cool. A short halt should be taken to adjust clothing and equipment after the first 15 minutes of movement.

4-22. In glacial areas, the principal dangers and obstacles to movement are crevasses and snow and ice avalanches. Exposure to the hazards of glaciated mountains increases at the company-level and above and movement should be limited to separate platoons and lower levels. When moving on glaciers, an advance element should be used. The advance element identifies the best routes of advance, marks the trail, and provides directions and distances for follow-on units. A marked trail is especially important during inclement weather and low visibility and provides a route for retrograde. Commanders must carefully weigh the advantages of a marked route against the possibility of ambush and the loss of surprise.

ADDITIONAL CONSIDERATIONS

4-23. In addition to the normal considerations regarding the tactical situation, commanders should take into account the following when selecting a route across cold/snow-covered terrain:

- Conduct a map/imagery reconnaissance.
  - Going around terrain features may be faster than going over them. Check the contour and select a route that involves the minimum amount of ascending and descending.
  - Old trail networks are more prevalent than many realize. These can be nothing more than a footpath through the woods or single lane vehicle paths. Areas around population centers usually have trails for many miles in the surrounding countryside. These may not be on any map but will show up on readily available imagery. Control of trails has proven to be decisive in the past.
  - Old river channels can be used as well. The vegetation may be less dense or easier to move through. Keep in mind that rivers in cold regions tend to meander a lot and this will add distance.
  - Vegetation can be estimated by the color. Dark green areas tend to be mature trees, White spruce, pine, birch, cottonwood etc. These are quite common immediately adjacent to river channels. They may have an understory of dense brush, alder or willow. Light green areas tend to be lower brush of black spruce, alder, willow and smaller birch.
  - Pay attention to the contour interval on maps. A 20-meter interval can hide a lot of very significant relief.
  - Wide open areas with little or no relief must be addressed as navigation can get difficult without landmarks.
  - Consider where the sun is and how the shadows fall. The south side of open areas will help conceal tracks because it has longer shadows as the sun stays in the southern sky for most of the winter.
- Are personnel on skis or snowshoes? How proficient are they and are they more capable of negotiating the terrain along the route with one or the other?
- Will Soldiers be carrying heavy rucksacks or pulling sleds? What will the temperatures be during movement?
- Are vehicles attached, and if so, what type of terrain/snow depth are they capable of negotiating?
- Is it necessary to camouflage tracks and how will this be achieved? In barren areas, or areas above the tree line tracks may be difficult, if not impossible, to conceal.
- Will the route be feasible during conditions of limited visibility?
- Will the route cross any potential avalanche areas?
- What obstacles can be anticipated? Will streams and other bodies of water be sufficiently frozen to support troops/vehicles? Will plowed roads perpendicular to your route have high banks of plowed snow? Will the water level in streams be so low that Soldiers will have to negotiate high banks?
- In open terrain, Soldiers should break only one set of tracks. Aircraft flying over movement routes can more easily spot several tracks than they can a single set of tracks. Follow the tree line as much as possible, this will aid in concealment from the ground as well as help hide tracks from the air.

BREAKING TRAILS FOR DISMOUNTED MOVEMENT

4-24. The terms broken and unbroken trail have specific meanings. When moving through undisturbed (unbroken) snow greater than 30 centimeters (12 inches), the lead two or three persons pack the snow for the rest of the file. Once accomplished, the trail becomes broken. Since the lead persons exert more effort breaking the trail, personnel cycle the same way they execute a last man up run. Leaders replace personnel in the lead every 15 to 30 minutes, depending on fitness level. One third of the unit should be allocated to the task of breaking trails. The trail breaking party should depart no less than one hour before the main body for each kilometer to be travelled.

4-25. The following techniques may be employed by units conducting dismounted trail breaking:

- The leader designates the direction and the lead Soldier begins moving, establishing the initial track.
- The second in line does not step into the first tracks. He will step opposite and flatten the track.
- The third and fourth Soldiers will offset their steps left and right by at least one snowshoe width. This widens the trail. Should it become necessary, these Soldiers are also the "cutters". Each one carries a machete to clear brush on the sides of the trail. Care must be taken to lop branches close to the main trunk so they do not become spears.
- The leader's primary focus is navigation. A march table will keep track of where the unit is. The trail-breaking squad should not solely rely on a GPS receiver as batteries drain easily in the cold.
- The trail team will clean up the trail by filling in low spots with snow, moving brush trimmings, and marking the trail for following units.
- An additional fire team can be assigned to provide security for the trail breaking squad.

INDIVIDUAL LOADS

4-26. Economizing the individual combat load is essential for conducting dismounted operations in the mountains. In steep terrain at elevations above 1,524 meters (5,000 feet), individual loads may need to be reduced by 50 percent. For example, water purification and the amount of bulky ammunition, such as pyrotechnics, must be considered. First class lightweight assault packs, however, are vital. Leaders at all levels review and modify existing unit packing lists and SOPs when conducting dismounted operations in mountainous terrain. Consider using the memory aid DROP–

- Decide mobility levels.
- Reduce unnecessary equipment.
- Organize resupply methods.
- Police the ranks and conduct inspections.

4-27. In the extreme cold weather environment, every effort should be made to keep the Soldier with his personal approach load (rucksack). The sleeping bags, extra clothing, rations, and other equipment, can mean the difference between life and death. Approach loads can be cached before an assault but avoid leaving them behind altogether. Sustainment loads must be pushed forward as soon as practical.

TERRAIN ANALYSIS

4-28. Unlike flat terrain on which the quickest way from point A to point B may be a straight line, moving in a straight line on mountainous terrain is often more difficult and time consuming. Considerations for route planning include—

- Physical network analysis.
- Contouring to prevent forces from gaining or losing elevation unnecessarily.
- Obstacles, such as population centers, rivers, and bridges.

STREAMS AND FORDS

4-29. Stream and river crossing operations are difficult and are usually accomplished by expedient means. Bridging operations in mountainous terrain are limited to spanning short gaps and reinforcing existing bridges by using prefabricated materials and fixed spans from floating bridge equipment. However, standard design or improvised suspension bridges may still be needed for longer spans. Existing bridges may have low vehicle load classifications, standard fixed tactical bridges and bridging materials should be on hand to quickly reinforce or replace them. In extremely rough terrain, cableways and tramways may be constructed to move light loads and personnel across gorges and up and down steep slopes. Soldiers operating in cold environments require bridging or rafting assets that only specialized engineer units can provide. Often times, units will not have these assets available and will need to use field expedient methods to employ mounted forces. The field expedient mode used in cold region environments is the ice bridge.

Ice Bridge

4-30. Units should exercise caution when constructing ice bridges. Both an art and science applies to building ice bridges. In general, rivers with slow currents, lakes, and deep swamps will freeze to a point that allows ice crossings in winter and well into spring. However, leaders must pay special attention to shorelines, weather, and river conditions. Ice is thinner near the shore so units may need to build ramps. If the temperature rises above freezing shortly after completing the ice bridge, then units may have wasted a lot of time and effort. Leaders consider the type of river. Glacial fed rivers are unpredictable. They have swift currents, they surge and recede quickly, and the course of the river changes frequently.

4-31. Construction of an ice bridge requires pumps or some other means of flooding the ice and freezing temperatures. Temperatures below 10° F (50° C) work best. If the ice is exposed to direct sunlight or the temperature is above 25° F (77° C), units flood the area in the evening to take advantage of the colder night temperatures. The time units spend selecting a good site results in reduced construction and maintenance effort. It takes less effort to conduct an adequate reconnaissance of a crossing site than to extract a vehicle that has broken through the ice. An ideal site, within the tactical limitations, provides the best combination of shortest distance, gradual sloping embankments, and low turbulence. The natural ice should be at least 10 centimeters (four inches) thick to support men and equipment required to construct the ice bridge. Personnel ensure hot springs are not present. Hot springs would make building an ice bridge impossible. For details of ice bridge construction, refer to ATP 3-90.4/*MCWP* 3-17.8 and Technical Manual (TM) 3-34.22/*MCRP* 3-17.1B.

Swift Waters

4-32. Operations conducted in mountainous terrain may require crossing swift flowing rivers or streams. Such crossings should not be taken lightly. The force of the flowing water is extreme and underestimated. All rivers and streams are obstacles to movement. They should be treated as danger areas and avoided, if possible. Not all rivers or streams in mountainous terrain will be fordable. If a water obstacle is too wide, swift, or deep, an alternate route should be used or the crossing will require major bridging by engineers. It requires the use of rafts or boats. Reconnaissance of questionable crossing sites is essential.

4-33. Map, photo, and air reconnaissance of the route do not always reveal where water obstacles exist. In a swamp, for example, unfordable sloughs may not show on the map and they may be concealed from aerial observation by a canopy of vegetation. Whenever a unit crosses a water obstacle, its commander plans some type of crossing capability.

Fords

4-34. A ford is a location in a water barrier where the current, bottom, and approaches allow personnel, vehicles, and other equipment to cross and remain in contact with the bottom during crossing. Fords are classified according to their crossing potential (or trafficability) for pedestrians or vehicles. Fordable depths for vehicular traffic increases by suitable waterproofing and adding deep-water fording kits. These kits permit fording depths up to an average of 4.3 meters (14 feet). Vehicle technical manuals provide further fording information.

4-35. Reconnaissance of potential fording sites is critical and should include—

- The soil composition of the approaches. They may be paved or covered with mat or trackway but they are usually unimproved. The composition and the slope of the approaches to a ford are carefully noted to determine the trafficability after fording vehicles saturate the surface material of the approaches.
- The current's speed. The velocity of the water and the presence of debris are used to determine the effect, if any, on the ford's condition. Currents are categorized as—
  - Swift (more than 1.5 meters [five feet] per second).
  - Moderate (one to 1.5 meters [three to five feet] per second).
  - Slow (less than one meter [three feet] per second).

4-36. The ford's stream-bottom composition determines its trafficability. It is important to determine whether the bottom is composed of sand, gravel, silt, clay, or rock and in what proportions. For more information see ATP 3-34.81.

Water Routes

4-37. Water routes are generally excellent for navigation. They can be superb avenues for movement after freeze-up. However the ice thickness must be checked by cutting a hole and measuring it. Very detailed reconnaissance is required before attempting to move on water routes. When moving on water routes treat them as an open area and stay close to the shore. This will help to conceal movement and tracks. Overflow is a condition common to most bodies of water where the water flows onto the ice.

DANGER

Failure to conduct a thorough reconnaissance of a route over ice can lead to loss of life and equipment.

4-38. Steam coming off the surface of the snow indicates that there is open water. Isolated patches of frost may form on the trees adjacent to the area. This can indicate open water and the ice around the area may be thin.

4-39. Frost flowers (when thin layers of ice are extruded from long-stemmed plants) form as a result of water vapor condensing on ice or snow. When an open area freezes over, the flowers form on the ice. This ice is quite thin but may be strong enough to support a load of snow, concealing its presence. Avoid any depression in the snow while on a water route. Listen for the sound of flowing water and hollow sounds.

4-40. As the winter progresses the water under the ice begins to drop. This sometimes leaves and air space. Ice is no longer supported by water and may collapse. Check for hollow sounds and the sound of flowing water.

WARNING

If ice is not supported by water (waterborne) because the water level has dropped, it will be too weak to support heavy loads.

CAUTION

Armored vehicles require at a minimum, 16 inches of waterborne ice in order to support 16 tons, with each additional inch supporting one additional ton. This does not apply for ice thicknesses under 16 inches. For example three inches of ice will not support three tons.

Note: In temperatures above 14º F, add 25 percent to all required ice thickness.

CASUALTY EVACUATION

4-41. Casualty evacuation in the mountains is resource-intensive in manpower, equipment, and time. Plan routes to identify casualty collection points accessible to multiple transportation assets, if possible. Units consider how they will move casualties when vehicles or aircraft are not available due to terrain and weather restrictions. Personnel are trained in rough terrain evacuation techniques prior to deployment to include raising, lowering, and nonstandard casualty evacuation (CASEVAC) platforms. Leaders plan and rehearse contingencies for mounted, dismounted, and aviation evacuations. Realistic time/distance analysis must be conducted to ensure proper allocation of assets and to maximize casualty survivability. Units consider pushing medical assets to lower echelons to reduce CASEVAC requirements. Chapter 6 provides more information.

> ***Note:*** Leaders should be familiar with casualty care and evacuation in an austere, mountainous, or cold weather environment. Leaders must plan to properly stabilize and prepare casualties for movement and keep casualties warm and comfortable during the evacuation process.

General Considerations

4-42. Mountainous environments limit mobility, the use of mutually supporting large forces, and the full use of sophisticated weapons and equipment. These limitations decrement many of the strengths U.S. military forces bring to the fight. However, they benefit the adversaries whose lesser sophistication better suits the environment.

4-43. Mountain operations restrict ground and air movement of units. Movement requires careful planning and execution as movement over arduous terrain is difficult. Forces must adapt their SOPs and develop innovative TTP to accomplish the mission.

4-44. The ability to move requires proper integration and use of all appropriate resources, including aircraft, wheeled and tracked vehicles, watercraft, porters, pack animals, and individual means. Successful negotiation of the terrain and overcoming the effects of the environment depends on specialized mountain training and proper equipment.

RECONNAISSANCE AND SURVEILLANCE

4-45. At the beginning of a campaign in a mountainous environment, requirements are answered by aerial or overhead platforms using radar systems to detect manmade objects. Terrain impacts the employment of overhead reconnaissance platforms. These systems are adversely impacted by the masking effect that occurs when mountainous terrain blocks the radar beam, so radar coverage may not extend across the reverse slope of a steep ridge or a valley floor. Attempts to reposition the overhead platform to a point where it "sees" the masked area causes masking elsewhere. This limitation does not preclude using such systems. Commanders and their staffs employ air reconnaissance with overhead reconnaissance platforms, such as balloons and satellites, when available to minimize these occurrences.

4-46. The subsequent use of ground reconnaissance assets to verify the data gathered by overhead and electro-optical platforms ensures that commanders do not fall prey to deliberate enemy deception efforts that capitalize on the limited capabilities of some types of overhead platforms in this environment. In mountainous areas of operation, it is necessary to commit ground reconnaissance assets to support strategic and operational information requirements. Conversely, strategic and operational reconnaissance systems are employed to identify or confirm the feasibility of employing ground reconnaissance assets. Surveillance teams may be inserted to gather information that cannot be collected by overhead systems or to verify data that those systems collected. In this instance, satellite imagery analyzes a specific area for inserting the team. The potential hide positions for the teams are identified using imagery and, terrain and weather permitting, verified by unmanned aircraft systems (UAS).

4-47. In harsh mountainous terrain, ground reconnaissance operations are often conducted dismounted. Commanders and their staffs assess the slower rate of ground reconnaissance elements to determine its impact on the entire reconnaissance and collection process. They must develop plans that account for this slower rate and initiate reconnaissance early to provide additional time for movement (see Chapter 4 for movement planning tools). Commanders allocate forces, including combat forces, to conduct reconnaissance, surveillance, or limited objective attacks to gain needed intelligence. Based on METT-TC, commanders prioritize collection assets, accept risk, and continue with less information from their initial reconnaissance efforts. In these cases, they must use formations and schemes of maneuver to provide security and flexibility, to include robust security formations, and allow for the development of the situation once in contact.

4-48. Although reconnaissance patrols use the heights to observe the enemy, they may need to send small reconnaissance teams into valleys or along the low ground to gain suitable vantage points, conduct counter-surveillance (as mountain villages often serve as a network of informants on friendly movements), or physically examine routes used by armored or Stryker forces. In mountainous environments, reconnaissance elements determine—

- The enemy's primary and alternate LOCs.
- Locations and directions where the enemy attacks or counterattacks.
- Heights that allow the enemy to observe the various sectors of terrain.
- Suitable observation posts for forward observers.
- Portions of the route that provide covert movement.
- Level of mountaineering skill required to negotiate routes (dismounted mobility classification) and sections of the route that require mountaineering installations).
- Trafficability of existing trails and routes to support sustained military movement requirements and an engineer estimate of the effort required to improve/maintain this capacity.
- Location of enemy obstacles/barriers (including minefields) and feasibility of breach bypassing.
- Bypass routes.
- Potential airborne and air assault drop zones and pickup zones (PZs) and aircraft landing areas.
- Location of locally available engineer resources, such as construction materials, borrows pits, water, and construction equipment.

OPERATIONAL CONSIDERATIONS

4-49. Snow poses a serious threat to units not properly trained and equipped for movement. Avalanches have taken the lives of more troops engaged in mountain warfare than all other terrain hazards combined. Reconnaissance units conduct a thorough reconnaissance of the area of operations to determine areas where avalanches and rockslides are most prevalent and most likely to hinder mobility. This information should be included in their reconnaissance overlays in order to generate a full picture for the commander (see Chapter 5 for mitigation procedures).

RECONNAISSANCE IN FORCE

4-50. The mountain terrain's geography and mobility restrictions are risky for reconnaissance in force operations. Since the terrain allows enemy units to defend along a much broader front with fewer forces, a reconnaissance-in-force is conducted as a series of smaller attacks to determine the enemy situation at selected points. Commanders and their staffs should consider mobility restrictions that affect plans for withdrawal or exploitation. They should position small reconnaissance elements or employ surveillance systems throughout the threat area of operations to gauge the enemy's reaction to friendly reconnaissance in force operations and alert the force to possible enemy counterattacks. In the mountains, the risk of having at least a portion of the force cut off and isolated is extremely high. Mobile reserves and preplanned fires must be available to reduce the risk, decrease the vulnerability of the force, and exploit any success as it develops.

ENGINEER RECONNAISSANCE

4-51. Engineer reconnaissance assumes greater significance in a mountainous environment to ensure that supporting engineers are task-organized with specialized equipment to quickly overcome natural and reinforcing obstacles. Engineer reconnaissance teams conduct the following functions:

- Assess the resources required for clearing obstacles on precipitous slopes.
- Construct crossing sites at fast-moving streams and rivers.
- Improve and repair roads, erect fortifications, and establish barriers during defensive operations.
- Integrate into all mountain reconnaissance operations, since the restrictive terrain has obstacles.

4-52. Additional information on engineer reconnaissance can be found in ATP 3-34.81. In some regions, maps are unsuitable for tactical planning due to inaccuracies, limited detail, and inadequate coverage. In these areas, engineer reconnaissance precedes, but not delay, operations. Because rugged mountainous terrain makes ground reconnaissance time consuming and dangerous, a combination of ground and aerial or overhead platforms are used for engineer reconnaissance. Data on the terrain, vegetation, and soil composition, combined with aerial photographs and multispectral imagery, allows engineer terrain intelligence teams to provide detailed information that may be unavailable from other sources.

CHEMICAL, BIOLOGICAL, RADIOLOGICAL, NUCLEAR RECONNAISSANCE

4-53. The mountainous environment presents unique challenges when conducting chemical, biological, radiological, and nuclear (CBRN) reconnaissance. See ATP 3-11.37/MWCP 3-37.4/Navy Tactics, Techniques, and Procedures (*NTTP*) 3-11.29/ Air Force Tactics, Techniques, and Procedures (*AFTTP*) 3-2.44, and ATP 4-02.7/*MCRP* 4-11.1F/*NTTP* 4-02.7/*AFTTP* 3-42.3, for information that can be useful when conducting CBRN reconnaissance.

AIR AND OVERHEAD RECONNAISSANCE

4-54. During all but the most adverse weather conditions, air or overhead reconnaissance is the best means to gather information and cover large areas difficult for ground units to traverse or observe. Airborne standoff intelligence-collection devices, such as side-looking radar, provide excellent terrain and target isolation imagery. Planned missions ensure critical areas are not masked by terrain or other environmental conditions. Additionally, air or overhead photographs compensate for inadequate maps and provide the level of detail needed to plan operations. Infrared imagery and camouflage detection film can be used to determine precise locations of enemy positions, even at night. Furthermore, helicopters, such as the attack helicopter (AH)-64 and observation helicopter (OH)-58D, provide commanders and their staffs with critical day or night video reconnaissance using television or forward-looking infrared.

4-55. The UAS flight patterns may be affected by mountainous terrain. Line of sight (LOS) command links limit UASs from flying into valleys, also limiting signals collection or electro-optical resolution. This requires higher operating elevations to maintain positive control, use satellite-based command links, or operate in autonomous mode more often.

4-56. Radar shadowing is a distortion that occurs in a radar return image when the angle of an observed object (such as a mountainside) is steeper than the sensor depression angle. This occurrence causes ghost images or distorted images in mountainous terrain. Commanders and intelligence officers consider manned or unmanned systems that employ non-radar sensors to minimize these images. Overhead systems that employ electro-optical or infrared sensors may work better than radar systems when weather conditions facilitate their use. The subsequent employment of intelligence, surveillance, and reconnaissance assets to verify data provided by overhead sensors helps the commander avoid deception targeted against specific overhead sensors.

GROUND/LONG-RANGE SURVEILLANCE

4-57. In the mountains, surveillance of vulnerable flanks and gaps between units happens at well-positioned observation posts. These observation posts are inserted by helicopter and manned by small elements equipped with sensors, enhanced electro-optical devices, and appropriate communications. Commanders and their staffs develop adequate plans that address their insertion, sustainment, and ultimate extraction. The considerations of METT-TC dictate that commanders provide more personnel and assets than they would to operations in other types of terrain to adequately conduct surveillance missions. Commanders and their staffs ensure that surveillance operations integrate with reconnaissance efforts to provide adequate coverage of the area of operations.

4-58. Long-range surveillance units and snipers trained in mountain operations contribute to surveillance missions and benefit from the restrictive terrain and excellent line-of-sight or LOS. Overhead platforms and attack reconnaissance helicopters may also be used by the commander for surveillance missions of limited duration (see FM 3-04.126). However, weather impedes air operations, decreases visibility for both air and ground elements, and reduces the ability of ground surveillance elements to remain hidden for prolonged periods without adequate logistical support. Terrain may mask overhead surveillance platforms.

PICKETS

4-59. Pickets in mountain operations are generally dismounted but may consist of either mounted or dismounted elements. Mounted maneuver elements use scouts as forward reconnaissance elements. These elements are small, light, and mobile units that conduct route reconnaissance for the main body. In addition to a route reconnaissance, these elements establish security at danger areas by securing the high ground and establishing mountain pickets. The use of pickets decreases the speed a unit moves due to the difficulty of moving along the top of ridgelines. Characteristics of mountain pickets include—

- Provide flank security for the main body.
- Provide surveillance of adjacent compartments.
- Provide observed fires into and across adjacent compartments.
- Serve as a relay for voice communications.
- Serve as connecting files in offensive operations.
- Be either static or mobile along tops of ridgelines.
- Patrol for periods of three to 14 days.
- Be in a high state of physical fitness, acclimatized, and have any specialized equipment needed to move across the specific ridge complex, such as crampons, ice axes, and ropes (see Appendix F).

4-60. Pickets in cold regions may require these types of patrols to operate with snowmobiles, cross-country skis, or snowshoes.

Chapter 5
Engineering

ORGANIZATION

5-1. Only through an in-depth intelligence preparation of the battlefield or IPB, a thorough information collection plan, and in-depth analysis can units overcome the difficulties associated with mountain operations. Forces prepare thorough engineer battlefield assessments and terrain analysis products to support planning. There is no formula for success in the mountains as every valley over the next ridgeline will present new challenges that will require new solutions but through analysis, effective task organization, and the proper allocation of resources, engineers can adapt to those challenges.

TASK ORGANIZATION

5-2. Mobility in the mountainous environment is extremely limited, requiring extensive shaping operations. The sheer quantity of earth movement and horizontal construction hours involved in providing mobility in offensive operations requires a focused effort from all engineering elements. The inherent separation of areas of responsibility for the different engineering elements based on subordinate command element mission-essential tasks within units result in a separation of resources to support varying requirements with varying priorities. To maximize the allocation of engineering resources to the highest priority tasks and to prevent the possibility of a lack of productivity from any engineering element, commanders detach all horizontal construction engineering elements from subordinate commands and combine them to create a separate element.

JOINT ENGINEER SUPPORT ELEMENT

5-3. The difficulties presented by the mountainous environment are mitigated by the combined effort of all engineer elements in the area of operations. Units with limited engineering assets to accomplish the mission, must liaise with joint elements vital to the procurement of critical engineering capabilities and support that are organic to the other services.

Naval Construction Force

5-4. Joint Publication (JP) 3-34, describes the basis for naval construction force support to the operational forces.

Rapid Engineer Deployable Heavy Operational Repair Squadron Engineer

5-5. The rapid engineer deployable heavy operational repair squadron engineer (known as RED HORSE) is a U.S. Air Force unit with the mission of assessing, planning, and establishing contingency facilities/infrastructure to support contingency operations and combat missions. In short, RED HORSE constructs facilities and infrastructure to support Air Force operations.

Prime Base Engineer Emergency Force

5-6. The mission of prime base engineer emergency force (known as Prime BEEF) is to provide civil engineer support for the bed down of personnel and aircraft. In other words, Prime BEEF provides utilities and civil engineer support to improve and maintain infrastructure to support air and space expeditionary task force operations.

MOBILITY

5-7. During mountain operations where limited mobility exists, it is critical that units maintain security and control of available road/transportation networks, including securing key bridges, fords, crossing sites, intersections, and other vulnerable chokepoints. These locations must be protected against enemy air, obstacle, and ground threats but commanders must carefully balance their available combat power between protecting their freedom of mobility and allocating forces to critical close combat operations. Effective risk analysis and decisions are essential. Route clearance patrols, traffic control posts, and other security operations aid commanders in securing routes. During offensive operations, commanders commit forces to seize key terrain and routes that afford their forces greater mobility and tactical options against the enemy. Engineer support in front of convoys and combat formations is necessary to clear and reduce obstacles, such as washouts, craters, mines, landslides, avalanches, and snow and ice in colder mountainous regions. Snow removal and road plowing is a continuous problem for the full depth of a unit, from the forward most fire team to the division headquarters. Reducing obstacles is more difficult in mountainous areas because of reduced maneuver space, lack of heavy equipment, and an increased competition for engineer support. Minefields are breached since bypassing properly sited obstacles is often impossible.

GAP CROSSING

5-8. Stream and river crossing operations are difficult and accomplished by expedient means. Bridging operations in mountainous terrain are limited to spanning short gaps and reinforcing existing bridges with prefabricated materials and fixed spans from floating bridge equipment. Troops use nonstandard bridging techniques and fording techniques where possible in mountainous terrain. During the spring and early summer months, snow melt causes passable gap crossings to become untenable. Alternate routes ensure mobility.

Limited Assembly/Construction Area

5-9. Due to the narrow road systems and limited radius of curves in mountainous environments, locations for gap crossing are limited and crossing locations are located further from the objective. Setting up staging areas, equipment parks, and assembly areas is not possible near the gap crossing location because of limited open space in the vicinity of the gap. These factors influence the employment of the medium girder bridge and the improved ribbon bridge. Properly conducted engineer reconnaissance/IPB identifies the best locations for gap crossings.

Dry Gaps

5-10. Areas identified as dry gaps during the initial engineer reconnaissance may become wet gaps overnight and wet gaps may become dry gaps in the summer. Using available intelligence and geospatial and historic meteorological methods, engineers identify historical high water marks during the reconnaissance to predict the rise in water level during the wet seasons.

Non-standard Bridging

5-11. Mountainous terrain hinders the employment of standard bridging assets, so the alternative option is to use nonstandard bridging techniques, such as rope, cable, or suspension bridges in order to ensure mobility to both mounted and dismounted maneuver forces.

COUNTER-IMPROVISED EXPLOSIVE DEVICE/MINE OPERATIONS

5-12. In a mountainous environment, the terrain favors the enemy’s use of mines and IEDs as standalone weapons and in the initiation of ambushes. In the mountains, using mechanical mine plows and rollers or other standard route clearance vehicles, such as the vehicle mounted mine detection system (Husky) and mine protected clearance vehicle (Buffalo), is frequently impossible due to the lack of roads and trails and the low classification of those that do exist.

5-13. Commanders employ mounted and dismounted counter-radio-controlled IED electronic warfare systems where possible to counter radio-controlled/detonated IEDs. When on foot patrol, breaching or bypassing mines and IEDs may be required. The use of robots or demolitions is required and preferred. Commanders exercise extreme caution when employing demolitions in the vicinity of snow- and rock-covered slopes because they cause dangerous rockslides, avalanches, and secondary fragmentation. More information on breaching operations and required synchronization can be found in ATP 3-90.4/*MCWP* 3-17.8. Countermine tasks in this environment are affected by the temperature. Mines placed in snow cover can be plowed away to clear a route. Detonation and breaching is more difficult due to freezing temperatures, frozen ground, and concealment of the snow cover (see ATP 3-90.8).

Snow Laid Mines

5-14. Mines are emplaced in the snow quite easily, especially antipersonnel mines. However, if the mines are covered by a couple feet of snow and the snowpack hardens, the mines become ineffective until the snow begins to melt in the spring. This situation presents the possibility that routinely used paths or routes during the winter contain mines underneath the snowpack. All snow-covered routes considered cleared during the winter must be cleared again once snow begins to melt.

Route Sweep Formations

5-15. Tactical mobility teams are task-organized and employed in front of convoys or combat formations to perform contiguous and combat route clearance operations. Teams also repair routes and remove non-explosive obstacles such as rocks, snow, and downed trees. As opposed to formations in other terrain, route clearance formations in the mountains push the flanks up the hillside to fulfill the role of mountain pickets/overwatch and to uncover potential radio-controlled IED triggermen. In many cases, flanks on one side of the formation may be removed if the slope drops off in a steep decline.

Metal Detectors

5-16. Dismounted engineers with mine and metal detectors perform dismounted sweeps on the battlefield to deny the enemy the intended effects of mine and IED warfare. Commanders understand the physical and psychological toll that performing dismounted sweep operations take on Soldiers operating in a mountainous environment. Soldiers of all other military occupational specialties (MOSs) are cross trained on the use of metal detectors as a force multiplier.

Technological Considerations

5-17. Extreme cold weather and snow and highly mineralized soils found in the mountains affect mine and metal detectors. Proper operation is first tested in a secure area. Terrain and snowpack conditions hinder counter-IED technology, such as robotic platforms that use line-of-sight remote control interface. Mine detection systems, whether vehicle mounted or handheld that use ground-penetrating radar technology are affected by snow- and water-covered surfaces. Mountainous terrain and weather hinder the counter-radio-controlled IED electronic warfare systems that use LOS.

ENGINEER RECONNAISSANCE

5-18. To prepare for operations, engineer reconnaissance in the development of the engineer battlefield assessment, IPB, mobility, combined obstacles, and ambush sites overlay is the most important task that the brigade combat team performs in the mountains. Accurate and detailed reports provide all maneuver element commanders including at BCT with the critical information necessary for proper operational planning.

5-19. Engineer reconnaissance assumes greater significance in a mountainous environment to ensure supporting engineers are task-organized with specialized equipment to overcome natural and reinforced obstacles. Engineer reconnaissance teams assess the resources required for clearing obstacles on precipitous slopes, constructing crossing sites at fast-moving streams and rivers, improving and repairing roads, erecting fortifications, and establishing barriers during the conduct of defensive operations. Since the restrictive terrain promotes the widespread employment of point obstacles, engineer elements integrate into all mountain reconnaissance operations.

5-20. In some regions, maps are unsuitable for tactical planning due to inaccuracies, limited detail, and inadequate coverage. In these areas, engineer reconnaissance precedes, not delays, operations. Because rugged mountainous terrain makes ground reconnaissance time consuming and dangerous, a combination of ground and aerial or overhead platforms are used for the engineer reconnaissance effort. Data on the terrain, vegetation, and soil composition, combined with aerial photographs and multispectral imagery, allow engineer terrain teams to provide detailed information unavailable from other sources.

Route Selection

5-21. Route selection criteria will vary by season. Full use of all intelligence available through map, ground, and air reconnaissance is necessary for proper route selection. Waterways, such as rivers and lakes, are obstacles during the spring and summer months but can become trafficable and an asset during the winter months. Water route reconnaissance must be very thorough and detailed and, as a result, will be very time consuming. Tools, such as augers and spuds (chisels), are required to measure ice thickness properly. Regardless of the season, over-the-snow vehicles will not eliminate the need for roads.

Engineer Ground Reconnaissance

5-22. Engineer reconnaissance includes observation of soil, snow cover, vegetation, ground water, surface water, ice thickness, road surface conditions, and sources of local construction materials as well as the condition of alternate routes. The purpose of this reconnaissance is to verify all information previously collected; check all possible routes for natural and manmade obstacles, such as avalanche debris, mines, and ice obstacles; and select the best site or route to accomplish the mission.

Snow and Ice

5-23. As much data and information regarding snowfall and ice growth as possible should be collected in the area of operations. Both are equally important and can be used as an advantage or become a disadvantage. As snow accumulates, it reduces the mobility of both man and machine. Heavy accumulation of snow results in avalanches, so engineers must be aware of the slope angles and aspects that favor avalanches in their area of operations. This awareness enables the commander to use the following forces of nature to his advantage:

- Fresh water freezes at 32° F and salt water freezes at 28° F.
- Ice is strong and has a varying degree of toughness and high bearing power.
- As temperatures drop, the strength increases rapidly from the freezing point to about 0° F.
- From this temperature, the strength of ice remains fairly constant despite lowering temperatures.

COUNTER-MOBILITY

5-24. During mountain operations where limited mobility exists, it is easy to conduct counter-mobility.

OBSTACLES

5-25. Obvious natural obstacles include deep defiles, cliffs, rivers, landslides, avalanches, crevices, and scree slopes (accumulated broken rock fragments), as well as the physical terrain of the mountains themselves. Obstacles vary in their effect on different forces. Commanders evaluate the terrain from the enemy and friendly force perspective. They must look specifically at the degree where obstacles restrict operations and at the ability of each force to exploit the tactical opportunities when obstacles are employed. Manmade obstacles used with restrictive terrain and observed indirect fire are extremely effective in the mountains but their construction is very costly in terms of time, materiel, transportation assets, and labor. Commanders know the location, extent, and strength of obstacles so that they can be incorporated into their scheme of maneuver. Commanders should allot more time for personnel to construct obstacles in cold weather due to the restriction of additional clothing and equipment. When developing barrier obstacle plans, they consider what affect changes in weather have on the plan. For example, if temperatures increase significantly, many areas that were solid ground become untrafficable, such as rivers and lakes. Conversely, if temperatures fall, causing rivers and lakes to freeze, these areas may become new avenues of approach for the enemy. These areas are covered by demolitions or artillery.

5-26. The engineer should never fail to use the natural obstacles that the environment offers. Icy slopes and fallen trees disrupt and channel troop movements. Leeward slopes with heavy deposits of snow can be rigged with explosives to catch enemy forces in the avalanche runout zone. Barbed wire and concertina wire are still effective on snow. It is easy to create effective obstructions in mountains by cratering roads, fully or partially destroying bridges, or inducing rockslides and avalanches. Units can use antitank minefields (family of scatterable mines) effectively to canalize the enemy, deny terrain, or support defensive positions. Commanders remember that clearing or reducing these same obstacles may be extremely difficult and a hindrance to future operations. Using reserve and situational obstacles, lanes and gaps, and plans to rapidly reduce friendly obstacles must be an integral part of all defensive operations. Commanders consider the enemy's ability to create similar obstacles and minefields when developing courses of action that hinge on speed of movement or a particular avenue of approach.

MINES

5-27. Snow, ice, frozen ground, and low temperatures affect mine-laying operations. Burying mines in a frost layer of more than three to four inches (8-10 centimeters) may be prohibitive, causing mines to be placed on top of the ground. Snow or ice prevents sufficient pressure from being put on the mine to cause detonation. Water seeping into and around the pressure-firing device freezes and prevents detonation. Plastic laid over the top of the mine prevents this type of failure. Mines are painted white if possible for camouflage purposes. During the spring and summer months, flash floods and excessive runoff dislodges mines from their original location but they normally remain armed.

AVALANCHES

5-28. Avalanches occur in nature when snow loads exceed the strength of the snowpack structure. Artificial loads, such as explosive detonations, can be applied to the snowpack to artificially trigger an avalanche. Artificial avalanche triggers allow engineers to cause avalanches at a specific time when it is safe, or most advantageous, for friendly forces to hinder enemy force movement. The use of demolition charges or artillery air munitions is one method of applying stress to the snowpack's instability. Explosives do not provide the same loading of stress onto the snowpack as other control trigger mechanisms but they may be ideal for some snowpack conditions. The range of terrain types and the operational requirement causes the use of various delivery methods to optimize the effectiveness of the explosives. The explosives delivery methods employed in a control area are chosen on the basis of the general terrain, snowpack, effectiveness, operational necessity and potential for noncombatant casualties, and destruction of civilian property and infrastructure.

5-29. To mitigate the threat of avalanches and rockslides to friendly forces, noncombatants, and destruction of civilian property and infrastructure, the Marine Air-Ground Task Force has several methods to artificially trigger the event when it is safe. Engineers place demolition charges on the snowpack or use indirect fire or direct fire with explosive projectiles to trigger the event. Indirect fire allows the Marine Air-Ground Task Force (MAGTF) and BCT to control the time of the event from a safe distance without the burden of movement. They plan to trigger close enough to offensive operations that time is available to clear routes, yet not allow for the threat potential to rebuild. In stability operations, planners mitigate the avalanche threat regularly for all LOCs. Small patrols in unfamiliar areas carry mortar systems to mitigate any suspicious slopes they encounter from a safe distance.

SURVIVABILITY

5-30. The ability to dig survivability positions into a slope increases the amount of usable terrain, increases survivability of the positions, and saves on time and money for protection. Engineer units task-organize and deploy with the proper resources to cut into the hillsides so survivability positions are placed into the mountain instead of building on top of them. Such operations require extensive use of heavy equipment and demolitions.

ELEVATION OF FORWARD OPERATING BASES/COMBAT OUTPOSTS IN RELATION TO SURROUNDING TERRAIN

5-31. When planning to establish a fixed site, the position and angle of the enemy's fire is important when choosing the site location. Whoever maintains the high ground has an advantage of fire and cover, so defensive positions should be elevated. Do not place fixed sites on peaks or ridges because it makes the site vulnerable to fire from 360 degrees. Ideally, sites are located on the military crest of the reverse slope with observation posts on both the military crest of the forward slope and surrounding key terrain. As time permits, positions are camouflaged and concealed and dummy positions established.

OVERHEAD COVER

5-32. Mountains present the enemy with the opportunity to shoot at the friendly base from an elevated position, so most rounds will impact on the top of structures. Overhead cover should be heavily reinforced and maintained, requiring increased structural support in load bearing walls and roof supports.

FORWARD OPERATING BASE SITE SELECTION

5-33. The trend for most bases is to locate them where it is convenient for logistics, mission command, and mobility, which is most likely next to a local main supply route. In the mountains, MSRs follow river valleys. Such routes present an issue when the river valley floods in the spring and washes out the entire MSR and parts of the local population center. Bases must be established high enough off the flood plain to avoid being damaged by the spring snow melt and should have a local MSR that is also clear from the flood plain.

SNOW REMOVAL/DRAINAGE

5-34. Construction in snow covered areas must plan space for snow removal. A location must be identified for storing snow piles and that these locations have adequate drainage to remove the snow melt from the site and they must not interfere with fields of fire in the defensive plan for that installation. This may require hauling off and spreading out the snow to deny the enemy's use of it as a concealed attack position.

GENERAL ENGINEERING

5-35. General engineering involves activities that identify, design, construct, lease, and provide facilities. Characterized by high standards of design, planning, and construction, general engineering in mountainous terrain must be carefully considered due to extreme temperatures, altitudes, and difficulty of terrain. If feasible, construction should be undertaken when little or no frost is on the ground as often, if the permafrost is too thick, it can make it impossible to dig. Construction operations in mountainous terrain are extremely slow and complicated by the lack of local material, heavy equipment operating difficulties, and enemy defensive activities. Due to the uneven terrain, surveyors must be used to allow for the best structural integrity of the construction project. Local materials, if available, are used for construction purposes to help with stability operations and to help alleviate the strain on overburdened transportation and aviation assets.

HORIZONTAL CONSTRUCTION

5-36. The most noticeable challenge in the mountains is the lack of road networks and railroads. Both are practically nonexistent, making road construction a major operation. Heavy equipment and combat engineer operators exposed to the elements rapidly become fatigued and require regular relief after short periods. Continuous operations, except for short periodic stops for operator checks and minimum equipment maintenance, prevent equipment from freezing. Maintaining roads is critical after snow storms and during spring thaw run off, this requires snow/mud removal by heavy equipment assets. Cross-country movement of units without engineer support is difficult.

Roads

5-37. For the most part, creating new road systems in mountainous regions is impractical because of the large amount of rock excavation required. Most roads in cold regions are built up, requiring additional quarrying and transportation. Further, in winter months, rock excavation will be nearly impossible with the use of only heavy equipment. Therefore, roadwork is limited to the existing roads and trails that require extensive construction, improvement, maintenance, and repair to withstand the increased military traffic and severe weather conditions. Frost heaves are common in areas where permafrost is present. In certain mountainous areas, materials may be difficult to obtain locally and it may be impossible to make full use of conventional heavy engineer equipment for road and bridge construction or repair. In such cases, large numbers of engineers are required and units rely heavily on hand labor, light equipment, and demolitions.

Secondary Roads

5-38. Secondary roads and trails are improved to accommodate wheeled and tracked vehicles and, eventually, heavier vehicles. Their selection depends on necessity and the speed with which the routes can be put into service. Abnormal gradients on roads are necessary to ensure that construction keeps pace with tactical operations. Side hill cuts are the rule and the same contour line is followed to avoid excessive fills or bridging. When terrain permits, turnouts should be constructed in order to mitigate traffic congestion on single-lane roads or trails. Drainage requirements are considered in detail because of the effects of abnormally steep slopes, damaging thaws, and heavy rains. During winter, use of ice roads on lakes and rivers may be available (to either friendly or enemy forces).

Landing Zones

5-39. Engineers must be prepared to consider LZs for aviation assets. Drainage is an important factor in selecting an airfield site and planning the construction. Engineers should be aware of the following features related to drainage in order to ensure a successful LZ design:

- Sites should be selected in areas where cuts or the placement of base-course fills will not intercept or block obvious existing natural drainage ways.
- Areas with fine textured and frost susceptible soils should be avoided.
- Soil stabilization and dust abatement must be understood.
- An LZ should normally be on the windward side of mountain ridges or peaks to ensure a reasonably smooth air flow. However, in forward areas, concealment from the enemy observation is a more important factor in selecting a site. These sites should be well clear of structures and vegetation, which are vulnerable to helicopter rotor downwash, particularly in confined spaces.
- An LZ should be as level as possible and may not be on a slope exceeding seven degrees in most situations. Aircrews that experience difficulty landing due to extreme slope angles in LZs request to reposition to a less drastic slope angle for operations. A helicopter cannot land on slopes greater than seven degrees, however, if rotors are clear of obstructions, they may be able to load and unload in the low hover.
- Snow-covered LZs are marked with colored dye, timber “letters,” or obscurants, and camouflaged with more snow when not in use.

5-40. In soft snow a suitable reference point, such as a vehicle, should be available to the pilot to avoid disorientation in recirculating snow during descent. Stamping snow to form LZs is dangerous because compacted snow forms a crust when frozen, which the powerful downdraft of large helicopters breaks up causing a foreign object damage hazard. As with soft snow, some form of reference is desirable and, if time permits, the area is dampened down with water or other dust abatement material. Helicopter-blown sand or ice is a hazard to Soldiers and weapons, particularly optics. Downwash in freezing conditions can cause frostbite to exposed skin.

5-41. An LZ should be clear of fine dirt or sand, which develops on spaces frequently trafficked by personnel and heavy vehicles. Fine soft dirt becomes deep on a relatively flat LZ and may cause brownout conditions for landing and departing aircraft. This situation becomes even more dangerous with the addition of confined approach and departure paths due to surrounding steep terrain. When possible, LZs should have an adequate system in place to reduce the amount of dust prior to aircraft arriving. Crushed rock, matting pads, large amounts of water sprayed on the LZ, glue-or grease-based dust abatement products, and commercial products approved by aviation leadership are all viable methods of preventing pilot disorientation due to whiteout/brownout incidents.

VERTICAL CONSTRUCTION

5-42. Field construction time and the difficulty of conventional engineer work are magnified in mountain operations. Environmental characteristics that complicate engineer tasks are permafrost, extreme and rapid changes in temperature, wind, moisture, snow, ice storms, and flooding. Although standard construction principles remain the same in mountainous environments, some considerations must be given to construction during times of heavy snowfall.

5-43. The standard pitch of the roof (4:12 pitch [four inches of rise over 12 inches of run]) is sufficient for snow to slide off but corrugated steel must be used atop plywood in order to allow the snow to slide off more freely. Ceilings need to be sealed in to prevent dripping into structures.

5-44. For wood frame construction, all material design requirements for structures without a snow load should be increased to the next standard material size. For example, a building with two-inch by four-inch studs without a snow load should be designed with two-inch by six-inch studs for use in an environment with a snow load. If material of a greater size is not available, on-center spacing for both studs and trusses can be decreased to accommodate the increased weight due to snow load.

UTILITIES

5-45. Electrical and water equipment have associated winter kits. It is imperative that these winter kits are deployed with the gear in order to allow the gear to work under extremely cold conditions. Further considerations must be given to the altitude change for output of equipment. Also, when emplacing utility equipment, the operator must ensure that the equipment is on as level terrain as possible (not to exceed a 15 percent gradient) and the equipment is placed on any insulating material to keep it from freezing to the ground.

Tactical Electrical

5-46. Generator sets can start and operate at temperatures as low as -25° F without a winterization kit. With a winterization kit, generators can operate at temperatures as low as -50° F and can be stored in temperatures no colder than -60° F. It is recommended that winterization kits be installed prior to deployment. Generators must be allowed to rise to normal operating temperature before applying a load to reduce the possibility of engine damage. When the ambient temperature is lower than -25° F, most engines require preheating before they are started and the engine type determines the method used. The two basic types of cooling systems used on power-generating equipment are air cooled and liquid cooled. A blowtorch is used to preheat most air cooled engines. Most liquid cooled engines are equipped with a winterization kit that contains a preheater. The respective generator's technical manual for preheating and cold weather starting operating instructions is a good reference.

5-47. Special care must be taken when emplacing and using field wiring harness kits. Typically, in extreme weather conditions, a lower American wire gauge is needed. If temperatures drop to below -32° F, a 12-gage American wire will not be able to withstand the weather. Wires will become brittle and need to be covered with thermal protectors. At the same time, if wire is buried, it needs to be below the permafrost layer, which can be up to three feet (one meter) in some areas, or the gauge needs to be low enough to be able to withstand the extreme temperatures.

5-48. Generator sets are rated based on sea level altitude. The rating of the set may decrease as the altitude increases. Information about operating equipment at high altitudes is usually printed on the data plate. The kilowatt rating may be reduced at high altitudes, depending on the type of engine used to drive the generator. Refer to the appropriate technical manual for information for each model of generator set. As a rule, a generator loses 3.5 percent of its power for every 305 meters (1,000 feet) over 1,219 meters (4,000 feet) that it ascends.

5-49. Cold weather maintenance must be done on all electrical systems. In all generators, the antifreeze solution must be able to protect the equipment at the lowest temperature expected. Also, the batteries will need to be fully charged to prevent freezing. In some cases, ice fog, which is caused by engine exhaust in very cold climates (-25° F and below), may occur. To eliminate ice fog, a tube should be placed on the exhaust pipes and covered with a tarpaulin to diffuse the exhaust in the snow. Lastly, ice, snow, moisture, and other foreign material should be removed from the generator set prior to operating the equipment.

Potable Water

5-50. Major sources of water supply, in order of efficiency and economy, are:

- Drawing water from under rivers or lakes.
- Melting ice or snow.
- Drilling wells.

Note: Over the long-term, melting snow for large units is not efficient. A well is more likely to meet the needs of a large unit. Melting snow is very time consuming and fuel intensive and can be prone to contamination. This is best left to the small unit.

5-51. The tactical water purification system operates down to 32° F without the winter kit and down to -25° F with it. However, heated shelters are necessary to operate water purification equipment and prevent the inner pipes from freezing when not purifying water. When temperatures go below 32° F, water purification personnel have difficulty operating and maintaining their equipment. Constant winterizing and use of the water heaters are required to prevent freezing. Winterizing, however, is not always feasible. Surface water in winter must be pumped from beneath an ice layer. To prevent freezing, it is necessary to preheat the water during operations and keep it heated until it is issued, which may require additional heaters.

5-52. The water site selection can be tricky in mountainous terrain. The water site needs to be on high porous ground, reasonably level, and well drained to prevent water from impeding resupply operations. During the winter in cold regions, reconnaissance teams use ice augers to determine ice thickness on a potential water source. The team measures the depth of water under the ice at several spots because of the variations in the beds of shallow streams and rivers in mountainous regions. Once a site has been selected, shaped charges are far superior to hand tools for cutting large holes through thick ice to prepare a water hole. A consideration when using shaped charges is that ice must be allowed to stabilize after being blown up as it shatters for a long distance around the hole. This will delay access to the water source. Gas or hand powered augers will allow immediate access but will take longer to employ.

5-53. Maintenance of the water distribution systems must be considered. In very cold weather, it may be necessary to periodically drain the raw water pump and the raw water hoses and bring them into a warm shelter so they do not freeze. Frazil ice is the slushy ice that forms as the water travels in turbulent unfrozen sections of a river. If frazil ice is present at the water supply hole, the ice filter should be used to keep the frazil ice from being sucked into the raw water pump and freezing.

5-54. Higher altitudes require adjustments in planning factors (see Chapter 6). For example, the water treatment chemicals react differently at extremely low temperatures. At 32° F, chlorine requires twice as much contact time to properly disinfect water. Soldiers should carry iodine tablets to purify their own water for personal consumption. Further information on potable water in cold weather and mountain water operations is found in ATP 4-44.

5-55. More information on water usage requirements can be found in Chapter 6.

Fuel

5-56. Mountain operations challenge the storage and distribution of fuel. Cold weather operations require increased testing, recirculation, equipment maintenance, and fuel usage due to extended equipment operation requirements. In the extreme cold weather environment, fuel is the single point of failure in the whole operation. If there is no fuel, simple work does not happen. Ground operations increases fuel consumption rates of individual vehicles by 30 to 40 percent, requiring more fuel filtering and distribution. Depending on the temperature, adding icing inhibitors to fuel may be necessary. Diesel fuel will reach its freezing point and begin to gel at around 15° F, whereas, jet fuel has a much lower freezing point of around -51° F. Fuel additives are available to decrease the possibility of fuel gelling (Military Detail [MIL-DTL] Specification 85470, Inhibitor, Icing, Fuel System, High Flash, North Atlantic Treaty Organization Code Number S-1745).

Although fuels do not completely freeze, they will be the same temperature as the air. To prevent frostbite, fuel handlers must always wear gloves designed for handling petroleum products when working with fuels.

HEAVY EQUIPMENT

5-57. Engineer equipment use in mountainous environments does not change drastically from its use in other regions, however, there are considerations that must be made when planning engineer equipment operations.

Hard Starting

5-58. Diesel engines, found on all engineer equipment, will be prone to hard starting. Some are equipped with engine block heaters to help alleviate this problem. Commanders must plan on increased fuel consumption if vehicles are to remain running during extreme cold in order to counter cold soak.

Tire Chains

5-59. When conducting heavy equipment operations in snow, check your basic issue items, tire chains will increase mobility and make material handling operations safer and must be part of BII for every vehicle. Tire chain installation should be treated as a battle drill and practiced.

Snow Removal

5-60. Front end loaders and road graders make excellent snow removal tools but road edges, especially drainage ditches, should be marked to avoid accidents. When removing snow, operators must be cautious not to break through the soil permafrost layer to prevent muddy conditions. Bulldozers do not make good snow removal tools for site operations. The amount of mechanical damage to the ground surface generally outweighs the reduced time for removal. Commanders weigh the use of bulldozers for snow removal outside of the site against the damage to road surfaces that can be caused. They exercise extreme caution when ordering heavy equipment operations in deep snow or ice, since both tracked and wheeled vehicles are prone to sliding on ice. Since rollover conditions are increased when operating on uneven snow packs, operators must be cautious of varying snowpack and snow stability.

Excavation and Earthmoving

5-61. Mountain soil conditions are prohibitive to excavation and earthmoving operations due to the amount of subsurface rock. During extreme cold weather conditions, excavation and earthmoving operations will be additionally hindered by the permafrost layer. If excavation and earthmoving operations take place, commanders plan for increased time and equipment repair parts, especially cutting edges, cutting blades, and hydraulic systems.

UNDERGROUND CONSTRUCTION AND CONFINED SPACES

5-62. Mountains present natural and manmade cave complexes for convenient weapon caches, patrol bases, and rally points. The dynamic nature of earth movement and the threats associated with confined spaces make underground areas extremely dangerous. As a result, these should be avoided unless necessary. Manmade caves and underground shafts should be avoided at all costs. If weapons or enemy forces are suspected of occupying manmade underground spaces, commanders should attempt to coerce the enemy to come out of them before using demolitions to destroy the cave portal. Units deploying to any terrain that supports underground spaces, equip their maneuver elements with gas detectors capable of identifying oxygen and carbon monoxide levels.

Chapter 6
Sustainment

GENERAL PLANNING CONSIDERATIONS

6-1. Planning considerations for sustainment begin with the concept of logistic support. Other considerations include cross-training and interoperability, waste management, accountability, security, aviation support, and seasonal challenges.

LOGISTIC SUPPORT CONCEPT

6-2. Due to the increase in time associated with moving at high altitude, logistic support is forward positioned as close to the supported unit as possible. The FOBs will likely be supported by intermediate support bases and main supply hubs.

Logistic Support Elements

6-3. In mountain operations, logistic units are task-organized and attached to combat units in order to support widely-dispersed forces. Infantry battalions operating in mountainous areas may disperse into company- or platoon-sized elements that operate from FOBs and combat outposts (COPs). Each support element should include personnel, such as winter mountain leaders, who have expertise in route planning and movement techniques. Logistic support elements may provide container delivery system (CDS) recovery, sling operations, helicopter landing zone-LZ coordination, convoy escort, health services, motor transport, material handling, supply, maintenance, vehicle recovery, and field feeding.

Intermediate Staging Bases

6-4. Operating farther back in intermediate staging bases (ISBs), logisticians will employ convoys and aerial drops to deliver critical and sensitive materials and supplies. Logistic organizations at an ISB should assume that key support personnel will be on duty 24 hours a day, seven days a week. At a minimum, the following logistic support tasks should be located at an ISB: Class I, III, V, and VIII commodity oversight; mortuary affairs; parachute rigging; sustainment; and transportation movement coordination.

Liaison Officers

6-5. Supported units maintain a liaison officer at the logistic operations center. Additionally, Service LNOs should be maintained with the theater of operation support organizations and other higher level joint commands. They are needed when resupplying along ring routes to ensure supplies distributed to units operating in the mountains are properly prioritized.

LOGISTIC CROSS-TRAINING

6-6. During mountain operations when units often operate outside of the range of immediate external support, personnel are cross-trained in many functional areas, including logistics. The institution of combat lifesaver training for nonmedical personnel is one example of successful implementation of this concept. Potential areas for logistical skills cross-training include casualty evacuation, utilities, maintenance, food service, and air delivery recovery. For example, in an environment where IED attacks are prevalent, vehicle recovery crews may need to be able to conduct firefighting, CASEVAC, search and recovery of human remains, and sanitization of blast sites and equipment. More information on mortuary affairs is available in ATP 4-46, Contingency Fatality Operations.

INTEROPERABILITY

6-7. Joint operations in mountainous terrain require interoperability among the Services. For example, when 1st Battalion, 3d Marines was deployed in the mountains of Afghanistan, all logistical support for the battalion (except Marine Corps-unique items) came from the Army. Units operating in the mountains rely on other service, coalition, and host-nation support for extended periods. Support between adjacent units from different Services or country origin is frequently necessary during mountain operations. Cross-servicing agreements are needed.

SUSTAINMENT CHALLENGES

6-8. Logistic planners accept that time and distance double by the environment. In some areas, terrain is so restrictive that only air or foot movement is possible. Three kilometers (two miles) on the map may actually require nearly 10 kilometers (six miles) of foot movement due to the switchbacks of trails, high elevation, and weather. Taking shortcuts and unnecessary risks typically delays movement and compromises the safety of logistic efforts.

6-9. When operating in remote mountainous areas, units prepare for extended periods without resupply. They may need to maintain two to three times the anticipated requirement for supplies or adopt innovative methods to overcome shortfalls. In mountain operations, units plan for 10 to 20 percent loss of supplies for the following reasons:

- Damage often occurs during air delivery.
- Host-nation trucks get damaged while traversing rough roads over long distances.
- Pack animals carrying supplies over treacherous mountain trails can easily be lost.
- Due to less open space to store supplies, enemy indirect fire often has a greater effect than it would if supplies were properly dispersed.
- Packaged supplies easily break open or get buried under snowstorms and avalanches.
- Pilferage is common.

6-10. Units operating in mountainous terrain rely on innovative and unorthodox methods of logistic support. For example, units might need to make use of captured enemy supplies and equipment. They might need to rely on locals who know the terrain or “piggyback” on a coalition partner’s assets. Maintenance personnel may be tasked to repair host-nation military or civilian equipment. The use of hidden supply caches may need to be implemented.

ROUTE SECURITY

6-11. In mountain operations, the enemy uses terrain as a force multiplier in order to target logistics units and interdict resupply operation. Enemy units infiltrate and seize key terrain that dominates supply routes in an effort to disrupt and isolate units from logistical support. A combination of patrolling and air reconnaissance is the best means for providing route security in mountainous terrain. Observation posts on dominant terrain along supply routes provide early warning of enemy activity. Checkpoints between bases enhance route security. Route clearance operations are conducted at regular intervals to verify the status of roads and prevent enemy emplacement of obstacles, mines, or improvised explosive devices tied in with restrictive terrain features that canalize movement. Finally, movement of supplies at night reduces vulnerability to enemy attack but night marches present other hazards due to the difficult terrain and require daylight reconnaissance, careful route preparations, and guides.

AVIATION SUPPORT

6-12. Wide variations in climate and frequent and sudden changes of weather preclude continuous aviation support, especially during the winter when mountain passes are regularly impassable due to low ceilings and poor visibility. Rapid weather changes do not allow for aircraft to reach casualties and therefore, alternative modes of evacuation must be planned in this environment.

6-13. The reduced hours of daylight consistent with mountain arctic or subarctic winter operations dictate a greater need for artificial lighting. The provision of the additional lighting must be planned for in the logistic concept of operations. For example, sufficient lighting equipment is available to furnish adequate illumination for maintenance services. Conversely, the extended daylight during summer requires important operational adjustments.

WINTERIZATION

6-14. Equipment and facilities may need to be winterized in mountain operations. For example, heated buildings, shelters, or tents with wood flooring are required for maintenance in cold weather. Winterization can be a significant operation that requires extensive advance planning in preparing facilities and equipment. Material and equipment need to be ordered well in advance of the winterization date. Contracts may need to be negotiated with host-nation providers for facilities, generators, and other winterization-related items and services. Delays in delivery of long lead-time items, such as lumber, require extending winterization target dates. Competing construction projects stress engineer and logistical assets. These challenges highlight an important point that staff responsibilities must be synchronized so that winterization is viewed as a force-wide mission, not just a task for engineers.

SUPPLY

6-15. Logistics and sustainment requires the consideration of several types of supplies. Chief among those are personal nourishment, protection, and equipment items.

FOOD AND WATER (CLASS I)

6-16. Mountain operations, particularly in extremely cold weather, increase Class I item consumption and energy requirements by as much as 50 percent. The average person’s caloric need may increase to 6,000 or more calories per day albeit despite the greater caloric requirement, high altitude reduces the appetite. If a reduced appetite is allowed to result in decreased consumption, the effect can reduce morale and fighting capabilities and make personnel more susceptible to mountain-related illnesses. Some Soldiers conducting dismounted operations during Operation ENDURING FREEDOM lost 20 to 40 pounds during deployment. At least one Soldier was evacuated due to malnutrition and severe (60 pound) weight loss. Refer to Appendix A for risks related to dehydration. The standard meal, ready to eat (MRE) contains insufficient calories and nutrition for mountain operations. The meal, cold weather ration is more suitable for the environment, if sufficient water is available. If possible, fresh fruit and vegetables should be provided as well.

6-17. The meal, cold weather ration contains menu bags that contain 1,540 calories each. At high altitudes with extreme cold, an individual consumes three menu bags per day. Each case contains 12 meal bags, weighs approximately 15 pounds, and measures approximately 1.02 cubic feet.

6-18. The MRE ration can be used for high altitude and cold climates, however, the MREs include components that contain liquid that can freeze during extreme cold weather operations if these items are not kept warm, such as by carrying them inside the clothing. Each MRE contains approximately 1,250 calories. At high altitudes, an individual would need to consume more than the standard three MREs per day to meet energy demands. Each case contains 12 meals, weighs approximately 22 pounds, and measures 1.02 cubic feet.

6-19. The first strike ration (FSR) may be a better option for use as long as temperatures remain above freezing. The FSR has already been used by units operating at high altitude up to about 2,438 to 3,048 meters (8,000 to 10,000 feet) without issue. The ration does not contain an individual heater and some items may not be palatable if frozen. The FSR includes liquid-containing components that can freeze during extreme cold weather operations if not kept warm, such as by carrying them inside the clothing. It is meant to be used in mobile and combat-intensive scenarios where eating on the move or out of hand is required. At high altitudes, eating small, frequent meals and consuming more fluids is advised. The FSR ration contains more fluid beverage bases to increase consumption of water and easy-to-eat snacks. It is used for three days or fewer at a time due to the limited menu and limited caloric content. To meet increased caloric needs while operating at high altitude, the FSR will need supplemental items, such as fruit, vegetables, and milk, or the addition of one MRE to increase calories and menu variety. When compared with three MREs, the one day FSR subsistence weighs 50 percent less and takes up half the space.

6-20. Units that employ pack animals must account for their feed as well. For planning purposes, pack animals require two percent of body weight in dry weight of feed per day, although individual animals will vary in their need. As the temperature drops below freezing, animals require an additional one percent of feed for each degree of temperature change.

6-21. Water requirements of production, resupply, storage, and consumption, are often the most significant logistical challenge to extended mountain operations. Leaders should enforce an increase in water consumption for two days prior to an operation. When operating at altitude, it may be difficult to carry enough water to sustain a unit for more than a day. Soldiers equipped with lightweight water purification equipment and squad stoves will be able to easily deal with the issues of procuring water. Dismounted patrols should plan for daily resupply of water, if possible. In low mountains, leaders should plan on each individual consuming four quarts of water per day when stationary and up to eight quarts per day when moving. In high mountains, planners should increase these planning factors by about two quarts per individual.

6-22. Water increases in viscosity in extreme cold weather, and therefore moves slower through pumps. Disinfection chemicals require additional time to be effective in freezing temperatures. Water flow through treatment systems must be slowed to account for increased time for chemical reactions. For these reasons, production rates of water treatment systems will be reduced during cold weather operations. Extreme cold weather may cause parts to crack, especially if made of plastic. Electronic instruments may become less dependable and even fail. A winterization kit (custom component of all water treatment systems) is required when operating in freezing temperatures, and when expecting to operate in freezing temperatures. All systems components should be drained when not in use to prevent freezing.

6-23. In high mountains, where subfreezing temperatures persist year round, water may be extremely difficult to find unless Soldiers are equipped with a stove to melt snow or ice. Logistic planners and operators explore multiple methods of water delivery to ensure water needs are met. Units must rely on sources of natural water, if it is available, to reduce the logistic burden. It is important to remember that purification is always necessary no matter how clean mountain water may appear (see Chapter 5). Individuals must take regionally appropriate prophylaxis medications as an additional precaution against food and waterborne illnesses. If clean snow is available, it can be melted for drinking and heated or sterilized using small squad stoves and cook sets. Clean snow is defined as snow that is undisturbed and fresh snowfall that is uncontaminated by animal waste or debris. As each gallon of water weighs approximately eight pounds, carrying a small water filter or water purification pump or stove and cook set for extended operation can be a weight saver, despite the added weight of fuel for the stove. Each Soldier will require approximately six ounces of stove fuel per day to boil water and prepare food.

6-24. Measures, such as placing canteens or other personal water storage containers inside clothing where they can be warmed by body heat, should be taken to protect water containers from freezing in cold weather. Plastic water cans may break if filled at extreme temperatures and therefore when in use, cans should be kept partially full and turned upside down.

6-25. Beyond individual consumption requirements, water will also be required for personal hygiene, vehicle maintenance, medical care, and pack animals, however, priorities must be set for water consumption and conservation in all areas. For example, in the mountains, it may be necessary to avoid cleaning the exterior of vehicles, except for windows and the undercarriage.

Clothing, Individual Equipment, and Tents (Class II)

6-26. In cold weather, preferred clothing consists of loose-fitting layers and insulated, polypropylene clothing designed to wick away moisture and ensure perspiration does not accumulate close to the body. Fleece caps and jackets offer warmth without weight/bulk. Cold weather boots must be issued in a cold weather environment. While personnel are in static positions, they should either wear over-boots for warmth or stand on insulating material such as a pine bough or a flat piece of wood. Soldiers operating in rugged, mountainous terrain should be issued mountain boots. Leaders should understand mountain terrain requirements and that mountain boots are different in characteristics and design than a standard issue boot. If personnel use improper or worn clothing for even a short time, the chance of developing cold-related injuries increases significantly. A lost or damaged glove in sub-zero degree conditions, can quickly result in a debilitating or permanent injury. Clothing should be fire retardant, if possible. Due to the rugged nature of the terrain, there will be an increased need to replace lost or damaged individual clothing and equipment. Boots, jackets, and gloves will generally wear out faster under the harsh and rugged conditions of a mountain or cold weather environment. In operational planning, sufficient clothing overages should be considered and clothing stocks should be built up prior to deployment.

6-27. In cold weather, special equipment requirements include snowshoes, boot crampons, avalanche beacons, avalanche probes, skis, skins, ski wax, backpacking stove and fuel, candles, ice axes, snow shovels, matches, 100 percent ultraviolet protection glacier glasses, sunscreen, special fuel containers, tire chains, and winterization kits. A more comprehensive list can be found in ATTP 3-21.50.

6-28. Prefabricated, synthetic, four-season, mountaineering tents are useful in cold mountainous environments. Tents must be easy to carry and assemble at high elevations and retrievable from deep layers of snow. Tents must also be able to withstand high winds and the weight of snow and be equipped with winterization kits.

6-29. In cold weather, tent heaters and stoves in billeting and storage areas are necessary. Heated tents will be required for storage of some classes of supply items. Refrigerator boxes may be turned off and used to keep supplies warm. Some units prefer to use multi-fuel backpacker stoves, however, at high elevations, multi-fuel cook stoves will operate at a lower efficiency.

6-30. In cold weather, all batteries provide less power, so a greater quantity of batteries or more frequent charging of batteries is required. Cold weather batteries are recommended, if available. Dry batteries must be stored at temperatures above 10° F and must be warmed gradually, either with body or vehicle heat, before use. In subzero weather, additional battery chargers must be on hand to meet heavy requirements for battery maintenance. Battery stocks should be replenished often, paying particular attention to items with unique proprietary batteries. Also, personnel must avoid relying on Service-specific items that require batteries not carried by the theater-level sustainment organization.

PETROLEUM, OILS, AND LUBRICANTS (CLASS III)

6-31. In steep-sloped mountains, vehicle fuel consumption increases by 30 to 40 percent. As vehicles ascend, the amount of oxygen available is reduced and the engine efficiency drops. On average, vehicles lose 20 to 25 percent of their rated carrying capacity, however, overall fuel consumption for the unit decreases because of lower vehicle movement. Heavy reliance on aviation assets for resupply and movement increases aviation fuel requirements. Units that operate in cold weather to need plan for fuel use and storage. Fuel points supply units with refined or white gasoline produced for pressurized stoves. Special fuels may be needed for host-nation equipment. Individuals carry special fuel for personal or squad stoves. National Stock Number (NSN) 7310-01-578-6413 uses diesel or jet propulsion fuel, type 8, cutting the need for multiple fuels. Some fuels may need additives to prevent freezing and gelling. In arctic conditions, fuel spilled on flesh can cause instant frostbite if the proper gloves are not worn.

6-32. Multi-viscosity oil (15W-40) is recommended for most vehicles in cold weather. Use of 15W-40 prevents frequent oil changes in an environment with a great variance in temperature. Vehicles should be changed to multi-viscosity oil before embarkation. In sustained extreme cold conditions, 10W oil will be required.

6-33. Cold weather mountain operations require arctic engine oil, a synthetic SW-20 lubricant used for temperatures down to -65° F. Arctic engine oil is approved for engines, power steering systems, hydraulic systems, and both manual and automatic transmissions. For weapon systems, lubricant specifically designed for arctic weather should be used.

6-34. When units are widely-dispersed, FOBs may be able to store only a limited quantity of fuel, which limits operations when circumstances prevent timely resupply. Increased quantities of lightweight, portable fuel storage containers may be needed. Up to twice the normal number of fuel cans may be required if transporting fuel to vehicles, rather than bringing vehicles to the refueling point. Adequate quantities of 5-gallon cans, nozzles, and 1-quart fuel bottles must be available. When vehicles; generators; and petroleum, oils, and lubricants containers are brought into warm storage from the cold, fuel tanks and containers should be filled at least three-quarters full to prevent condensation. See ATP 4-33.

MATERIAL STORAGE AND HANDLING CONSIDERATIONS

6-35. Cold weather and snow has significant effects on all types of supplies. Personnel operating in these conditions must undergo special training to work effectively.

Effects on Material and Equipment from Extreme Cold

6-36. Extreme cold can significantly slow material handling and maintenance activities by numbing exposed skin, such as the face and hands. Activities that normally require only minutes in temperate weather may require hours in extreme cold. Movement by foot or vehicle over snowy and icy surfaces is slower and poses a high risk of injury to personnel and damage to equipment. Subfreezing temperatures result in freezing water in water tanks, waterlines, and equipment exposed to snow and water penetration. Because water expands when frozen and metals and plastics become brittle in subzero temperatures, standing water in equipment may freeze and damage components in areas with close tolerances and no room to expand. Additionally, metals contract at lower temperatures and expand at higher temperatures. Consideration must be given to guard components and equipment against improper clearances that can lead to binding or excessive looseness when exposed to subfreezing temperatures.

6-37. Commanders and logisticians must make every effort to winterize vehicles and equipment with cold weather lubricants and antifreeze liquids. Equipment should be kept free of snow and water to prevent the effects of freezing water by keeping equipment running or placing impermeable covers on it when in storage or not in use. Material handling and storage personnel should be provided with suitable head gear and gloves to minimize the effects of severe cold weather.

Effects on Metals from Extreme Cold

6-38. Metals become brittle and subject to failure in severe cold temperatures. Storage, handling, and use of equipment that contains dissimilar metals that are bolted together or are in constant friction are most at risk for failure during transportation, handling, or when placed into operation following long periods of exposure to subfreezing temperatures. In cold weather, special care should be taken to protect equipment from excessive shock and mechanical components should be allowed to slowly warm up before being started.

Effects on Rubber and Plastics from Extreme Cold

6-39. Rubber and plastic gradually stiffen but retain a large part of their elasticity until reaching extreme cold temperatures, normally below -20° F, at which rubber loses its elasticity and becomes brittle. For example, fuel hoses may crack when allowed to crystallize from cold weather exposure or may break if bent when frozen. Aircraft tires become rigid in cold weather, causing flat spots on parts that come in contact with the ground. In severe cold temperatures, sidewalls become brittle and crack. Every effort should be made to minimize the length of time that material constructed primarily from rubber and plastic is exposed to extreme cold temperatures.

OTHER SUPPLIES

6-40. Other supplies required for logistics and sustainment include ammunition, major end items, and medical supplies. Spare parts and supplies for nonmilitary programs should also be considered.

Ammunition (Class V)

6-41. Planners expect increased use of indirect fire ammunition because of dead space, deep snow, and other effects of mountainous terrain. Preparing ammunition dumps is more difficult due to freezing and mud. Special storage for ammunition is not required but it should be stored in its original containers. Ammunition is transported by air from intermediate support bases to forward deployed units.

Major End Items (Class VII)

6-42. Resupply of battle damaged major end items is a significant challenge in mountain operations. Movement of deadline equipment clogs narrow supply routes. There will be an increased demand for power generators, heaters, and rough terrain loaders with a snow removal capability. Forward-based units that stay lean may not be able to stock many spare end items. When equipment is destroyed or damaged beyond repair, the only course of action is redistribution.

Medical Supplies (Class VIII Including Medical Repair Parts)

6-43. High consumption rates for medical supplies should be anticipated. Solid medications and freeze-dried material instead of liquids can be used when building the list of authorized medical stocks to minimize freezing, storing, and handling problems. Refrigerated and heated storage areas, such as warming tents, vehicles, and containers, are required for storing liquid medications and packed red blood cells or fresh whole blood that has been collected and processed on an emergency basis in theater (see ATP 4-02.1). Perishable materials must be packaged and marked for special handling. Procedures must be established and followed for special handling requirements for Class VIII material from embarkation to its final destination. There will also be an increased requirement for lip balm, sunscreen, cough syrup, and decongestants. More information is presented in this chapter under Medical Support Considerations.

Repair Parts (Class IX)

6-44. Due to the increased stress on vehicle parts and adverse effects of cold weather, a unit may need to increase its Class IX block by up to 300 percent. Repair parts blocks for motor transport and engineering equipment is increased, especially for parts that are susceptible to cold temperatures. Examples of these parts include starters, generators, alternators, and glow plugs. There will be an increased reliance on secondary repairable, component repairs, and selective component exchanges. Like other items, obtaining parts for specialized equipment can take prolonged periods in mountain operations.

Material to Support Nonmilitary Programs (Class X)

6-45. In mountain operations, the same protective measures and commodities necessary to protect friendly forces are also needed for detainees, indigenous inhabitants, and dislocated civilians. Considerable effort and expenditure may be necessary to provide for native inhabitants and dislocated civilians. Secure storage, transportation, accounting, and delivery of humanitarian supplies must be planned. Distribution of such supplies to the local populace can affect mission accomplishment as significantly as the support of offensive operations.

VEHICLE AND EQUIPMENT OPERATOR CONSIDERATIONS

6-46. In high mountain operations, equipment must be prepared for cold weather prior to arriving in the theater of operation. Most vehicles are designed to operate in temperate climates and must undergo winterization to function properly in the cold. Cold weather kits are necessary for every vehicle and include tire chains for all wheels, tire chain repair kit, deicer, non-freeze windshield wiper fluid, scrapers, tow bars or straps, extra chock blocks, and plastic or canvas to cover windshields to reduce buildup of ice or frost. The following subparagraphs discuss broad principles that apply to all vehicles. For specific information on pieces of equipment, the user must always refer to the appropriate technical manual.

Vehicle Loading

6-47. When loading materiel in any form of transport for delivery to an area of operations, items of low priority should be loaded first. Those high priority items required first at the destination should be loaded last. Experience has shown that this principle is especially important in mountain operations. A vehicle load SOP should be established to ensure that recovery equipment, first aid materials, and battle damage assessment and repair equipment are placed on top or immediately accessible when vehicles are loaded. Due to the reduced vehicle-carrying capacity in mountain operations, personal items must be kept to a minimum and road and bridge limitations must be considered.

Vehicle Operation

6-48. Vehicle operation are difficult in the rough terrain and colder temperatures associated with mountain operations. Driver training is critical, particularly at night. Also, training is required in rough terrain and fording. Ground guides should be used when navigating sharp bends and turns and when pulling to the side of the road. Braking distance is generally doubled and increases with the amount of weight carried.

6-49. Every vehicle has a complete, serviceable set of chains for all wheels. Because chains break frequently, chain repair kits should also be carried. All licensed operators know how to put chains on their vehicles. Additional chains are required for trailers and towed artillery pieces. Chock blocks are used instead of emergency brakes when parking, since emergency brakes easily freeze when set. Air tanks are drained when parking a vehicle to prevent condensation from freezing.

6-50. Major snowfall and snow cover can significantly reduce a unit's logistic mobility in both improved and unimproved road surfaces when using vehicles not designed or equipped to operate in snowy conditions. Snow tires, chains, and tow chains should be available and used as needed. Snow cover of more than 12 inches deep normally stops all movement of two-wheeled vehicles. Snow cover of more than 36 inches deep normally stops all wheeled vehicle movement. All-wheel or 4-wheel drive vehicles with low ground pressures are best for moving over snow-covered or muddy terrain.

6-51. All operators are aware of the dangers that drainage ditches and soft shoulders present in most areas where heavy snowfall is expected. These areas help drainage and are easy traps for vehicles that stray too close to the side of the road. Although snow stakes are good indications of where the road is, they can often lead one too close to the side of the road and into a ditch. Whenever parking in cold, wet conditions, some kind of dunnage, such as tree branches, wood, or MRE boxes, should be used to park on to prevent tires from freezing to ground. If tires become frozen to the ground, antifreeze or fuel may have to be used to free them. Always park where a vehicle is easily towed and where slave receptacles are within easy reach.

6-52. Special considerations must be given to keeping engines warm and out of the weather or started regularly, at least every three to four hours. Vehicles should be run for at least 10 minutes or until normal operating temperature is reached with the air cocks open to prevent them from freezing. The valves should be closed once the vehicle is shut down but never all at the same time. A rotating system is established when a vehicle is used to start another before it is shut down. Vehicles have to be operated continuously when weather is at or below -25° F. Personnel are not allowed to sleep under or in vehicles and must remain vigilant for vehicle deficiencies that might expose personnel to carbon monoxide poisoning.

Vehicle Rollover

6-53. A primary cause of death and serious injury in mountain operations is vehicular rollover accidents. Rollover drills are rehearsed using egress trainers, if available, and equipment is tied down in vehicles.

Vehicle Recovery

6-54. Mountainous terrain is hard on vehicles and when a vehicle breaks down, recovery is also difficult. Recovery capabilities are adversely affected by heavy snow, extensive muskeg (bog-like) areas, unpredictable weather, and a limited road network. When these conditions occur, recovery alternatives include attempting to fix the vehicle with a contact team, towing it to a vehicle collection point, extracting it by heavy lift aviation asset, or destroying it in place. More information can be found on Recovery and Battle Damage Assessment and Repair (BDAR) in ATP 4-31/*MCRP* 4-11.4A.

6-55. Recovery and on site repair by forward contact teams is preferred, if possible. In recovery operations, lightweight tow bars are useful but may become a liability if used improperly. A minimum of two tow bars should be carried in every combat patrol. Vehicles with winches are essential. Unit vehicles can accomplish towing however, since chains and cables can easily break loose and allow the disabled vehicle to slide, wreckers or tank retrievers, if available, are more appropriate.

6-56. Personnel must be trained to recover vehicles themselves in mountainous terrain because a wrecker may be unable to reach the recovery site. Training for mountain operations should include vehicle recovery missions that use real world scenarios, such as simulated IED/mine-damaged vehicles with different levels of catastrophic destruction, and allow for the evaluation of appropriate recovery assets selected and for the actual recovery mission to take place.

VEHICLE MAINTENANCE

6-57. In mountain operations, vehicle maintenance is inherently difficult because units are almost invariably forced to drive heavily-laden vehicles over uneven terrain. Road networks in the mountains are unforgiving on motorized equipment. Rocks, ever present dust, shifts from desert heat to arctic cold, and dramatic gradient changes take a significant toll on military motorized equipment. Overall, maintenance failures may far exceed losses due to combat.

Maintenance Personnel

6-58. Additional mechanics are needed to support dispersed operations in the mountains. At least one mechanic should be at every forward operating base, with two or three mechanics preferred. The ability to drop an engine at a distant FOB is an immeasurable combat multiplier. By teaching operators the next level of maintenance (supervised by a company mechanic), units can free up the mechanics for larger, more complicated jobs. Mechanics need to be assigned to patrols and convoys with maintenance and recovery assets. General support maintenance sections need to be reinforced with extra mechanics. Further clarification on the levels of maintenance can be found in AR 750-1.

Preventive Maintenance and Repair

6-59. Preventive maintenance is crucial in mountainous terrain and cold weather. Vehicle operators must be well-trained in maintenance and driving techniques and suitable cleaning solvents and lubricants need to be available and appropriate to the weather and terrain. Units may have to adjust the preventive maintenance checks and services process to focus on items that are most susceptible to breaking in the mountains, such as HMMWV half-shaft bolts, alternator brackets, and fluid levels. For vehicles operating in rough terrain, the maintenance service interval may need to be reduced. For example during Operation ENDURING FREEDOM, the maintenance interval for up-armored HMMWVs operating in the mountains was reduced from 6,000 miles to 3,000 miles. Refer to appropriate equipment technical manuals for special considerations for preventative maintenance in cold weather operations.

Field Maintenance

6-60. In mountain operations, leaders need to balance operating tempo with sufficient time for proper maintenance. The ability to maintain vehicles directly correlates to a unit's ability to conduct operations. Commanders should consider alternating between motorized operations and heliborne and foot-mobile operations to allow vehicle maintenance teams time to make repairs. They should also set aside at least one day for maintenance each week.

6-61. The increased weight of sandbags, bolt-on armor, and other counter-IED protective measures on vehicles will stress the shocks, springs, and struts, leading to a dramatic increase in damaged pitman arms, tie-rods, and half-shafts. Commanders must make appropriate risk management decisions, since counter-IED safety measures also increase the risk to operators and crew due to rollover. This threat is multiplied in mountainous terrain.

6-62. Proper maintenance on springs and shocks is critical to combat the high rate of front-end failure. Torque wrench tightening of all bolts on the suspension is needed regularly. Because transmissions will break down due to the combination of added weight and dramatic gradient changes, training on transmission troubleshooting should be provided to all maintenance teams.

6-63. Cold weather has a significant effect on vehicle maintenance operations as well. For more information, see TM 4-33.31.

DISTRIBUTION AND TRANSPORTATION

6-64. Conventional distribution methods are challenged in the mountains, so redundant methods of distribution is planned. Distribution consists of a combination of methods such as airdrops, assault support, tactical vehicles, pack mules, and porters. Since ground transportation is preferred for distributing food, water, fuel, and construction material, units should be task-organized with additional motorized assets, specifically trucks. Such organization reserves more rotary- and fixed-wing assets for higher-value supplies, such as ammunition, major end items, and medical supplies.

6-65. In mountain operations, the biggest distribution challenge is in transporting supplies across those last few miles to the FOB. Whereas supplies can be transported hundreds of miles to an ISB within hours or days, it may take as much or longer to move supplies much shorter distances from an ISB to the FOB. At higher altitudes, pack animals are the preferred means of transport. At altitudes where even pack animals cannot go, porters or military personnel must. While prepackaged loads are preferred at higher echelons, loads may need to be broken up and distributed among men and animals at the lowest echelons.

Ground Distribution

6-66. Methods of transportation vary in a mountainous or cold weather environment. They include a variety of vehicles, animals, and human-powered methods.

Military Vehicles

6-67. Small cargo vehicles with improved cross-country mobility sustain and transport units at high altitudes. For example, a vehicle used in recent mountain operations is the Small Unit Support Vehicle (SUSV), formerly a program of record and produced by Hagglunds of Sweden. The SUSVs are specially designed for restrictive terrain, can operate on top of snow, if the snow can support the weight, or through snow up to 1.2 meters (four feet) deep, and can drive over any road with packed snow. In snow, tracked, over-the-snow vehicles are invariably required for movement off roads and necessary on roads in icy conditions. All-terrain vehicles, such as the John Deere Gator, are useful in the mountains. They are highly mobile but may be limited by their lack of protection against enemy fires, mines, or IEDs. Snowmobiles with a small trailer or Ahkio sled can be used to resupply up to a company effectively. The SUSV can tow a trailer as well, however, there should be a SUSV without a trailer to break trail as using one vehicle in extreme cold weather operations is not advised.

6-68. The HMMWV is a useful vehicle in mountain operations. The high-back variant may be the only troop-carrying vehicle that can negotiate some of the terrain encountered.

Host-Nation Vehicles

6-69. Host-nation trucks are a major source of ground distribution in mountain operations. For routine resupply of non-sensitive items, contracting for use of host-nation trucks can be essential to conserving combat power dedicated to the fight. Roads support local trucks until engineer efforts widen and improve roads. Host-nation trucks can be configured for dry, refrigerated, and liquid cargo. For example, a fuel bladder may be placed on the bed of a host-nation pick-up truck or small truck to haul Class III supplies.

6-70. Host-nation trucks, however, do have shortcomings, such as:

- Host-nation drivers may not move into high-risk areas without security and they may be particular about driving in certain weather conditions.
- Timelines for delivery are unpredictable and drivers will frequently take a circuitous route to their destination to visit family, avoid enemy contact, or make other deliveries.
- Loads are often pilfered.
- Local trucks may not be properly maintained and may require frequent towing.

6-71. Units working with host-nation trucks need to verify that these vehicles are maintained, loaded, fueled, and manned properly. Good relations with the host-nation truck provider are essential.

Pack Animals

6-72. Pack animals, such as mules and donkeys, are an essential distribution method in mountainous terrain. For load planning purposes, mules carry 200 pounds depending on the terrain and altitude. Donkeys, on the other hand, carry about 65 pounds. As a general rule, pack animals carry up to 25 percent of their body weight. While mules can travel 20 miles per day under moderate conditions, they may make only eight to 10 miles per day in severely rugged terrain. Crude or improvised pack equipment, unconditioned animals, and the general lack of knowledge in the elementary principles of animal management and pack transportation make the use of pack transportation difficult and costly. These animals require care, attention, and training. Planners account for the weight and bulk of food and water required daily and for the handlers required.

6-73. Animals are conspicuous, vulnerable, and can be noisy. Animal care and preparing and tying on loads take time to learn. Ad hoc animal transport units may be formed using locally obtained animals, with or without local handlers, and any personnel who have experience with animals. For units planning to operate in the mountains, a pack animal training course is recommended.

Porters

6-74. Units operating in the mountains hire local porters who are accustomed to breathing thin air to transport equipment and supplies by foot. Porters are employed to move supplies to a certain point prior to handing them over for unit movement to the furthermost dangerous forward positions. The disadvantages of hiring local porters is that they may be reluctant to work too far away from their homes and villages, there will always be a security consideration when using them, and they will require escort.

6-75. When calculating the number of porters required for a particular operation, the following factors must be considered:

- Distance of movement.
- Terrain, including height above sea level.
- Type of porter available.
- Availability of water.
- Size, shape, and weight of the loads.
- Location of an area suitable for offloading supplies.
- Escort.

Military Personnel (Man-packing)

6-76. Any combination of resupply usually includes man-packing supplies to forward positions. Personnel carry awkward loads, including cans of kerosene, rations, and building materials for bunkers. Commanders develop priorities, accept risk, and require the combat force to carry only the bare essentials needed for its own support. Any excess equipment and supplies reduce the efficiency of their personnel. Nonessential equipment is identified, collected, and stored until needed. In situations where there are conflicts between the weight of ammunition and weapons, experience has shown that it is better to carry more ammunition and fewer weapons.

6-77. Training emphasizes foot marching over difficult terrain with heavy loads. In cold weather, movement is conducted at a slow pace, depending upon the fitness level of the individual, to avoid sweating and cold weather injuries.

River Distribution

6-78. Troops analyze terrain to determine if resupply by river is possible. Boats, ferries, and rafts are employed up, down, or across rivers. While it may seem counterintuitive, it is possible to raft against the current and move into mountains which is an option explored in Russian doctrine. If the river type allows, this method mitigates the limitations of aviation assets in a mountainous environment and may release them for other missions. For example, during the Soviet-Afghan war, it would take an MI-8 MTV transport helicopter 340 to 580 flights, depending on altitude, range, and temperature, to transport the same amount of material as a 58-raft Russian model boat company.

Air Distribution

6-79. In mountain operations, aviation assets should be maximized to deliver supplies directly to units. Aerial resupply may consist of parachute drop, free drop, or assault support asset (such as the MV-22 Osprey helicopter) delivery. During Operation ENDURING FREEDOM, units operating in the mountains relied heavily on aerial resupply. During Operation MOUNTAIN LION in Afghanistan, almost all resupply was conducted by helicopters and container delivery system (CDS) drops for five weeks.

6-80. Aerial resupply, though effective, is limited by weather, which must be permissive from the point of origin to the point of delivery and all stops in between. Fog, cloud cover, sudden storms, icing, and unpredictable air currents can shut down air support. Higher elevations decrease overall aircraft lift capabilities. Temperature and density altitude restrict an aircrew's ability to carry loads and high mountain weather conditions frequently shut down flying for days. Air distribution is cancelled due to the inability to observe the ground or to navigate through the mountains. Mountain terrain interferes with air-to-ground and air-to-air communication. Aviation assets follow the terrain features of the mountains, adding predictability to their approaches and increasing the risk to the crew.

6-81. The aircrew determines loading and altitude restrictions. Mountainous terrain interferes with communication but satellite communications (SATCOM) and friendly force tracking add to the capacity for aircrews and ground forces to communicate. Aircrews choose the routes best suited for their missions and opt for high altitude operations in areas of relatively low antiaircraft artillery and man-portable air defense system threat.

6-82. Air distribution in the mountains requires detailed planning, effective liaison, and a habitual relationship between the aviation crew and the ground unit. Suitable drop zones in the mountains are difficult to find and, if close to the enemy, covered by mortar and small-arms fire. Aviation assets must be able to safely hover over the drop zone while supplies are distributed. Support personnel are well-trained in sling-load operations and supplies must be packaged to be immediately man-portable.

Ring Routes

6-83. Air transportation using a ring route is the only way to move among various outlying bases in an area of operations. During combat operations, one ring route of regularly scheduled rotary-wing assets departs from a large, centrally-located airfield, and is the primary means to deliver Class V items, personnel, and mail, especially to FOBs. Prioritization of supplies using ring routes must be done with caution to prevent backlogs. Due to weather, ring route flights change, sometimes delayed by a week or more. Distribution planners submit air mission requests (situationally dependent from scratch) to ensure aircraft are scheduled. Ring routes are determined by schedule and sequence.

Container Distribution System Drops

6-84. In mountain operations, air distribution by CDS is used but is a challenging and manpower-intensive operation. Use of CDS involves detailed drop zone coordination. It requires landing support teams trained in the recovery of air-dropped supplies and in using sling loads. When using CDS, planners expect load attrition even with seasoned crews. Sleds are useful in recovering CDS in the high mountains. Material handling equipment may be required at the drop zones and LZs. In all cases, aircrews will advise supported ground units to determine limitations.

Low-Cost Low-Altitude Delivery System

6-85. This system is used in mountain operations and is a successful asset when high risks prevent ground resupply options. Low-cost low-altitude delivery systems have the following characteristics:

- They might be restricted to day use.
- The typical load is 500 pounds or less when using one parachute but up to three parachutes can be used for heavier loads.
- There is no rigger requirement.
- The parachute system is an expendable item.

Speedball Technique

6-86. Speedballs are a field expedient technique using duffle bags or similarly-sized containers with resupply items and releasing them out the door of hovering aircraft. Items include cold weather clothing, rations, or ammunition.

MEDICAL SUPPORT CONSIDERATIONS

6-87. In a cold, mountainous environment, personal hygiene is difficult to maintain due to limited water. The potential for the spread of infectious diseases increases by confined living spaces shared by multiple individuals. Field hygiene and sanitation is important. Personnel use sunscreen and sunglasses to prevent severe sunburns and damage to the eyes from the sun's ultraviolet rays, which are possible at high altitude or in snow-covered environments. Numerous cold and altitude illnesses and injuries threaten personnel operating in a mountainous/cold weather environment. Refer to Appendix A, Altitude and Environmental Hazards. Technical Bulletin, Medical 505, Altitude Acclimatization and Illness Management, and Technical Bulletin, Medical 508, Prevention and Management of Cold-Weather Injuries for more information. Medical personnel should receive training in identifying and treating these prior to deployment.

6-88. For small unit operations with widely-dispersed forces, all troops must be well-trained in combat lifesaver and CASEVAC procedures, including the following:

- Self and buddy aid, advanced first aid, and field sanitation.
- The use and capabilities of the CASEVAC bag and pole-less litter, including combat lifesaver and higher levels of first responder care.
- The ability to transmit a 9-line medical evacuation (MEDEVAC) request and setup of a helicopter LZ.

6-89. Each squad (preferably each fire team) has one trained combat lifesaver to augment the squad's corpsman or combat medic. Also, MEDEVAC crew chiefs should be combat lifesavers to assist, if time and the mission allow, during flight operations. Flight medics should be EMT [emergency medical technician] qualified. Given the distances involved, en route patient care is vital. Medical providers are trained in diagnosing and treating low orthopedic and low back injuries. Combat medics trained in providing spinal and muscular manipulation apply these skills to prevent back injuries.

6-90. Medical personnel have some unique training requirements for mountain operations. Hoist operations are a planning consideration for medical units operating in mountainous areas. These personnel are trained and familiar with high, steep angle rescue, air CASEVAC, and the equipment used in hoist operations, preferably using actual air platforms in rugged terrain. Mountain operations require evacuation teams, preferably Level 2 mountaineers, who have the capability to reach, stabilize, and evacuate casualties in the steepest terrain. All personnel are trained to conduct less technical, steep-slope evacuations.

Casualty Collection and Evacuation

6-91. Casualty evacuation is the movement of casualties aboard nonmedical vehicles or aircraft. Casualties transported in this manner may not receive proper en route medical care or be transported to the appropriate medical treatment facility to address the patient's medical condition. When possible, nonmedical vehicles have a combat medic or combat lifesaver on board. On nonmedical aircraft, sufficient space may not be available to permit a caregiver to accompany the casualties and the type of en route monitoring or medical care and first aid provided may also be limited. Casualty evacuation (CASEVAC) is used in extreme emergencies or when the MEDEVAC system is overwhelmed.

6-92. Mountain operations present numerous challenges for casualty collection and evacuation. Leaders consider the following when planning mountain operations:

- Difficulty associated with accessing casualties in rugged terrain.
- The increased need for technical mountaineering skills for CASEVAC.
- Proximity of expert medical help.
- Longer periods of wait time for CASEVACs.
- Prior to evacuation, injured and immobilized patients are at the greatest risk of cold injury, and they must be well insulated during transport.
- Evacuating the wounded from mountainous areas normally requires a larger number of medical personnel and litter bearers than on flat terrain. Soviet experience in the mountains of Afghanistan proved that three to 15 men might be involved in carrying one patient.
- Tough, physical casualty handling should be conducted in every training event.

6-93. Each unit has a detailed CASEVAC plan that is repeatedly rehearsed. Each FOB must have ground evacuation assets and a dedicated security element. The security element is on call and familiar with primary and alternate routes to higher roles of care (roles two and three). Commanders consider what levels of risk they are prepared to accept to air evacuate patients using nonmedical aircraft.

Medical Evacuation

6-94. A MEDEVAC is performed by dedicated, standardized MEDEVAC platforms (ground and air ambulance platforms), with medical professionals who provide the timely, efficient movement and en route care of the wounded, injured, or ill persons from the battlefield and other locations to the supporting medical treatment facilities. Air MEDEVAC of seriously wounded personnel is the preferred method in mountain operations. Positioning aviation assets forward on the battlefield is critical to supporting such operations, however, during periods of decreased visibility and high winds, these assets cannot fly and land in extreme mountainous terrain. Hoist operations are inherently dangerous and result in fatalities if preventive measures are not considered. Personnel need training prior to deployment on MEDEVAC procedures and the equipment used in hoist operations.

ACCLIMATIZATION

6-95. Regardless of an individual's standard of physical fitness, all personnel acclimate in order to be effective and to prevent associated altitude illness. Acclimatization achieves maximum physical and mental performance and minimizes the threat of altitude-related illness. Mountain warfare training is not a substitute for the acclimatization process but it does provide personnel with an appreciation for the challenges of surviving and fighting in a mountainous environment.

6-96. Acclimatization is required before undertaking extensive military operations. Even the most physically fit troops experience physiological and psychological degradation when thrust into high elevations. Time must be allocated for acclimatization, conditioning, and training. There is no shortcut for the acclimatization process and any attempt to trim or bypass the process will result in injuries. Commanders should see FM 7-22 to build physical fitness plans that will help prepare personnel for operations at altitude.

6-97. For most troops between elevations of 2,438 meters (8,000 feet) and 5,486 meters (18,000 feet), 70 to 80 percent of the respiratory component of acclimatization occurs in seven to 10 days, and 80 to 90 percent of overall acclimatization is generally accomplished within two weeks to one month. Maximum acclimatization may take months to years. Acclimatization cannot be accelerated as some troops acclimate more rapidly than others and a few may not acclimate at all. There is no reliable way to identify those who cannot acclimate except by their experience during previous altitude exposures. When brought to lower altitudes, all personnel will lose their acclimatization in a matter of days.

6-98. There are two methods for acclimating troops in high mountains: the staged ascent and graded ascent. In a staged ascent, troops ascend to an altitude of 2,438 to 3,962 meters (8,000 to 13,000 feet) and remain there for four days or more to acclimate before ascending higher. When possible, troops should make several stops during the ascent to allow for increased acclimatization. A graded ascent limits the daily altitude gain to allow partial acclimatization. The altitude at which troops sleep is critical to acclimatization—work high, sleep low is a rule of thumb (for example, sleeping 1,000 feet lower than the working elevation.) Once they have ascended to 2,438 meters (8,000 feet), troops should gain no more than 300 meters (984 feet) of sleeping altitude each day. This process reduces high-altitude illnesses. A combination of staged ascent and graded ascent is the safest and most effective method to prevent high-altitude illnesses.

Chapter 7
Aviation

PLANNING CONSIDERATIONS

7-1. In general, aviation operations will require additional time, planning, equipment, and personnel in order to operate successfully in this environment. The combat aviation brigade (CAB) must strive to affect the mission in all weather conditions and all environments. Mountain weather conditions that can limit or ground some aviation assets are clouds, fog, heavy rain, and snow. Icing presents a problem to aircraft that do not have anti-icing equipment. Aircraft with those capabilities are capable of safe instrument flight into clouds or visible moisture when the temperature is below freezing but their ability to influence and support the ground scheme of maneuver will be limited. Army aviation assets will only use instrument flight plans in emergency situations during combat. The weather and environment can also greatly affect ground maintenance. The climate history of the operational area should be studied to determine the probable frequency and duration of weather conditions that will limit or preclude flight operations and the support ground units can expect from them.

DEPLOYMENT

7-2. Aviation units should be deployed to best support the troops on the ground. Unlike many other environments, mountainous environments require the CAB commander, ground task force commander, or joint task force commander to use dispersed operations to effectively support their ground troops. The objective is to have aviation forces available to the dispersed units for planning and execution on short notice so they can react to combat information and support ongoing ground operations. Dispersed operations impart increased risks for the CAB commanders as it is more difficult to provide supply/resupply, a full echeloned maintenance capability, fuel, forward deployed ordnance, mission command, and security when aviation units are not centrally located with these support functions. For the ground commander, this environment imposes difficulties in surface transportation. This creates an increased demand for aviation support. The delicate balance between these factors requires careful planning and a solid understanding of aviation capabilities among the services.

COORDINATION WITH SUPPORT GROUND FORCES

7-3. Army aviation in support of ground forces in a compartmentalized mountainous environment, establish command relationships between air and ground commanders to enable direct support to ground forces without having to route frequent air mission requests through the CAB's owning division headquarters. Battalion-sized task forces may support brigade combat teams in a direct support capacity, resulting in more fluid combat operations without the BCT being responsible for the logistical support of the aviation battalion task force.

7-4. During the Army's planning process, the brigade aviation element, led by the brigade aviation officer, assists the ground force commander with the coordination of aviation assets for utility, cargo, and attack reconnaissance operations. The brigade aviation element coordinates with air defense and fire support personnel to de-conflict air assets and gives the ground force commander critical information regarding the best method for using aviation assets. The brigade aviation officer provides fluid and seamless planning in preparation for all combat aviation support, ensuring that the ground force commander understands the limitations and benefits of each type of aircraft and mission performed. Performing additional coordination for the ground and aviation forces is the aviation liaison officer, directly selected from the aviation task force to provide a communication point between the supported ground force and the aviation task force commander. While not part of the brigade aviation element, the LNO assists the brigade aviation officer by providing a direct link to the aviation task force. This ensures information about the aviation task force is widely disseminated for planning purposes.

RECONNAISSANCE

7-5. While some aircraft have reconnaissance as their primary mission, all aircraft, regardless of type or mission, collect valuable information and conduct air reconnaissance as a secondary or concurrent mission. Reconnaissance is most successful only if ground and aviation units communicate and exchange information. Prior coordination and participation in mission planning alerts pilots to look for critical intelligence information to maneuver forces. Ground personnel or LNOs participate in mission debriefs for information about the enemy terrain or weather and to pass the information to units.

7-6. Aircraft specifically designed for the reconnaissance mission is available to ground forces, providing real-time information to the ground force commander. Thermal imaging, forward-looking infrared, and daytime television recording provide commanders and Soldiers with an accurate depiction of what aircrews are seeing and how it affects their operations. The most widely used air reconnaissance platforms in mountain operations are rotary-wing aviation and unmanned aircraft systems, UASs.

ATTACK RECONNAISSANCE HELICOPTER OPERATIONS

7-7. The use of rotary-wing aircraft to conduct reconnaissance operations enables the ground forces to have additional maneuver and effect. Rotary-wing assets can be either planned, in the case of an air mission request, or unplanned, such as an established quick reaction force. Within the CAB, the attack reconnaissance battalion (typically comprising the AH-64D Apache Longbow) and the attack reconnaissance squadron support ground operations with numerous reconnaissance capabilities and missions, including landing and pickup zone (LZ and PZ) reconnaissance, route reconnaissance, and area or zone reconnaissance. These platforms provide security coverage for ground forces during operations as a screening force, providing ground forces with reaction time and maneuver space on the battlefield.

7-8. Given the compartmentalized nature of mountainous terrain, the CAB chooses to divide attack reconnaissance aircraft and lift and cargo helicopters into smaller maneuver elements that are part of an aviation task force to provide the ground force commander with a wide range of aviation support options. For further information on Army aviation attack reconnaissance, refer to FM 3-04.126.

UNMANNED AIRCRAFT SYSTEMS

7-9. The addition of UASs to the piloted capabilities increases the reconnaissance capability of forces in the mountains. These aircraft are generally assigned the following tasks in all environments:

- Conduct air reconnaissance.
- Analyze and synthesize information.
- Control indirect fire.
- Conduct terminal guidance operations.

7-10. Planners make considerations in mountainous environments regarding UAS planning, hub and spoke operations, and fires integration, which are discussed in the following subparagraphs.

UNMANNED AIRCRAFT SYSTEM PLANNING CONSIDERATIONS, CAPABILITIES, AND LIMITATIONS IN MOUNTAINS

7-11. Terminal guidance operations are those actions that provide electronic, mechanical, voice, or visual communication to approaching aircraft and weapons regarding a specific target location (not to be confused with terminal attack control). Additionally, deployed unmanned aircraft squadrons are tasked to conduct radio retransmission for a supported unit. Radio retransmission allows the UAS crew to communicate with ground forces using the aircraft. The UAS is also configured for supported ground element to overcome environmental limitations in the mountains for internal unit communication.

7-12. Mountain operations using UASs are affected by several unique planning considerations (see Appendix C). More information on UAS considerations can be found in ATP 3-04.64/*MCRP* 3-42.1A/*NTTP*

3-55.14/*AFTTP* 3-2.64/*AFTTP* 3-2.64, and FM 3-04.155,. The following are the most important UAS considerations in a mountainous environment:

- Altitude, air density, and temperature. For example, the RQ-7B Shadow cannot be commanded above 4,572 meters (15,000 feet) mean sea level or operate in temperatures below -4° F or above 122° F.
- Aircraft icing at the operating flight altitude, icing is often more prominent at higher mountain elevations.
- Communication restraints are caused by mountainous terrain and line-of-sight constraints, LOS between the unmanned aircraft and the controlling station.
- High winds typical of mountainous terrain are often channeled through valleys and mountain passes. Smaller unmanned aircraft are more affected by severe weather than their manned counterparts. High winds, turbulence, and wind shear negatively affects the flight profile of unmanned aircraft. It causes the aircraft to make wider turns, rapidly change altitude, cause erratic flight, or cause a departure from the controlled flight.
- Climb and descent rates of most types of unmanned aircraft are affected by the higher elevations. Planners account for longer launch and recovery times for their aircraft, especially when supporting the acquisition of time-sensitive targets.

7-13. Due to the higher elevation, the recommended unmanned aircraft flight profile is not the most efficient for its payload.

Airspace Management of UAS and Airframes in Mountains

7-14. Rotary- and fixed-wing aircrews, UAS operators, and command and control operators and airspace control managers must be vigilant when integrating unmanned aircraft into the airspace control plan due to the restrictive flight environment and numerous obstacles and hazards to flight in mountainous terrain. Congested airspace surrounding FOB airfields and canalizing terrain causes flight paths to encroach and may cause mid-air collisions. Aircrews must be provided with current UAS restricted operations zone information as they check in with individual units upon crossing unit boundaries. Constant attentiveness to air tasking orders, airspace control measures, immediate restricted operations zones, and civilian helicopter and fixed-wing aircraft traffic can prevent catastrophic consequences.

"Hub and Spoke" Operations and Unmanned Aircraft System Handoff Method

7-15. The UAS scheme of maneuver is dictated by the mountainous terrain and inherent LOS limitations. Hub and spoke or handoff operations, which extend the coverage area of a single UAS, is used in this environment. For example, crews for a medium-sized tactical UAS launch and recover from a central "hub" or launch and recovery location and electronically pass control of the unmanned aircraft and its payload to other UAS control locations ("spokes") near the desired operational area. The hub retains responsibility for mission tasking and maintenance of the unmanned aircraft. The spoke, or receiving control station, is responsible for mission execution and tactical employment according to the supported unit's requirements, which allows units to overcome LOS limitations presented by terrain, distances, or areas of responsibility

7-16. Positioning spokes with operators and a ground control station at or near the supported commander's command post enhances the responsiveness of the intelligence production process. Spokes may be located with command outposts and if not with COPs, with various fires and maneuver units. Hub and spoke operations depend on coordination between personnel at the hub and those at the spokes to conduct the handoff of unmanned aircraft. The UAS units rely on timing and procedural control or employ radios, landlines, and secure local area networks to communicate between the hub and outlying spokes during unmanned aircraft handoffs.

Fires Integration

7-17. Planners consider the capabilities of UAS systems in integrating fires (aviation and surface-to-surface) within the objective area. Movement within mountainous terrain is difficult and time consuming, however, unmanned aircraft assist forward observers, rotary-wing aircrews, and forward air controllers (FACs) in observing targets and calling for artillery fire, to include Excalibur and HIMARS (High Mobility Artillery

Rocket System) and guided MLRS (multiple launch rocket system) fires from a remote location instead of from an observer near the target area. Unmanned aircraft equipped with a laser target designator deliver precision fires by designating the location of the target for laser-guided weapons, while some larger unmanned aircraft carry weapons. The UAS video can be fed directly to the fire support officer, joint fires observer, air officer, FAC and joint terminal attack controller (JTAC), or attack reconnaissance helicopter aircrew.

7-18. Coordination between armed helicopter aircrews or armed UAS controllers can enable a cooperative engagement between the two systems, during which UASs enabled with armament or a laser designator can fire or designate reconnaissance aircraft for attack. Such engagements require direct communication between the UAS observer and controller and the aircrews. This method may also be known as manned and unmanned teaming, or MUM-T, which overcomes some of the LOS limitations, ensures the information gets to the people who need it most, and shortens the sensor to shooter loop. As with any system, UAS proficiency requires units to train in similar environments to that in which they will operate.

AIR ASSAULT SUPPORT

7-19. Mountain and extreme cold weather operations result in a decrease of troop capacity, combat radius, endurance, and payload. These same limitations apply to all rotary-wing aircraft in the joint inventory.

AIR DELIVERY

7-20. Mountainous terrain imposes unique requirements on usable LZ terrain to deliver supplies in support of ground forces. Due to higher slope angles, confining terrain, variable mountain winds, and limited avenues of ingress/egress, use of externally-delivered or air-dropped supplies may be required instead of internally delivered cargo offloaded in the LZ. Helicopter/tilt-rotor external delivery requires the support of helicopter support teams, which are needed to hook up external loads for transport. Due to the dispersed nature of mountain operations, additional personnel should be trained in these skills so they can be available to the receiving units as well. Planners consider operating aircraft and helicopter support teams out of multiple dispersed locations and using forward arming and refueling points (FARPs) to mitigate the effects of weather and terrain on the availability of support provided.

7-21. Higher elevations and higher temperatures negatively affect the lift capability of support aircraft. Due consideration is given to the location of the PZ and drop zone, the weight of the load(s) to be inserted/extracted, and the time required to transit to/from the location. More aircraft will be required to deliver supplies in the mountains due to the higher altitude’s effects on aircraft performance. Moreover, if more assets are not available, then a larger number of sorties are required to accomplish the same tasking.

7-22. While external air deliveries place supplies and logistics in a precise drop location, air delivery by air-drop loads allows assets to remain in flight during the drop, which, in most cases, allows a larger and heavier load to be delivered and decreases the vulnerability of the aircraft to indirect fires during the delivery process. Precise coordination between air delivery aircraft and supported ground assets is required to ensure that dropped loads fall in the correct locations. Due to the variable nature of mountain winds and the confining nature of terrain, air delivery by air-dropping spreads dropped supplies over a larger area and is usually not the preferred method.

COMBAT SEARCH AND RESCUE AND TACTICAL RECOVERY OF AIRCRAFT AND PERSONNEL

7-23. Army personnel recovery is the military efforts taken to prepare for and execute the recovery and reintegration of isolated personnel (FM 3-50). The effects of weather on isolated personnel and their ability to endure the conditions until recovery forces locate, authenticate, and recover them should be analyzed. Pilots and crews must be trained to survive in harsh conditions and survival kits should be prepared accordingly. High mountain winds and limited LZs inhibit the recovery forces’ ability to land close to the isolated personnel and aircraft, further delaying the recovery effort and limiting the time on station available for supporting aircraft. Lastly, weather affects the responsiveness of recovery aircraft and impedes the recovery force from reaching isolated personnel if the supporting assets operate from dispersed locations and conduct operations spanning impassable mountainous terrain closed by weather.

7-24. Personnel Recovery Operations require pre-established criteria for the launch of assets. These missions involve a coordinated effort among several organizations, all of which are challenged by the mountainous terrain, dispersed forces, and weather. Such challenges include communications, isolated personnel detection, lift, and time on station capability of helicopters used to conduct the rescue and recovery.

7-25. Terrain hampers communication between the rescued individuals and the forces trying to locate them because of LOS communication restrictions, so planners consider using over-the-horizon communications capabilities. Communications planners use aerial relays, satellite - SATCOM, and other techniques to locate and communicate with aerial and downed personnel. Detailed information on the planning and execution of personnel recovery can be found in FM 3-50.

MEDICAL, CASUALTY, AND AIR EVACUATIONS

7-26. As with any assault consideration, the effects of mountainous terrain on the responsiveness and capabilities of aviation assets supporting a medical, casualty, or any air evacuation will be affected by supportability of LZ terrain and the time on station and lift capability of supporting assets. The need to deliver patients to appropriate medical facilities as fast as possible (commonly referred to as the golden hour) motivates rescuers to use the fastest aircraft available unless they evacuate large numbers of personnel. In offensive operations conducted over complex terrain, assault support ability to transport injured personnel to the appropriate level of care is limited by weather, which increases the risk and decreases the chance of survival for critically injured patients. To mitigate these risks, planners disperse aircraft and position them closer to the operating/operational forces or establish medical care facilities farther forward to cut down the travel time. If larger force extraction is required, heavy lift assault support assets at higher altitude offers the quickest means to move forces to safety. Planners consider using intermediate shuttle LZs to facilitate hasty extractions.

AIR ASSAULT OPERATIONS

7-27. High altitude assault operations, to include aerial resupply, are restricted due to the combined effects of canalizing terrain and mountain weather. At higher elevations, zone size, slope, and suitability for large-scale assault support landings are tempered with the desire to rapidly build combat power up in the LZ. Assault support aircraft planners require detailed analysis of the LZ suitability, the forecasted weather, the anticipated loads (passengers and cargo), and the requirements for transit and loiter in the objective area. Based on the impact of the weather at higher elevations and the limits imposed by aircraft performance and aircrew, dispersed operations will likely be required to facilitate timely support for the ground unit. Commanders recognize that timely support depends on aircraft availability and the location of supporting assets. Cold weather, mountainous terrain, and dispersed operations hamper security, maintenance, and logistic support, which affect aircraft availability in support of the ground scheme of maneuver. Further information regarding planning and execution of air assaults is found in FM 3-99.

AIRBORNE COMMAND AND CONTROL

7-28. Weather permitting, commanders consider the use of organic and joint airborne command and control capabilities to mitigate the effects of limited LOS communications in mountainous terrain. Rotary-wing platforms give the commander the ability to use LOS communications with aviation and ground forces and to land directly in an LZ to build the commander's situational awareness or communicate directly with forces on the ground.

7-29. There are numerous joint airborne command and control capabilities that can increase situational awareness and mitigate the effects of terrain. Commanders and their staffs request the use of these assets through normal air mission request procedures to augment their own capabilities and mitigate the effects of weather and terrain in the mountains.

BATTLEFIELD ILLUMINATION

7-30. To maintain situational awareness for Soldiers being transported, aviation assets plan for battlefield illumination in a mountainous environment. While conducting low light operations, battlefield illumination mitigates the effects of brownout and whiteout landings. In low light environments, proper planning of the objective area geometry, combined with the coordination of assets to employ battlefield illumination, enhance the capability of assets to accomplish the mission more effectively. Though battlefield illumination does not turn low light into high light, planners consider overt and covert illumination in a theater of operation. Battlefield illumination data should be requested in advance and made available to conduct such operations.

LANDING ZONE CONSIDERATIONS

7-31. Special considerations are made when choosing and evaluating an LZ for operations in mountainous terrain. The effects of high altitude on assault support aircraft include decreased hover power, decreased forward airspeed limits, susceptibility to blade stall, vortex ring state, and decreased maneuverability. Planners, working with aviation leadership familiar to the area of operations, evaluate landing sites, considering size and suitability for the mission. Aviation requirements for altitude, prevailing winds or weather, and safe approach and departure paths limit the selection of certain sites. Together, ground forces and aviators should select LZs that will be frequently used as part of routine air movements. These sites are well-marked and, if available, lighted by fixed or portable visible or infrared position lights.

7-32. Further considerations include the height and size of obstacles, slope, suitability, topography, temperature, wind direction, demarcation line, turbulence, null areas, escape/departure routes, drop-off, wave-off, elevation, density altitude, and power available versus power required. As assault support performance decreases, the transition period is critical, approaches are shallower, and transitions are gradual. As the height of obstacles increases, larger LZs facilitate appropriate approach angles and speeds and aviation planners should be consulted to ensure that the LZ meets their approach criteria. Additionally, planners consider the number of aircraft required to land to support operations. Although prevailing winds should be a key factor for landing direction, terrain produces local wind effects that are dangerous during landing or takeoff off from the LZ. Further guidance on effective air assault mission planning and LZ and PZ selection criteria are found in FM 3-99. Airborne and Air Assault Operations. 06 March 2015.

SNOW-COVERED TERRAIN

7-33. Brownout and whiteout can cause spatial disorientation. Winter operations in mountains bring recurring snowfalls that are characterized by deep, dry, powder-like snow, particularly in very high elevations. Viable whiteout mitigation plans are mandatory in these conditions. The procedures for landing in snow-covered terrain are similar to desert landing approaches and should be briefed and rehearsed (if possible) before execution. Aircrews should make situational calls to facilitate referenced landings by pilots. Recommended wave-off cues are briefed to ensure a safe, controlled approach into a high altitude, snow-covered landing. The aircrew should consider terrain beneath the surface of the snow to ensure safe touchdown of landing aircraft. To assist with the landing site, the landing points should be marked with an object that contrasts with the snow to provide a reference for depth perception. The aircrew considers a slow release of power in settling the landing aircraft to ensure stability of the landing gear on unknown, snow-covered terrain. Whenever it is available, commanders should consider the use of approved specialty equipment, such as skis for rotary wing aircraft, in order to improve the safety and effectiveness of air operations in mountain and cold weather.

AIR-GROUND INTEGRATION AND TRAINING CONSIDERATIONS

7-34. Training specific for a mountainous environment is required, depending on the proposed operational environment and aircrew proficiency and familiarization with their supported ground unit. Commanders focus training toward preflight planning in high altitudes with an emphasis on fuel planning, weight and power available, and blade stall considerations. Mountain flying requires close attention to aircraft and engine performance throughout the mission and its impact on flight However, the terminal operations of landing and takeoff differ little from confined area landing training accomplished regularly as part of unit workups. Crews need a thorough understanding of their aircrafts' capabilities, especially density altitude and its effects on performance.

7-35. When possible, aircrews train with their supported ground unit prior to deployment, ensuring a thorough understanding of ground force Tactics, Techniques and Procedures-TTP and operations. Such training allows ground forces to become familiar with various aircraft employment methods and aircrews to understand how they will be employed during combat operations.

ELECTRONIC WARFARE

7-36. The mission of the electronic warfare units is to provide electronic warfare support to designated forces. Aviation electronic warfare units conduct tactical jamming to prevent, delay, or disrupt the enemy's ability to use early warning, acquisition, fire or missile control, counter-battery, and battlefield surveillance systems. Tactical jamming also denies and degrades enemy communications capabilities. A more detailed discussion of their capabilities and employment considerations can be found in ATP 3-36.

WEATHER TERRAIN

7-37. The EA-6B Prowler is a subsonic, all-weather, carrier-capable, electronic warfare aircraft. Weather and terrain affect EA-6B operations by limiting the takeoff and landing options rather than inflight or target area weather. In mountainous terrain, however, it is necessary for electronic warfare planners to study the terrain carefully to determine how it impacts the effects of enemy radar coverage, communication capability, and friendly electronic warfare assets. This study begins with the intelligence section's IPB, which should be updated as new information becomes available from ground reports and other sources.

TIME ON STATION

7-38. Aircraft time on station is a significant consideration when planning electronic warfare fires in any environment. In general, airborne electronic attack assets will be tasked by the combined forces air component commander as a theater asset, which may impact the commander's priority for this asset, and warrants planning or time on station considerations. Airborne electronic attack is delivered at a critical time against a critical enemy electronic system, such as fire control nets during an enemy attack, air defense systems during friendly offensive air operations, and command and control communications for movement or commitment of reserves. While these factors apply in any environment, the dispersed nature of mountain operations complicates them. Air officers are familiar with electronic warfare capabilities and work with other staff members to ensure communication links or liaisons provide redundant ways to coordinate the proper use of these assets.

ELECTRONIC ATTACK

7-39. Though electronic attack operations should be preplanned, they may be conducted in response to the immediate tactical situation. These unplanned operations are difficult because of the centralized control of the asset and the communications challenges associated with mountain operations. Commanders do not count on electronic attack support in the mountains unless they are the main effort and they have put a great deal of planning effort into ensuring that changes at the tactical level will not affect other operations. If commanders choose to use electromagnetic jamming, they weigh the operational requirement against the rules of engagement, the effects on friendly systems, and the loss of enemy information otherwise gained by signal intelligence (SIGINT) and electronic warfare support. Degradation of some friendly communications are accepted to effectively employ jamming. Mountain operations can work to an advantage in that mountains can help electronic warfare units target one area while shielding friendly forces on the other side of the mountain from the effects of the electronic warfare attack. A good IPB that incorporates the enemy threat characteristics is critical to success.

ELECTRONIC WARFARE SUPPORT

7-40. Intelligence feeds electronic warfare support by making accurate threat characteristics information available to accurately program electronic warfare support equipment. Alternatively, electronic warfare support feeds intelligence through electronic warfare support systems that collect information. That information is disseminated as a threat warning or passed to intelligence production and analysis elements for further processing. Electronic warfare support provides immediate threat recognition and a source of information for immediate decisions involving electronic attack. To best meet immediate tactical requirements, electronic warfare support information used in immediate threat recognition is rapidly disseminated without in-depth processing.

ELECTRONIC PROTECT

7-41. Electronic protect is the subdivision of electronic warfare and involves actions taken to protect personnel, facilities, and equipment from any effects of friendly or enemy use of the electromagnetic spectrum that degrade, neutralize, or destroy friendly combat capability. Examples include spectrum management, electromagnetic hardening, emission control, and use of wartime reserve modes. There are no special considerations for mountain operations, however, units use mountains to shield them from the enemy's electronic warfare capability and consider the electronic order of battle and battlefield geometry when establishing communication sites and command posts.

TRAINING CONSIDERATIONS

7-42. Mountainous terrain has limited impact to electronic warfare operations. Electronic warfare operations and training are tailored to the expected threat in the area of interest rather than the expected terrain. Commanders consider the effects of terrain as well as the other elements of METT-TC in developing their training plans.

OFFENSIVE AIR SUPPORT PLANNING CONSIDERATIONS

7-43. While TTP for most offensive air support platforms will remain the same, some platforms, especially rotary-wing aircraft, experience the following limitations in mountainous environments, especially high mountains, due to altitude restrictions:

- According to AR 95-1, Flight Regulations, Army rotary-wing aircraft that are unpressurized may operate to:
  - 3,048 meters (10,000 feet) for up to one hour, after which oxygen is needed.
  - 3,650 meters (12,000 feet) for up to 30 minutes, after which oxygen is needed.
  - 4,267 meters (14,000 feet) and above, oxygen must be used.

7-44. The LOS challenges associated with communications in a mountainous environment apply to the terminal control of attack aircraft as well. An understanding of communications paths is essential to provide timely, effective fires in rugged mountains. Consideration of the usage of other radio relay and digital CAS platforms can greatly enhance communication between the JTAC and attacking aircraft.

ORDNANCE VERSUS FUEL

7-45. The more ordnance an aircraft carries, the less fuel can be carried, decreasing time on station. The time on station required by the commander may affect weapons load out and selection. While higher elevations benefit fixed-wing aircraft fuel burn and time on station, they negatively affect rotary-wing operations. The thinner air at higher elevations affects rotary-wing power management and limits the ability to hover in certain conditions, necessitating rolling takeoffs or landings on large, improved surfaces and shallower than normal approach and departure paths.

FORWARD OPERATING BASE AND FORWARD ARMING AND REFUELING POINT LOCATIONS

7-46. FARP locations in higher altitudes affect how much fuel or ordnance an aircraft reloads. An aircraft that arms and fuels at lower elevations provides a different capability than an aircraft arming and fueling at a higher elevation. Planners must be aware that loading up with the same amount of ordnance and fuel may not be possible, which is a significant planning factor when developing supportability timelines as it will affect time on station for all close air support and rotary-wing aircraft. These issues should also be considered when planning forward operating base and FARP locations. Prior coordination with forward support companies located within each aviation battalion and squadron enable ground forces to extract information about refueling point capabilities and limitations prior to emplacement. Further information on FARP planning and operations is found in ATP 3-04.94, Forward Arming and Refueling Points.

Ordnance Selection

7-47. Target type, composition, location, risk estimate distance, and collateral damage estimate drive ordnance selection. Terrain impacts ordnance fuzing and explosive effects. Planners understand how to employ certain aerial weapons in mountainous and snow-covered terrain and the capabilities and limitations of attack aircraft. The terrain and the mission requirements directly influence the munitions selected and the fuzing used. When employing laser-guided weapons, lower than typical cloud layers and heavy mountain fog has a negative effect on the ability to laser designate a specific target. Depending on whether the target is located in a cave, on the side of a mountain, or in the middle of a valley, the effects of laser energy should be planned. Risk estimate distances may be reduced by the effects of surrounding terrain, allowing the use of larger munitions in close proximity of friendly forces—a significant advantage in compartmentalized terrain.

Reduced Power Available

7-48. During operations at high altitude, rotary-wing aircraft experiences different flight characteristics than at sea level. The most significant among the differences is a limitation of power available due to the general aerodynamics of rotor systems. Whether these limitations are felt in less lift, reduced tail rotor authority, the inability to recover quickly from a dive, or the reduced ordnance and fuel combinations available to planners, the challenges are significant and must also be accurately and continually planned. Planners must update supported units on what they can expect during different times of year and in different environmental conditions of heat, humidity, and altitude.

Geometry of Fires

7-49. The ground commander's scheme of maneuver, enemy position, environment, and terrain are all factors when determining attack geometry. Special attention must be paid to CAS in mountainous terrain, which becomes more significant when integrating fires in a combined arms scenario. Reverse slope, terrain features, type of weapon, aircraft type, and attack profiles are all factors for consideration while employing fires. The terrain restricts the marking platform, the terminal controller, and attacking aircraft's sight to the target. The enemy has a significant advantage in the mountains, because he or she is in a position to use terrain to effectively counterattack CAS aircraft.

Weather

7-50. Weather conditions in the mountains will have the same effect on aviation assets as they do in flat terrain. Over reliance on aviation assets render a force susceptible to the uncertainties of weather. Winds, cloud deck, visibility, and temperature must be considered because it affects the type of supporting aircraft and ordnance employed. It affects the accuracy of certain weapon systems as well as the delivery profile of the attacking aircraft. Knowing capabilities of attack and CAS aircraft will help to successfully prosecute targets despite a deteriorating weather condition. Differences in the way CAS aircraft are affected must be understood by planners: fixed-wing aircraft may be unable to see the target or use specific weapons due to quickly materializing cloud layers, while rotary-wing aircraft may not have the ability to climb high enough to safely avoid mountainous terrain due to altitude limitations.

Deep Air Support

7-51. Deep air support is not affected by this environment. The limitations created by weather patterns and winds must be considered.

Training Considerations

7-52. Training requirements are outlined in aircrafts' training and readiness manuals and should be relied upon for the accomplishment of full spectrum missions, to include offensive air support. Continual training and skill refinement is necessary to overcome the difficulties associated with aviation operations in a mountainous and high altitude environment. This environment requires achieving and maintaining a high degree of aircrew proficiency.

AVIATION GROUND SUPPORT PLANNING CONSIDERATIONS

7-53. An effective aviation ground support deployment capability enables the CAB to establish and maintain a viable expeditionary force. Aviation assets must be capable of deploying under a variety of conditions and configurations. Considerations for fixed-wing aircraft should be made when operating in a mountainous environment. Normal runway lengths of 2,438 to 3,048 meters (8,000 to 10,000 feet) can be reduced with the addition of arresting gear and the reduction of fuel and ordnance loads.

FORWARD ARMING AND REFUELING POINTS

7-54. The FARP mission is to provide the fuel and ordnance necessary for highly mobile and flexible helicopter, tilt-rotor, and fixed-wing operations. The size and capabilities of the refueling point vary with the mission and the number of aircraft to be serviced. Normally, FARPs are temporary, transitory facilities established for a specific mission and duration. The scope of flight operations in the FARP area should include individual aircraft or aircraft sections or divisions requiring ordnance and refueling. The location and size of the LZ remain the same for mountainous and cold environments but weather considerations impact FARP operations. Deep snow could cause an aircraft landing gear to sink, greatly reducing the rotor ground clearance and increasing the hazards to personnel operating in and around the area.

7-55. There are several hazards to consider during aircraft arming and refueling operations in a mountainous environment with snow. A major concern is eliminating sources of ignitions and controlling vapor generation. One of the primary sources of ignition is static electricity. Deep snow retards the grounding of aircraft, which could generate enough static electricity to ignite fuel vapors. The storage of ordnance is also a concern. Terrain should be used when possible to satisfy the safe storage of explosives and quantity distance separation requirements. An aviator must certify the FARP prior to it being available for refuel and rearm (see ATP 3-04.94).

FORWARD OPERATING BASE LOCATIONS

7-56. Airfield size, approach and departure paths, and security for the forward aviation sites are the same for normal operations. If an airfield that can be used by the CAB does not already exist, there are various options available to the CAB to build one. Unimproved surfaces will be engineered to allow for safe continuous flight operations. Varying types of expeditionary airfield systems provide fully portable options that range from individual AM-2 landing pads to a full 8,000-foot runway with taxiways and parking areas. These systems can include tactical air traffic services packages that provide both airfield control and radar guidance as needed.

AVIATION LOGISTIC SUPPORT IN A MOUNTAINOUS ENVIRONMENT PLANNING CONSIDERATIONS

7-57. As with all air operations, planning for mountain warfare should be no different with regard to its aviation logistical support process. Aviation logistic success is based on having a centralized location for the distribution and repair of components for its supported dispersed units. These concepts are set forth in FM 3-04.111. More maintenance support personnel may be necessary, depending on the number of dispersed units in the area of operations, the size of the area of operations, and number of aircraft at each dispersed site.

7-58. The following problems result from the increased maintenance and continuous operation of equipment at low temperatures and higher altitudes:

- Thickening of oils at low temperatures presents problems in starting and operating most equipment.
- Covers for equipment on aircraft should be used to protect it from the elements. When possible, aircraft should be removed from the elements and maintenance should be conducted in temporary hangar structures.
- Maintenance time factors may increase in areas of extreme cold.

- Aircraft mechanics are hampered by heavy winter clothing and gloves. Shelters or warming tents must be provided for personnel performing maintenance. Proper clothing is necessary for all personnel and survival kits tailored to the environment must be carried on all flights.
- Preventive maintenance on all equipment is more critical in cold weather environments associated with operations in the mountains.
- Parts availability and differing levels of maintenance will vary based on location and distance from the aircraft wing.
- Units may go through far more consumables because equipment and vehicles may have to be started often or run continuously in order to mitigate the effects of extreme cold weather.
- Resupply must also be planned.

TRAINING CONSIDERATIONS

7-59. Aviation maintenance and logistical personnel must train for this environment and plan for additional requirements before deploying to mountainous regions. The most effective training program includes hands-on and real time environmental and survival training for the individual Soldier followed by supporting actual aircraft in the environment to which they will deploy. They must understand all the factors affecting the aircraft, tools, equipment, vehicles, support gear, and themselves in order to keep airplanes flying. The Soldiers will likely be responsible for their own force protection and security when operating in remote regions while supporting aviation operations. Training for this mission should include fire team and squad tactics and an understanding of quick reaction forces and supporting fires from higher headquarters. Communications equipment, weapons, and ammunition tailored to the operational area will be required.

7-60. To be truly effective in mountain warfare, the commanders must understand the limitations imposed by the effects of this environment on aviation elements. While the terrain, altitude, and weather impact certain operations, the basic tenets of military aviation support the mission of the Soldier regardless of the location in which he is fighting. The inherent skills and knowledge of aviation Soldiers ensures the successful integration between aviation units in support of the ground commander's overall mission. Successful planning will result in the mitigated effects of high altitude and extreme weather.

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Chapter 8

Fires

ORGANIZATION FOR ARTILLERY

8-1. To mitigate some of the limitations in the mountains and in order to better support isolated maneuver units, the artillery battery can be broken down into smaller platoons than what is called for in the unit's table-of-organization-and-equipment. This organization does allow support of maneuver units across vast distances but it strains its personnel and equipment. Despite these constraints, these smaller gun platoons can operate independent of the battery, while retaining the capability to mass fires as a battery depending on the distance. Platoons also operate from forward operating bases or command outposts in support of missions but ammunition could be limited due to logistic requirements in these FOBs or COPs.

8-2. Although the use of smaller gun platoons supports the commander in a dispersed environment, such dispersal complicates his ability to mass fires, lead, and sustain each platoon. He must depend on officers and senior and junior noncommissioned officers capable of operating independently and sometimes performing duties above their table-of-organization-and-equipment rank structure. The requirement for specialized logistics, security, communications, computers, and vehicles for each platoon position may require a significant increase in personnel, exceeding a battery's authorized TOE. As a result, proper staffing based on pre-deployment mission planning is essential.

8-3. The structure of the artillery battalions will dictate how they can be divided into two-gun platoons. For example, armored brigade combat teams and infantry BCTs have a fires battalion with two, eight-gun batteries, while Stryker BCTs have three, six-gun batteries. Currently, artillery TOEs do not support two-gun platoons from the standpoint of fire direction center (FDC) communications equipment, computers, or personnel. To meet this challenge, units may have to either cross-train personnel or request additional equipment or operate with reduced personnel at all FDCs and divert communications and computers from other sections. Such a plan detracts from mission accomplishment by the sections from which the equipment and personnel are taken.

MOVEMENT AND POSITIONING

8-4. Movement and Positioning includes reconnaissance and slection as well as occupation.

RECONNAISSANCE, SELECTION, AND OCCUPATION OF A POSITION

8-5. The reconnaissance (the examination of the terrain to determine its suitability for use in accomplishing the mission), selection, and occupation of a position are critical to mission accomplishment. Rugged terrain and reduced mobility increase the reliance on field artillery fire support. However, the employment and positioning of field artillery systems may be severely impacted by the extreme difficulty of ground mobility in mountainous terrain. The battery leadership must analyze the routes to be used by the unit assets and the time and distance required to make the move. The ability to move one firing platoon while leaving a second platoon able to fire is critical in the support of dispersed maneuver units. Moving the battery over long, difficult routes requires well planned, coordinated movement orders and unit SOPs (see ATP 3-09.50/*MCWP* 3-1.6.23). Clearance of near and intervening crests is always a factor in selecting firing positions.

MOVEMENT

8-6. The effects of the weather on the terrain to be crossed must be analyzed to facilitate rapid movement. Weather affects visibility (fog and haze) and trafficability (ice and rain-softened ground). Ground movement of field artillery is often limited to traveling on the existing road and trail networks and positioning in their immediate vicinity. Towed field artillery may require forward displacement of gun sections by helicopter to provide forward troops the necessary support.

AIR MOVEMENT

8-7. Air movement of towed field artillery is possible with fixed- or rotary-wing aircraft and therefore, gun crews should be proficient using equipment-rigging techniques and air assault procedures and possess ample sling-load equipment. Field artillery emplaced by helicopter normally requires continued airlift for subsequent displacement and ammunition resupply and often necessitates substantial engineer support.

POSITION SELECTION

8-8. Normally, field artillery is employed far enough to the rear to take advantage of increased angles of fall. Flat areas, such as dry riverbeds, villages and towns, and farmland, can usually accommodate firing units but these positions present particular problems in the mountains for the following reasons:

- Dry riverbeds are hazardous because of the danger of flash flooding.
- Towns and villages usually have adequate flat areas, such as parks, schoolyards, and playing fields. However they are relatively scarce and often easily targeted by the enemy.
- Farmland is often difficult to negotiate from spring to fall. In the winter, if the ground is frozen, farmland may provide good firing positions but frozen ground may cause difficulty emplacing spades, base plates, and trails.

8-9. Consequently, good artillery positions that have been selected for cover, flash defilade, and accessibility to road nets and LZs are difficult to find and their relative scarcity makes it easier for the enemy to target probable locations. Commanders must ensure that positions on dominant terrain provide adequate defilade. Positions on commanding terrain are preferable to low ground positions because there is—

- A reduction in the number of missions requiring high-angle fires.
- A reduced amount of dead space in the target area.
- Less exposure to small arms fire from surrounding heights.
- Less chance of being struck by rockslides or avalanches.

8-10. Some weapons may be moved forward to provide long-range interdiction fires or, in extreme cases, direct fires to engage a road-bound enemy in mountain passes or along valley floors. Because of rugged terrain, higher angles of fire, and reduced ranges, it is generally necessary to displace artillery more frequently than on level terrain to provide continuous support. Additionally, even when maneuver units are not dispersed, artillery commanders may often be forced to employ field artillery in a decentralized manner or disperse it in multiple locations in the same general area because of the limited space for gun positions. Security must be provided for each gun location.

MULTIPLE LAUNCH ROCKET SYSTEM, M270A1 AND HIGH MOBILITY ARTILLERY ROCKET SYSTEM, M142 POSITION CONSIDERATIONS

8-11. While mountains can mask all types of firing units, they present special challenges and limitations to rocket-fired munitions. Dead space is the area that is masked behind a crest and cannot be attacked by rockets from particular firing positions. Masks are terrain features that have enough altitude to potentially interfere with the trajectory of the rocket or missile. There are two categories of masks: immediate and downrange. Immediate masks are within 1,981 meters (6,500 feet) of a launcher firing point and are measured and input to the launcher fire control system by individual section chiefs. Downrange masks are beyond 1,981 meters (6,500 feet) and are measured and input into the advanced field artillery tactical data system's fire direction system by the platoon leader and battery operations officer in accordance with unit operating procedures.

8-12. Downrange masks are measured and applied using crest clearance tables and automated downrange mask checks. Both M270A1- and M142-equipped units in mountainous terrain must be familiar with these tables, which allow leaders to establish minimum planning ranges beyond a crest for launchers in a specific firing area. Proper use of these tables will ensure rockets will clear the crest and not detonate prematurely. It will also help to identify the dead space that must be covered by other indirect fire weapons, such as mortars, or by aviation or direct fire weapons placed behind the intervening slopes.

ACQUISITION AND OBSERVATION

8-13. Acquisition and Observation includes radar, observer, and laser considerations.

RADAR CONSIDERATIONS

8-14. Because of high-angle fire requirements, radar can be effective against enemy indirect fire systems if properly emplaced. However, terrain masking can diminish the radar's line-of-sight and degrade its effectiveness if it is not properly emplaced. Sites should be selected on prominent terrain to obtain the lowest possible screening crest, but it is often difficult to obtain a low and consistent screening crest in mountainous terrain. Too low of a screening crest drives the search beam into the ground while too high of a screening crest allows the enemy to fire under the beam and avoid detection.

8-15. In mountainous terrain, selecting general position areas to take full advantage of the radar range and capabilities is difficult. Helicopter assists are often required to move radar teams to optimal locations. Very often the positions that provide the best LOS for acquisition provide the least concealment and survivability, so proper camouflage techniques are critical for survival. Additionally, the heavy rain and snow often found in the mountains can degrade the capabilities of radar by decreasing the probability of location (see ATP 3-09.12, for additional information on radar positioning).

8-16. When positioning weapons-locating radars, commanders should also consider the following:

- Although time consuming, visibility diagrams are extremely useful in determining the probability of acquiring targets within the radar's search sectors.
- To limit search areas, radars should focus on terrain that can be occupied by artillery and mortars.
- Accurate survey control is essential because of the extreme elevation variations in mountainous terrain. Helicopters may be useful in performing survey by use of the Position and Azimuth Determining System. If possible, digital radar maps may be used to minimize the time required for height correction of the weapon system. Digital maps allow the Firefinder systems to initially locate weapon systems to within 250 meters (820 feet), which allows the radar operator to make few visual elevation adjustments to accurately locate the weapon system.
- Prediction is computed at the radar's elevation and therefore, excessive errors in the prediction can be expected.
- Radars in the same area that face one another and radiate at the same time can cause interference and emissions burnout, resulting in equipment failure. If radars must face one another to accomplish the mission, commanders must coordinate with each other to ensure that they do not radiate at the same time.
- Computing track volume may become a critical task in determining the radar's effectiveness for a proposed position (see ATP 3-09.12 for computations).
- Units will need to rely more on shelling reports to determine enemy firing locations so pre-deployment training must ensure all units meet minimum standards for this skill.

OBSERVER CONSIDERATIONS

8-17. High-angle fire is used for firing into or out of deep defilade, such as that found in heavily wooded, mountainous, and urban areas. It is also used to fire over high terrain features near friendly troops. The observer may request high-angle fire on the basis of terrain in the target area. The fire direction officer may also order high-angle fire on the basis of a terrain analysis from the firing unit position to the target area. The primary characteristic of high-angle fire is that an increase in elevation causes a decrease in range.

8-18. Because high-angle fire involves large quadrant elevations and long times of flight, it will not be as responsive as low-angle fire to the immediate needs of a maneuver force. In addition, trajectories will also be more vulnerable to enemy detection. The longtime of flight and the steep terrain make it difficult for the observer to identify his round. Corrections may change drastically from round to round because spotting rounds often get lost in defilade positions. To help the observer, personnel at the fire direction center, announce the time of flight in the message to observer five seconds before each round impacts (see TC 3-09.81/*MCWP* 3-16.4).

8-19. To prevent fratricide, noncombatant casualties, and destruction of civilian property and infrastructure, field artillery fires in mountains will be observed, especially close support and defensive fires. Unobserved fires are generally more unreliable in mountains because of poor maps, rapidly changing meteorological conditions and elevation changes. A good FDC can overcome some of the challenges of weather and high-angle fires through training and by capturing timely and accurate meteorological data.

8-20. Elevated points, such as crests and trees, are often used for observation posts. Landmarks and prominent terrain features should be avoided as these are probably targeted. When selecting an observation post, the observer must consider the characteristics of forward slope (military crest) versus reverse slope positioning:

- Advantages of the forward slope position include—
- The view of the front and flanks is better.
- Fires impacting on the topographic crest will not neutralize the position.
- The hillside provides background, which aids in concealment.
- Disadvantages of the forward slope position include—
- Difficulty in occupying during daytime without disclosing the position.
- Radio communications may be difficult and require remoting radios to the reverse slope.
- Cover from direct fire may not be available.
- The advantages of a reverse slope position are—
- It may be occupied in daylight.
- Greater freedom of movement is possible.
- Communications installation, maintenance, and concealment are easier.
- Protection from direct fire is available.
- Disadvantages of the reverse slope position are—
- The field of view to the front is limited.
- Enemy fire adjusted onto the topographic crest may neutralize the observation post.

8-21. Low clouds or fog may require moving the observation post to preplanned emplacements at lower elevations. Observers must be prepared to perform assault climbing to reach the most advantageous observation site. Commanders may use aerial observers or UASs to detect long-range targets and complement forward observers by adjusting fires beyond terrain masks, in deep defilade, and on reverse slopes. Commanders may also consider the use of long-range telescopic cameras for use in observation but in extremely high mountains, air observers may be confined to valleys and lower altitudes due to altitude limitations on different types of aircraft. Observing fires in mountains is difficult because the area being observed is three dimensional relative to other types of terrain. As such, the observer may encounter increased difficulties in determining accurate target location (to include altitude). Additionally, subsequent corrections may appear more exaggerated, particularly as angle T increases. In most cases, increased accuracy comes with experience and training gained from operating in mountains before deployments.

Laser Range Finders and Laser Designators Usage for Laser Guided Munitions

8-22. Use of laser range finders and laser-guided weapons in the mountains also demands increased emphasis on training and observation techniques. Laser target ranging and designation systems help to overcome difficulties in range estimation by providing accurate directional distance and vertical angle information for use in locating enemy targets. However, when using a laser designator, an observer should consider LOS with the target and cloud height. While laser-guided munitions (artillery, mortar, or air delivered) self-correct in flight, the ability to correct the trajectory is based upon the seeker head acquiring the target in sufficient time to make the correction. Cloud ceilings that are too low will not allow laser-guided munitions enough time to lock on and maneuver to the target. GPS-aided munitions can overcome this limitation as they do not rely on reflected laser energy.

SURVEY OPERATIONS

8-23. Survey operations are always critical and those in mountainous environments are no exception. There may be times in the mountains when normal survey operations are not possible due to the terrain, electrical interference, limited equipment, or equipment failure. When these hindrances occur, units can use the trigonometric functions to compute a traverse method or the triangulation methods that are explained in ATP 3-09.02. The triangulation method is ideally suited for rough mountainous terrain when other methods are impractical. It employs oblique triangular figures and enables the surveyor to cross obstacles and long distances. While this method is time consuming and requires careful planning and extensive reconnaissance, it is nonetheless effective and can help ensure accurate fires even in the mountains.

GLOBAL POSITIONING SYSTEM LIMITATIONS AND CONSIDERATIONS

8-24. GPS receivers rely on electronic LOS with satellites. Initially, they search and select satellites that are 10 degrees or more above the true horizon. Mountains, mountain forests, or deep canyons may mask the signal. If usable satellites cannot be detected, operators may have to move to higher ground to get better LOS to the satellites and use more traditional techniques in order to survey firing positions. Personnel operating GPS-enabled equipment or munitions need to consult their Army space support team for updated GPS navigational accuracy predictions and electromagnetic interference information. For more information regarding the Army space support team, see FM 3-14. Additionally, the operating temperature of the GPS receiver is -4° F to +158° F. Many mountain temperatures are much colder, so the GPS receivers must be protected by carrying them inside clothing or in a heated vehicle and using an auxiliary antenna system.

METEOROLOGICAL MESSAGE SPACE AND TIME VALIDITY

8-25. The accuracy of a meteorological message may decrease as the distance and time from a sounding site increases. Local topography has a pronounced effect on the distance that meteorological data can be reasonably extended. In mountainous terrain, distinct variations of wind and temperatures occur over short distances. Normally, meteorological messages for artillery are considered valid up to 20 kilometers (about 12 miles) from the balloon release point but the validity distance decreases proportionally with the roughness of the terrain. As a result, messages for artillery are only considered valid up to 10 kilometers (about six miles) from the balloon release point in mountainous terrain, which can lead to increased targeting error and should be considered when firing in close proximity to friendly or civilian positions in mountains.

TARGETING

8-26. Because of the decentralized nature of mountain operations, targets warranting massed fires may be fewer than those in open terrain. However, narrow defiles used as routes of supply, advance, or withdrawal by the enemy are potentially high payoff targets for interdiction fires or large massed fires. Large masses of snow or rocks above enemy positions and along MSRs are also good targets because they can be converted into highly destructive rockslides and avalanches that may deny the enemy the use of roads and trails and destroy elements in defilade. In the mountains, suppression of enemy air defenses takes on added importance because of the increased dependence on all types of aircraft. A clear understanding of the targeting methodology combined with the knowledge of the capabilities and limitations of target acquisition and attack systems in a mountainous environment is crucial to the synchronization of all available combat power. To provide accurate and timely delivery of artillery fires in mountainous terrain, commanders must consider the following:

- High angles of elevation and increased time of flight for rounds to impact.
- Targets on reverse slopes, which are more difficult to engage than targets on flat ground or rising slopes and require more ammunition for the same coverage.
- Increased amounts of dead space unreachable by artillery fires.
- Intervening crests that require detailed map analysis.

8-27. When the five requirements for accurate predicted fire (target location and size, firing unit location, weapons and ammunition information, meteorological information, and computational procedures) are not achievable, registration on numerous checkpoints becomes essential because of the large variance in elevation (see TC 3-09.81/*MCWP* 3-16.4 for more detailed information).

MUNITIONS

8-28. Terrain and weather also affect the use of field artillery munitions. When evaluating the use of lethal or nonlethal effects, commanders must carefully weigh the operational requirements against the rules of engagement. Considerations for mountain employment of high explosive munitions, obscurants, high-angle fire, and thermobaric weapons are discussed in the following subparagraphs.

HIGH EXPLOSIVE MUNITIONS

8-29. High explosive munitions include point-detonating fuzes, variable/electronic time fuzes, mechanical time super quick (MTSQ) fuzes, and mechanical time-only fuzes.

8-30. Impact fuze, high explosive shells are very effective on rocky ground, scattering stones and splintering rocks, which themselves become missiles. However, deep snow that is often found in high mountains during the winter months reduces their bursting radius, making them approximately 40 percent less effective. Also, the rugged nature of the terrain may afford added protection for defending forces, so therefore, larger quantities of high explosives may be required to achieve the same desired effects against enemy defensive positions than in other types of terrain.

8-31. Variable time or electronic time fuzes should be used in deep snow conditions and are particularly effective against troops on reverse slopes. The MTSQ fuzes are typically not used in high-angle high explosive fire due to an increased height of burst probable error. There are some older MTSQ fuzes that may prematurely detonate when fired during times of precipitation (M564 and M548 fuzes). Base ejection rounds (such as illumination) using mechanical time-only fuzes are less affected by height of burst probable errors than are high explosive rounds fuzed with MTSQ fuzes. For example, if a high explosive projectile armed with a variable time fuze and set with a time less than the minimum safe time is to be fired over marshy or wet terrain, water, ice, or snow, then the average height of burst will increase. The vertical clearance must be significantly increased (see TC 3-09.81/*MCWP* 3-16.4 and ATP 3-09.50/*MCWP* 3-1.6.23).

OBSCURANTS

8-32. Obscuration operations in mountainous areas are challenging due to the terrain and wind. Inadequate roads enhance the military value of existing roads, mountain valleys, and passes and add importance to the high ground that dominates the other terrain. Planners can use obscurants and flame systems to deny the enemy observation of friendly positions, supply routes, and entrenchments and degrade their ability to cross through tight, high passes to engage friendly forces with direct and indirect fires. White phosphorous should be used cautiously in snow cover. Pieces of white phosphorous may burn for up to four days if covered by snow as it ignites only after being exposed to air. Thermally-induced slope winds that occur throughout the day and night increase the difficulty of establishing and maintaining obscuration operations, except in medium- to large-sized valleys. Wind currents, eddies, and turbulence in mountainous terrain must be continuously studied and observed. Forward observers who understand these local weather patterns can skillfully exploit them and enhance obscuration operations rather than have them deterred by the weather. Screening obscurants may be of limited use due to enemy air observation, to include UASs, and observation by enemy forces located on high ground.

HIGH ANGLE FIRE

8-33. High-angle trajectory, often required in mountainous environments, has two inherent characteristics that affect munitions selection. These include a steep angle of fall and a large height of burst probable error for MTSQ fuzes. The steep angle of fall means the projectile is almost vertical as it approaches the ground. When the high explosive projectile bursts, the side spray contains most of the fragmentation. Since the projectile is nearly vertical side spray occurs in all directions and is nearly parallel to the ground, hence, high explosive shells with quick fuzes or variable time fuzes are very effective when fired at high angles. On the contrary, large probable error in height of burst makes the use of mechanical time fuzes impractical in high-angle fire.

THERMOBARIC WEAPONS

8-34. Thermobaric weapons are useful in mountainous environments due to their destructive capability when employed against tunnels, caves, and isolated terrain compartments. The shockwave and overpressure created by these weapons create casualties in confined spaces. This effect is ideal if units are tasked with clearing confined areas, such as caves. Thermobaric weapons have been used in the cave networks of Afghanistan with positive results, so commanders and their staffs should consider these weapons for this type of mission. These weapons are restricted due to their destructive capabilities and they require extensive planning time to acquire release authority from higher echelons.

MORTARS

8-35. Mortars are essential during mountain operations. Their high angle of fire and high rate of fire are suited to supporting dispersed forces. Mortars can deliver fires on reverse slopes, into dead space, and over intermediate crests. Like field artillery, rock fragments caused by the impact of mortar rounds may cause additional casualties or damage. Suitable mortar firing positions can still be a challenge to find even though they are often easier to find than artillery positions. By design, mortars must be emplaced closer to the supported unit than artillery due to their limited maximum range.

8-36. Mortars come in three different configurations: 60 millimeter (mm), 81 mm, or 120 mm. The 60-mm mortars are usually carried on dismounted movements due to their light weight and mobility. They provide smaller units with an organic fires capability when conducting independent operations and can be used to pin down an enemy to escape from an ambush, to maneuver on him, or to allow time for other firing assets to acquire the target. While it is possible to carry 81-mm and 120-mm mortars on dismounted movements, it is not desirable to do so in rugged mountainous terrain. The increased weight of the 81-mm and 120-mm mortar rounds severely hampers movement that is already slow due to the constraints of the mountainous environment. Planners must consider that small units will also be forced to sacrifice carrying other heavier items, such as Javelins, AT4s, additional ammunition for crew-served weapons, and fewer mortar rounds if they carry larger mortar systems. If possible, larger mortar systems should be placed at COPs or FOBs for use, which is often the only way to ensure there are tactically significant quantities of ammunition available. During movement to contact or other offensive operations, larger mortars should be transported along valley roads and trails to provide continuous fire support coverage to the lighter dismounted units in the higher rugged terrain. Continuous coverage can be achieved by splitting into sections and conducting bounding techniques to ensure at least one section is always ready to fire. See FM 3-22.90 and ATTP 3-21.90/*MCWP* 3-15.2, for additional information on employing mortars in mountainous environments.

AIR SUPPORT

8-37. Because the terrain compels the enemy to concentrate his forces along roads, valleys, reverse slopes, and deep defilades, close air support is very effective even though the terrain restricts the attack direction of the CAS strikes. The enemy also conducts an intelligence to determine the likely direction of the CAS strikes and will weight his air defenses along those routes. The fire support officer must aggressively identify the enemy air defense systems and target them to enhance the survivability of the CAS assets.

8-38. Air interdiction and CAS operations can be particularly effective in mountains, since enemy mobility is also restricted by terrain. The forward air controller (Airborne) (FAC(A)) and CAS pilot are valuable sources of information and can find and designate targets that may be masked from direct ground observation. Vehicles and personnel are particularly vulnerable to effective air attack when moving along narrow mountain roads. Precision-guided munitions, such as laser-guided bombs, can quickly destroy bridges and tunnels and, under proper conditions, cause landslides and avalanches that close routes or collapse on both stationary and advancing enemy forces. Precision-guided munitions can also destroy or neutralize well-protected point targets, such as cave entrances and enemy forces in defilade.

8-39. Low ceilings, fog, and storms common to mountain regions may degrade air support operations. Despite these challenges, GPS-capable aircraft and air-delivered weapons can negate many of the previous limitations caused by weather. Terrain canalizes low-altitude air avenues of approach, limiting ingress and egress routes and available attack options and increasing aircraft vulnerability to enemy air defense systems. Potential targets can hide in the crevices of cliffs, the niches of mountain slopes, and on gorge floors, so pilots may be able to detect the enemy only at short distances, requiring pilots to swing around for a second run on the target and giving the enemy more time to disperse and seek better cover. Additionally, accuracy may be degraded due to the need for pilots to divert more of their attention to flying while executing their attack.

8-40. Planning considerations for CAS are discussed in ATP 3-09.32/*MCRP* 3-16.6A, JFIRE Multi-Service Tactics, Techniques, and Procedures for the Joint Application of Firepower. CAS is requested in a standardized 9-line format.

8-41. CAS is requested by using forward air controllers or joint terminal attack controllers. Both are certified Service members who, from a forward position, direct the action of combat aircraft engaged in CAS and other offensive air operations. A FAC(A) is a specifically-trained and qualified aviation officer who exercises control from the air of aircraft and indirect fires engaged in CAS of ground troops. According to ATP 3-09.32/*MCRP* 3-16.6A, a certified JTAC or FAC(A) will be recognized across the Defense Department as capable and authorized to perform terminal attack control.

8-42. A joint fires observer is a certified Service member who can request, adjust, and control surface-to-surface fires; provide targeting information in support of type 2 and type 3 CAS terminal attack controls; and perform autonomous terminal guidance operations in accordance with ATP 3-09.32/*MCRP* 3-16.6A and JP 3-09.3. While not as highly trained as a JTAC, FAC, or FAC(A), more individuals can be trained as a joint fires observer. The joint fires observer adds warfighting capability but does not circumvent or nullify the need for a qualified JTAC, FAC, or FAC(A) during CAS operations. With JTACs, joint fires observers assist ground commanders with the timely synchronization and responsive execution of all joint fires and effects at the tactical level.

NAVAL SURFACE FIRES

8-43. As demonstrated in the Pacific Campaign of World War II, naval surface fires can be employed in mountainous terrain but the opportunity to use such fires has been limited. The issues of trajectory and intervening crests along the gun-target line often make its employment difficult in mountainous terrain. Conventional naval surface fires typically have a low angle of fire and a flat trajectory. Though the position of the naval vessel in relation to the target will determine the gun-target line and the accessibility of the target by conventional naval surface fires, operational level planners should not forget the capability that naval-launched, precision-guided munitions can bring to the battlefield. Cruise missiles launched from naval vessels can engage targets deep inland with devastating accuracy and are not subject to the same limitations as conventional naval fires.

NONLETHAL EFFECTS

8-44. Nonlethal effects are an important part of any arsenal and can be employed across the range of military operations in mountainous environments. As with lethal fires, nonlethal effects can be limited by terrain due to mobility restrictions and the fact that physical geographic features can create sub-environments where employment of the same nonlethal effects may yield entirely different outcomes.

INFORMATION OPERATIONS

8-45. Information Operations (IO) is the integrated employment, during military operations, of information-related capabilities in concert with other lines of operation to influence, disrupt, corrupt, or usurp the decision making of adversaries and potential adversaries while protecting our own (JP 3-13). Affecting threat decision making necessitates affecting all contributing factors that enable it. These factors include, although not limited to:

- Command and control systems.
- Communications systems.
- Information content (words, images, symbols).
- Cyber systems.
- Staffs, advisors, counselors, and confidants.

- Human networks and constituencies that influence the decision maker and to whom the decision maker seeks to influence includes, in other words, all relevant audiences in the areas of operations and interest.

8-46. Essential to conducting IO in any terrain is first understanding the information environment and its particular nuances, including such aspects as: information infrastructure; the ways information is packaged, transmitted, and received; the persons involved in communicating and interpreting the information; the cultural aspects of how information is processed; and the ways that decision makers make decisions. In some mountainous regions, for example, communities do not have access to modern communication technologies and also have low literacy rates. The IO officer or representative assists the commander and staff in visualizing the information environment and planning, executing, and assessing information operations to create requisite effects in and through this environment to support attainment of the commander’s intent.

FIRE SUPPORT COORDINATION MEASURES

8-47. The information contained in ATP 3-09.32/*MCRP* 3-16.6A is applicable to any environment but the mountains often necessitate changes to standard operating procedures. The Army normally conducts fire support coordination at the battalion level and higher. The distances and dispersed nature of the fight in mountainous environments often requires smaller units to control and clear fires within their operational area and companies to receive some of the same equipment and personnel that is normally only found in battalion and larger organizations.

8-48. Recommended methods to achieve this organization are to—

- Establish clear boundaries and simple direct fire control measures.
- Establish appropriate fire support coordination measures.
- Recommend appropriate airspace coordinating measures.

ARTILLERY LOGISTICS

8-49. Artillery requires a substantial logistic effort to supply and maintain itself on the battlefield. Mountainous terrain requires that artillery perform many high-angle missions and missions using propellant charges at maximum capability. Such artillery use causes premature failure of the howitzers and an increased maintenance effort to remain mission capable. In a mountainous environment, logistic support becomes very difficult and requires unique solutions due to the terrain limitations.

8-50. Helium and nitrogen management is vital in mountainous terrain. Helium is used by meteorological teams to gather updated weather data for firing units. Meteorological support can only extend up to 10 kilometers (about six miles) from the release point in mountainous terrain. In order to provide accurate meteorological support throughout the battlefield, the teams must be positioned and frequently resupplied in numerous locations across vast distances. As a result, logistical resupply of helium becomes more important and more difficult in mountainous terrain. Similarly, nitrogen resupply is essential in maintaining firing capability among artillery units. The amount of nitrogen used in howitzer recoil systems, how much is on hand in a given country, where it is located, and how to transport it to the area of operations are all logistical considerations when managing artillery operations in this environment.

8-51. Energy management and ammunition management are also other important issues of consideration for the artillery community in mountain operations. Many of these issues are covered in detail in Chapter 6 of this publication.

8-52. Fires are one of the strongest enablers for commanders and planners in mountainous environments. Effective use of lethal fires helps compensate for the long ranges and large amount of dead space that is found in mountainous environments. Commanders can, if necessary, break down batteries from their traditional modified TOE with proper preparation and training. There will be a heavy reliance on air support. Commanders and planners should train all personnel on CAS procedures and, if possible, train unit personnel to become joint fires observers. Effective information operations will build good will with the public and facilitate operations of all types in the mountainous environment.

SMALL ARMS

8-53. Weapon systems encounter common problems in mountain and cold weather environments. Units should consult TM 4-33.31, ATTP 3-21.50, and applicable technical manuals for a more detailed listing of technical issues that weapons experience in cold regions.

SLUGGISHNESS

8-54. Weapons function under extreme cold conditions if given proper care. Lubricants that personnel normally use under temperate conditions such as cleaning, lubricating, and preservative compound can thicken in cold regions and stoppages or sluggish weapon action will result from their use. Cleaning, lubricating, and preservative solution will freeze at -35° F (-37° C). To eliminate this problem, individuals must strip the weapon completely, thoroughly clean it, and lubricate it with lubricating oil artic-weapons (LAW). At a minimum, they should lightly oil the camming surfaces of the bolt with LAW. They can leave the rest of the weapon dry. LAW is available in one-quart containers but not in the refillable half-ounce bottles normally found in weapons cleaning kits. If LAW is not available, Soldiers fire the weapon dry.

CONDENSATION

8-55. Condensation forms on weapons when personnel take them from the cold into a warmer environment. This is called sweating. If personnel return weapons to the cold without removing the condensation, this sweat can turn to ice, which will result in stoppages. For this reason, personnel should leave weapons outside when temperatures are below freezing. When left outside, weapons should be readily accessible but sheltered. Shelter prevents ice and snow from getting into the working parts of the weapon (such as the sights and barrel). If necessary, Soldiers can take weapons inside for cleaning. Weapons will continue to sweat for approximately one hour after coming into a warm shelter. Individuals must wait until the sweating process stops before thoroughly cleaning their weapons. If units keep weapons in heated shelters, Soldiers should keep weapons near, but not on, the floor to minimize condensation. The prevention of condensation affects is addressed in the aforementioned TM 4-33.31.

FOULING FROM SNOW AND ICE

8-56. To keep snow and ice out of a weapon, it needs some type of cover. Soldiers should request muzzle caps from the unit armorer. Such caps are expendable and will do the job. If none are available, individuals improvise. They can use plastic bags, tape, or condoms. Soldiers close ejection port covers. Personnel should carry something to de-ice a weapon if part of the weapon becomes frozen. Windshield wiper fluid carried in a small bottle works as does aircraft deicer and antifreeze. Periodic cycling of the weapon will also keep parts from freezing. Soldiers operate the action on weapons periodically. This can help identify icing issues.

VISIBILITY ISSUES

8-57. Soldiers can encounter a visibility problem when they fire weapons in still air conditions with temperatures below -30° F (-34° C). As the round leaves the weapon, the hot propellant gases cause the water vapor in the air to condense. These droplets of condensed water vapor then freeze, creating ice particles that produce a cloud of ice fog. This fog will hang over the weapon and follow the path of the projectile, obstructing the gunner's vision along the line of fire as well as revealing the gunner's location to the enemy. When faced with this problem, fire at a slower rate and relocate to an alternate firing position. Tests have shown that even in warmer temperatures, a fog develops around the gun. Hot gases from the gun and the breath of the gunner create the fog, making it difficult for the gunner to observe the strike of rounds. For crew-served weapons, the assistant gunner may need to take up a position further left or right to help with adjustments. For individual weapons, Soldiers may need to change position frequently. When using optics in the cold, gunners must avoid breathing on the sight. Breathing on the sight causes condensation. Since the warmth put out by the proximity of the face can cloud the sight, individuals allow a space between the eye and the sight. When taken from a cold to a warm environment, individuals allow the optics to adjust to the new temperature slowly to avoid cracking the lens.

Breakage and Malfunctions

8-58. Extreme cold causes metal and plastic to become more brittle than it is at warmer temperatures. Breakage generally occurs early when individuals fire a cold weapon. When fired, the metal heats and rapid, unequal expansion of parts occurs. They should begin firing small arms at a slow rate of fire in extreme cold regions, if the tactical situation permits. The slower rate of fire greatly reduces potential weapon malfunctioning. Freezing of moisture produced by sweating or accumulated snow or ice in the weapon will also cause malfunctions and stoppages. After firing a weapon, the heat it has generated can cause any snow or ice it touches to melt. This water will then re-freeze and may cause the weapon to malfunction. Soldiers can use a deicer to thaw the weapon and keep it working properly. They can also cycle the weapon periodically. Unit armorers need to carry extra parts to overcome these problems.

8-59. Automatic weapons have a high rate of breakage and malfunction in a mountain and cold weather environments. Especially affected are the sear and bolt parts. Gun crews must carry extra parts of this type. One common malfunction is short recoil where the bolt does not recoil fully to the rear. A second malfunction is caused by the freezing and hardening of buffers. This causes great shock and rapid recoil, increasing cyclic rate and can cause parts to break. Soldiers must coat all internal components and friction surfaces of machine-guns with LAW. If LAW is not available, personnel should fire these small arms cold and dry. They begin firing slowly at first to allow the weapon to warm with short two- or three-round bursts at short intervals being sufficient until the weapon components warm. Soldiers test fire weapons in comparable temperatures prior to combat deployment to a cold region area of operations. They transport ammunition in enclosed drums or cans to prevent snow fouling. They keep the ammunition at the same temperature as the weapons.

Emplacement Issues

8-60. Crew-served weapons require some type of base or platform for firing. Emplacement of a weapon on snow, ice, or frozen ground may result in a broken weapon, inaccurate firing due to sinking, or the inability to absorb shock. Paragraphs 3-116 through 3-134 discuss emplacements relating to particular weapons.

Reduced-Velocity and Range of Projectiles

8-61. Soldiers need to re-zero all weapons when deploying to cold regions. As temperature drops, so does the muzzle velocity, and thus the range of projectiles. The range changes because internal and external ballistics change. Internal ballistics occur inside the weapon. As the burning rate of propellant decreases, the rate of gas expansion decreases, and the rate at which the projectile moves down the barrel decreases. External ballistics occur after the projectile leaves the muzzle. Decreased muzzle velocity reduces the stability of the projectile as it leaves the muzzle, possibly causing the projectile to tumble. At longer ranges, this further reduces velocity and accuracy. Colder air is denser than warmer air and may create increased drag on the projectile thus further decreasing range.

GROUND BASED AIR DEFENSE CONSIDERATIONS

8-62. Severely compartmentalized terrain presents many challenges to ground-based air defense assets that include communications, mobility, logistics, cueing and tactical employment.

COMMUNICATIONS

8-63. Mountainous terrain precludes the use of very high frequency (VHF) radio assets except in short-range, LOS situations. The nature of short-range air defense unit employment is such that the tactical dispersion of surface-to-air missile teams, sections, platoons, and batteries render VHF communications unreliable. Solutions that can be fielded within the battalion include satellite, SATCOM, assets and high frequency (HF) radio assets. In addition to organic communications assets, short-range air defense planners explore the possibility of nonorganic communications support, such as the use of an airborne communications relay, if such assets are operating within the area of operations.

MOBILITY

8-64. Given that typical air defense operations are motorized, mountainous terrain limits the mobility of the teams. Foot-mobile, short-range air defense teams carry a limited number of missiles and batteries and a limited amount of communications equipment, food, and water. It is difficult for a dismounted short -range air defense unit to execute sustained operations. Options for the air defense planner to consider include inserting helicopter/tilt-rotor teams if the assets are available or dispersing dismounted teams from a rally point or points that are accessible by vehicle. The most constricting terrain requires the use of pack mules.

LOGISTICS

8-65. Mobility constraints affect not only the air defense teams but also their logistic support. Planners assess and anticipate that the limited ability for vehicles of vehicles to support resupply efforts are limited so they should and explore the use of helicopters, airdrops, and pack mules as alternatives to sustain the force. Creative resupply options, using gas station or tailgate logistics or a combination of the two, based on METT-TC, and space, and logistics are considered.

CUEING AND TACTICAL DEPLOYMENT

8-66. Compartmentalized terrain impacts air defense unit employment and receiving electronic early warning and cueing from ground-based radar assets. The terrain limits what ground-based radars see and limits communications with the identification/engagement authority, extending the amount of time to gain approval authority to prosecute a threat (kill chain). Air defense planners decentralize identification and engagement authority to the lowest level possible given rules of engagement and mission constraints and coordinate with airborne early warning platforms to maximize the amount of cueing teams receive.

SUPPRESSION OF ENEMY AIR DEFENSES AND AIR-TO-AIR PLANNING CONSIDERATIONS

8-67. Aircraft performance may be degraded when attacking surface-to-air threats in high altitude environments, since height above target affects fuzing and ordnance delivery. Geometry of attack and weather are also considerations in this environment. Detecting air-to-air threats, ground-controlled intercepts, and overall radar coverage is affected by mountainous terrain because of the numerous radar blind zones caused by the mountains. A good IPB can map these blind zones and limit these effects.

TRAINING CONSIDERATIONS

8-68. When preparing to operate in mountainous environments, air defense units focus their training efforts on the area of operations. Training includes mountain warfare training such as survival, first aid, rope skills, climbing, mountain communications, and mule packing. Depending on the area of operations, cold weather mountain training, to include cross-country and alpine skiing, is also appropriate.

Chapter 9
Communications

PLANNING CONSIDERATIONS

9-1. Brigade Combat Teams (BCTs) are rarely employed independently. They are more likely operating within a larger force or coalition. Every effort should be made to maintain the integrity of these organizations to maximize their inherent synergies, such as their robust joint interoperable communication network that enables operational adaptability of mission command system capabilities. The mountainous environment poses unique challenges when trying to employ communications equipment. The following are communications planning considerations:

- Widely distributed units, such as companies and platoons, will require the same communications capabilities and decision-making authorities that are traditionally found at battalion or higher levels.
- Units must develop core communications competencies with a variety of communications equipment and systems down to the lowest echelons of command possible.
- Commands must develop the leadership and decision-making skills of junior leaders.
- Mission command architectures require redundancy and must account for the effects of the operational environment.
- Installation time of communication nodes in mountainous areas can double, depending on the terrain and the weather.
- Mission command plans for communications nodes should accommodate expansion as more equipment and personnel arrive and more capability is required.
- The communications priority should be single-channel radio (SCR) and satellite communication (SATCOM), since they will be the primary mission command links for headquarters.

REQUIREMENTS IDENTIFICATION

9-2. Each organization has its own unique requirements for mission command. The mission, area of operations, terrain, and weather will dictate the radio nets, local area networks, and special purpose systems required. Expeditionary units coming from the sea will initially rely heavily on long haul wideband communications until mission command transitions ashore. Once ashore, networks will expand as more units and capabilities are added. Units expand their mission command network from one that relies primarily on tactical radios to one that consists of a combination of radios and local area networks. A fully implemented mission command architecture integrates four different types of communication and information networks known as the tactical data network. See Table 9-1 for communications planning requirements.

Table 9-1. Communications Planning Requirements

#	***Requirement***
1	Identify critical communications nodes and support requirements based on mission analysis
2	Identify requirements for each node (power, electronics, network connections, data, equipment, and personnel)
3	Determine capabilities and limitations of equipment, given terrain and weather
4	Develop plans to mitigate effects of terrain and weather
5	Develop various communication courses of action to support the concept of operations and provide for redundant capabilities by combining them if required
6	Estimate timelines for installing communications networks, including timelines for different insertion techniques in the event weather or terrain preclude the primary option
7	Submit satellite access, ground access, frequency, and equipment and personnel augmentation requests (situationally dependent from scratch) to higher and supporting headquarters and agencies as soon as possible
8	Inform the commander about courses of action that are not feasible without the assignment of additional personnel and equipment
9	Identify shortfalls and aspects of warfighting functions that cannot be supported from a mission command perspective

COMMUNICATIONS SYSTEMS COMPARISON

9-3. The following subparagraphs and Table 9-2 (see page 9-5) discuss methods of communications available for use and the advantages and limitations of each.

SINGLE-CHANNEL RADIO

9-4. The SCR equipment includes radios that operate in the high, very high, and ultrahigh (HF, VHF, UHF) frequency, and UHF tactical satellite (TACSAT) bands that can provide secure voice and limited data communications capability (transfer rates are limited by bandwidth constraints).

9-5. Retransmission of tactical communications is one of the most effective means of mitigating the deficiencies of VHF and UHF communications. As a result, retransmission requires focused and detailed planning. The following are planning considerations for employing retransmission teams:

- Survivability of retransmission teams relies on operations security, the proper use of cover and concealment, light and noise discipline, and planned mutual support due to their exposure to enemy and environmental threats.
- Teams should be emplaced at night just before operations and should be accompanied by a security element.
- Logistical requirements such as batteries, food, water, and all relevant classes of supply, should be anticipated.
- Mobile retransmission sites should be identified, reconnoitered, and validated prior to execution of operations when the operational environment allows it.
- Airborne retransmission and relay of critical nets help to overcome many of the challenges associated with ground retransmission but they can only be relied upon for short duration missions (some UASs can provide extended periods of coverage).
- Specially configured rotary-wing and fixed-wing aircraft can serve as robust mission command platforms with prior coordination.

HIGH FREQUENCY

9-6. Though HF communications support long-range communications, they work best when stationary and require more training than VHF or UHF radios. Newer HF radios, such as the PRC-150, TRC-209, or vehicle-mounted MRC-148, VRC-104, and PRC-155, use the third general automatic link establishment. They are a suitable stationary alternative to TACSAT radios but often take longer to set up and are not as effective on the move.

VERY HIGH FREQUENCY

9-7. The VHF radios are greatly affected by terrain masking and are limited to near-LOS or line-of-sight employment in mountainous terrain. A LOS study should be conducted as part of the intelligence preparation of the battlefield (IPB) in order to maximize the potential of VHF communications. This LOS study will help to determine positioning requirements, relay requirements, and antenna farm positioning. The most widely employed VHF tactical radio is the single-channel ground and airborne radio system family of radios.

ULTRAHIGH FREQUENCY

9-8. The UHF signals are absorbed by intervening terrain and are another form of LOS communications, however, UHF signals are not restricted to LOS and can bend somewhat over mountain tops. The Soldier Radio Waveform (SRW) is an applique that rides on the UHF spectrum supporting the Lower Tactical Internet (NETT Warrior Systems).

9-9. Measures to improve UHF communications in the mountains include:

- Select communications sites that have a narrow single mountain crest between them. Aim the transmissions at the highest peak. Keep the sites away from the mountain base.
- Deploy radios away from the mountain base to a distance at least equal to the distance of the slope between the base and mountain crest.
- Deploy radios to commanding heights to improve their LOS to the top of the intervening mountain.
- Deploy radios where they can communicate over a single mountain rather than a series of peaks and defiles.
- When confronted with a large, domed mountain, deploy the radios away from the base of the mountain and on high ground.

TACTICAL SATELLITE RADIO

9-10. The radio of choice in the mountains is the TACSAT, also known as SATCOM, radio. It combines mobility, flexibility, and ease of operation with unlimited range. The PRC-117, PRC-148, PRC-152, VRC-110, and VRC-111 are all capable of transmitting SATCOM, UHF, and VHF voice or data and are suitable for base or mobile communications in the mountains. Though flexible and reliable in the mountains, TACSAT radios are more susceptible to electronic warfare and interference, channels are usually limited, and the radios have limited capability to support data transfer.

COMMERCIAL SATELLITE TERMINALS

9-11. Commercial satellite terminals with appropriate communications security modules can be used to provide reliable worldwide voice and data communications. These devices provide a first-in, redundant, and amplifying capability to TACSAT or SCR.

SPECIAL PURPOSE SYSTEMS

9-12. Special purpose communications systems support specific functions, such as position location, navigation, and intelligence dissemination. There are many types of special purpose systems in the U.S. Army inventory and many more when operating as part of a joint task force. Soldiers must be able to employ these systems to leverage the significant capabilities they represent.

MULTICHANNEL RADIOS

9-13. Broadband multichannel radios (MUXs) use frequencies in the UHF, super high frequency, and extremely high frequency bands. The demands of operating along these frequency bands as well as performing multiplexing functions require complex and relatively large pieces of equipment. The MUX systems, therefore, have considerably more logistical and operating requirements than SCR systems. In addition, they have a requirement to transmit and receive a tightly-focused beam of radio energy, which is not practical for units on the move. For sustained operations in mountains, ground relay stations or "RIPER" nets can be established to relay large amounts of data. Planners should consider the following MUX characteristics:

- MUX equipment is limited to LOS and, in some cases, a very low takeoff angle.
- Compartmentalized, mountainous terrain will require more nodes and larger packages.
- Communications between MUX communications nodes will not be possible if there is intervening terrain between the nodes.
- MUX repeater sites can enable mission command in the mountains. Repeaters need to be placed near or on the top of ridges or peaks.
- Wind speeds on top of ridges and peaks often exceed the operational tolerances of MUX antennas, requiring the antennas be taken down during inclement weather.
- Satellite terminals, such as the Support Wide Area Network system and the Secure Mobile Anti-Jam Reliable Tactical Terminal, along with older systems, such as the TSC-85 and TSC-93, provide a method of switched connectivity in addition to MUX that often makes them preferred over MUX in a mountainous environment.

ENHANCED POSITION LOCATION REPORTING SYSTEM

9-14. Because it is a LOS UHF radio, the enhanced position location reporting system is best suited for flat terrain and a battlefield that is heavily populated with units. The system has limited use in dispersed rugged mountainous terrain as a position reporting system because of the LOS issues. Like any LOS system, it must have an unobstructed view to receive signals. A thorough terrain study and detailed planning is required to make enhanced position location reporting system work in mountainous terrain.

BLUE FORCE TRACKING

9-15. Blue force tracking and Joint Capabilities Release provide reliable data communications links for sending preformatted and free text messages. Because blue force tracking uses satellites vice ground radio relays, it is an ideal system for mountainous environments. Unlike the enhanced position location reporting system, which is limited by the LOS, blue force tracking provides continuous coverage despite the terrain and number of users on the battlefield. It provides a near real-time feed to the common operational picture and is a highly reliable means of text communication between dispersed units.

ANTENNAS AND GROUNDS

9-16. Directional antennas, both bidirectional and unidirectional, may be needed to increase range and maintain radio communications. Although easy to fabricate, directional antennas are less flexible and more time-consuming to set up. Positioning of all antennas is also crucial in the mountains because moving an antenna even a small distance can significantly affect reception.

9-17. Antenna icing, a common occurrence in cold weather and high elevations, significantly degrades communications. Ice may also make it difficult to extend or lower antennas, and the weight of ice buildup, combined with increased brittleness, may cause them to break. Antennas should have extra guy wires, supports and anchor stakes to strengthen them to withstand heavy ice and wind loading. All large horizontal antennas should be equipped with a system of counterweights arranged to slacken before wire or poles break from the excess pressures of ice or wind. Soldiers may be able to remove wet snow and sleet that freezes to antennas by jarring their supports, or by attaching a hose to the exhaust pipe of a vehicle and directing the hot air on the ice until it melts. However, Soldiers must exercise great care to ensure that the antenna is not damaged in their attempts to dislodge the ice.

9-18. Ground rods and guy wires are often difficult to drive into rocky and frozen earth. Mountain metal spike pitons are excellent anchors for antenna guys in this type of soil. In extreme cold, ropes can be frozen to the ground and guys tied to these anchor ropes. Adequate grounding is also difficult to obtain on frozen or rocky surfaces due to high electrical resistance. Where it is possible to install a grounding rod, it should be driven into the earth as deep as possible or through the ice on frozen lakes or rivers. Grounding in rocky soil may be improved by adding salt solutions to improve electrical flow.

CELL PHONES

9-19. The proliferation and common use of cell phones may provide opportunities to exploit operational security issues, particularly as relay towers and usage expand in the future.

AUDIO, VISUAL, AND PHYSICAL SIGNALS

9-20. Leaders can use simple audio signals, such as voice or whistles, to locally alert and warn. Sound travels farther in mountain air and this effect may increase the possibility of enemy detection. Interrupting terrain, wind conditions, and echoes can restrict voice and whistle commands to certain directions and uses.

9-21. Like audio signals, visual signals such as pyrotechnics and mirrors, have limited use due to enemy detection but may work for routine and emergency traffic at the right time and place. Blowing snow, haze, fog, and other atmospheric conditions may periodically affect range and reliability.

9-22. Luminous tape on the camouflage band, luminous marks on a compass, or flashlights may be used as signals at night over short distances. Infrared sources and receiving equipment such as night vision goggles, aiming lights, and infrared filters for flashlights, can be used to send and receive signals at night. However, an enemy outfitted with similar equipment can also detect active devices.

9-23. A tug system is a common method of signaling between members of a roped climbing team. However, tug systems are often unreliable when climbers are moving on a rope or when the distance is so great that the friction of the rope on the rock absorbs the signals. Separate tug lines can be installed in static positions by tying a string, cord, or wire from one position to the next. Soldiers can pass signals quietly and quickly between positions by pulling on the tug line in a prearranged code.

MESSENGER

9-24. Although slow, communication by messenger is frequently the only means available to units operating in the mountains. Messengers should be trained climbers, resourceful, familiar with mountain peculiarities, and able to carry their own existence load. During cold weather operations, advanced skiing skills may also be required. Messengers should always be dispatched in pairs. Air messenger service should be scheduled between units and integrated with the aerial resupply missions. Vehicles may also be employed to maintain messenger communications when conditions of time, terrain, and distance permit.

Table 9-2. Communications Systems Comparison

Communications Systems	***Advantages***	***Disadvantages***
High Frequency (HF)	HF radios support long-range communications	Works best when stationary Requires more training than VHF or UHF Affected by terrain masking
Very High Frequency (VHF)	Single-channel ground and airborne radio systems are highly capable tactical radios due to their built in communications security and electronic countermeasures capabilities	Greatly affected by terrain masking Limited to near LOS employment A LOS study will maximize the potential of VHF communications
Ultrahigh Frequency (UHF)	Not restricted to LOS and can bend somewhat over mountain tops	Absorbed by intervening terrain

Table 9-2. Communications Systems Comparison (continued)

Communications Systems	***Advantages***	***Disadvantages***
Tactical Satellite (TACSAT)	Some are small and lightweight Flexible and reliable	Geosynchronous satellite can be masked by mountainous terrain More susceptible to electronic warfare and interference Limited number of assigned satellites
Distributed Tactical Communications System (DTCS)	Small and lightweight Most are flexible and reliable DTCS radios provide position location Can send preformatted text messages Non-geosynchronous, low orbiting satellites are not masked by mountainous or urban terrain	Limited data transfer More susceptible to electronic warfare and interference
Enhanced Position Location Reporting System	Transmits position location	Because it is a LOS UHF radio, it is best suited for flat terrain and a battlefield that is heavily populated with units
Blue Force Tracking	Transmits position location by geosynchronous satellite Provides a reliable data communications link for sending preformatted and free text messages Satellite based, making it an ideal system for the mountains	Must have LOS to the geosynchronous satellite Vehicle mounted
Multichannel Radio (MUX)	Small and lightweight, broadband MUXs use frequencies in the UHF, SHF, and EHF bands	More logistical and operating requirements than SCR systems Communications between MUX communications nodes will not be possible if there is intervening terrain between the nodes
Audio, Visual, and Physical Signals	Does not rely on an electrical power Can be employed during dismounted movements May be the only form of communication available within line of sight in mountain operations	Subject to enemy detection Audio may be drowned out by competing noises Visual and physical signals may be obscured by fog, haze, or blowing snow Visual and physical signals difficult to see in limited visibility
Messenger	May be the only form of communication available beyond line of sight in mountain operations	Slow. Messengers must be dispatched in pairs.

Chapter 10

Training Considerations

MILITARY MOUNTAINEERING SKILL SETS

10-1. While there are some small differences in organization and equipment at the small unit level, the Army and Marine Corps need to have the same training standards and programs for mountainous environments in order to ensure a common understanding of capabilities and expectations. The high interaction and interoperability between the Army and Marine Corps in the operational environment adds additional importance to establishing common training standards and programs.

10-2. Individual and collective unit mountain and cold weather training is essential prior to conducting operations in these environments. Commanders will make every effort to maximize the training capabilities of the Army Mountain Warfare School (AMWS), the Northern Warfare Training Center (NWTC), and the MCMWTC in order to enhance the units' warfighting capability in these challenging environments.

10-3. The Army recognizes three levels of military mountaineering skill sets. Table10-1 highlights the method the Army's NWTC and AMWS use to train Soldiers for mountainous environments and build the requisite skill sets in units so an institutional memory can be maintained.

Table 10-1. Army Mountain Training Strategy

Recommended Individual Military Mountaineering Training Strategy				
Training Focus	Combat effects of the environment		Leverage environment against enemy	
Training Level	Base – Orientation	Level I – Basic	Level II – Advanced	Level III – Master
Course Title and Qualification	Mountain Warfare Orientation Course (No qualification)	Basic Military Mountaineer (SQI E)	Advanced Mountaineer (Assault Climber)	Mountain Leader (Certified Mountaineering Instructor)
Target Audience	All unit personnel	1-2 per platoon	2 per battalion	1 per brigade
Individual Capability	Basic mobility skills Basic understanding of the fundamentals for operating in a mountainous region	Basic technical skills Trains Soldiers and leaders in basic mobility skills Assists in planning mountain operations	Advanced technical skills Advisor to the battalion commander Unit trainer and planner of mountain sustainment training and operations	Advanced technical skills and experience Advisor to the brigade commander Unit trainer and planner of mountain sustainment training and operations
Training Time	4-5 days	15 days	15 days	2+ years

Table 10-1. Army Mountain Training Strategy (continued)

Recommended Individual Military Mountaineering Training Strategy				
Training Provider	AMWS NWTC Unit Military Mountaineer	AMWS NWTC	AMWS NWTC MCMWTC	Fully qualified current or former Military Mountaineering Instructor
Unit Operational Capability	Basic: Soldiers, planners, leaders trained capability built and applied		Advanced: Advanced technical skills capability built and applied	
Legend AMWS – Army Mountain Warfare School MCMWTC – Marine Corps Mountain Warfare Training Center NWTC – Northern Warfare Training Center SQI – Special Qualification Identifier				

LEVEL I BASIC MOUNTAINEER

10-4. The basic mountaineer, a graduate of a basic mountaineering course, should learn the fundamental travel and climbing skills necessary to move safely and efficiently in mountainous terrain. These Soldiers should be comfortable functioning in this environment and, under the supervision of qualified mountain leaders or assault climbers, can assist in the rigging and use of all basic rope installations. On technically difficult terrain, the basic mountaineer should be capable of performing duties as the "follower" or "second" on a roped climbing team and should be well trained in using all basic rope systems. They may provide limited assistance to personnel unskilled in mountaineering techniques. Particularly adept Soldiers may be selected to be members of special purpose teams led and supervised by mountain leaders or advanced mountaineers. At a minimum, basic mountaineers should possess the following mountain-specific knowledge and skills:

- Characteristics of the mountainous environment (summer and winter).
- Mountaineering safety.
- Individual cold weather clothing and equipment use, care, and packing.
- Basic mountaineering equipment care and use.
- Mountain bivouac techniques.
- Mountain communications.
- Mountain travel and walking techniques.
- Hazard recognition and route selection.
- Mountain navigation.
- Basic MEDEVAC.
- Rope management and knots.
- Natural anchors.
- Familiarization with artificial anchors.
- Belay and rappel techniques.
- Fixed ropes (lines) usage.
- Rock climbing fundamentals.
- Rope bridges and lowering systems.
- Individual movement on snow and ice.
- Mountain stream crossings (to include water survival techniques).
- First aid for mountain illnesses and injuries.

> ***NOTE***: Level I-qualified personnel should be identified and prepared to serve as assistant instructors to train unqualified personnel in basic mountaineering skills. All high-risk training must be conducted under the supervision of qualified level II or III personnel.

LEVEL II: ADVANCED MOUNTAINEER

10-5. Advanced mountaineers are responsible for the rigging, inspection, use, and operation of all basic rope systems. They are trained in additional rope management, knot tying, belay, rappel techniques, and the use of specialized mountaineering equipment. Advanced mountaineers are capable of rigging complex, multipoint anchors, and high-angle raising and lowering systems. Level II qualification is required to supervise all high-risk training associated with Level I. At a minimum, assault climbers should possess the following additional knowledge and skills:

- Using specialized mountaineering equipment.
- Performing multi-pitch climbing on rock.
- Leading on class 4 and 5 terrain.
- Conducting multi-pitch rappelling.
- Establishing and operating hauling systems.
- Establishing fixed ropes with or without intermediate anchors.
- Moving on moderate angle snow and ice.
- Establishing evacuation systems and performing high-angle rescue.

LEVEL III: MOUNTAIN LEADER

10-6. Mountain leaders possess all the skills of the advanced mountaineer and have extensive practical experience in a variety of mountainous environments in both winter and summer conditions. Level III mountaineers should have well developed hazard evaluation and safe route-finding skills over all types of mountainous terrain. Mountain leaders are best qualified to advise commanders on all aspects of mountain operations, particularly the preparation and leadership required to move units over technically difficult, hazardous, or exposed terrain. The mountain leader is the highest level of qualification and is the principle trainer for conducting mountain operations. Level III qualification is required to supervise all high-risk training associated with Level II. Instructor experience at a military mountain warfare training center or as a member of a special operations forces mountain team is critical to acquiring Level III qualification.

ADDITIONAL KNOWLEDGE AND SKILLS

10-7. At a minimum, mountain leaders should possess the following additional knowledge and skills:

- Preparing route, movement, bivouac, and risk management assessments.
- Recognizing and evaluating peculiar terrain, weather, and hazards.
- Performing avalanche hazard evaluation and mitigation.
- Organizing and leading avalanche rescue operations.
- Planning and supervising roped movement techniques on steep snow and ice.
- Conducting glacier travel and crevasse rescue.
- Conducting ski instruction.
- Planning and conducting ski borne patrols in class 3 and 4 terrain.
- Using winter shelters and survival techniques.
- Conducting multi-pitch climbing on mixed terrain (rock, snow, and ice).
- Leading units over technically difficult, hazardous, or exposed terrain in winter and summer conditions.
- Advising commanders and staff during planning on mountain warfare considerations across all warfighting functions.

NORTHERN WARFARE TRAINING CENTER

10-8. The Army NWTC is located at Fort Wainwright, Fairbanks, Alaska, and features the—

- Basic Military Mountaineer, 15 days.
- Assault Climber Course, 15 days.
- Cold Weather Orientation Course, four days.
- Cold Weather Leaders Course, 11 days.

ARMY MOUNTAIN WARFARE SCHOOL

10-9. The AMWS is located at Camp Ethan Allen, Jericho, Vermont, and features the—

- Basic Military Mountaineer, 14 days.
- Basic Military Mountaineer Winter Course, 14 days.
- Advanced Military Mountaineer, 14 days (basic is prerequisite).
- Mountain Rifleman (see Army Training Requirements and Resources System for more detail on course schedule and availability).
- Rough Terrain Evacuation (see Army Training Requirements and Resources System for more detail on course schedule and availability).
- Mountain Planners, seven days.

SPECIAL FORCES COMMAND MOUNTAINEERING WARFARE TRAINING DETACHMENT

10-10. This training is located at Ft. Carson, Colorado Springs, Colorado, and features the–

- Senior Mountaineering Course, six weeks.
- Master Mountaineering Course, three weeks.

MARINE CORPS MOUNTAIN WARFARE TRAINING CENTER

10-11. While the MCMWTC is focused on training Marines, individual Soldiers and Army units should be aware of the opportunities and type of training it provides. Training at MCMWTC is meant to be conducted prior to deploying to a mountainous and cold weather operational environment. Training replicates the high altitude, mountainous, and cold weather conditions associated with the operational environment. At the MCMWTC, training is conducted at both the individual and unit level. The individual training by formal school courses is considered an integral part of unit training and should be scheduled one to three months before unit training and deployment.

COLLECTIVE TRAINING

10-12. The established collective training exercise is called Mountain Exercise. It is designed and customized to train all elements of a MAGTF and is normally divided into phases of pre-environmental, basic mobility, and field exercise.

10-13. Situations will arise when units are deployed to a mountainous area of operations without prior training. The unit should use their mountain leaders to schedule, prepare, organize, and conduct in theater training. This usually takes two to three weeks and is accomplished concurrent with acclimatization. If the unit does not have mountain leaders, mobile training teams can be requested from MCMWTC. The suggested training is not meant to be all inclusive but rather it is a guide that commanders may use to develop a customized mountain warfare training package.

Phase 1: Pre-environmental Training

10-14. Pre-environmental training is conducted over three to five days, preferably before a unit deploys to a mountainous environment (upon initial arrival, if necessary). It includes individual entry-level training. This phase encompasses environmental considerations, hazards and mitigation, the use of specialized clothing and equipment, and historical lessons learned. Refresher training prior to any significant change in altitude, topography, and temperature is recommended. Formal school training is completed prior to or during this phase for necessary mountain/cold weather skill sets within the unit.

Phase II: Basic Mobility Training

10-15. This training is conducted over seven to eleven days at the operational altitude and climate. Emphasis is initially placed on survival, movement, and fighting skills, then environmental considerations for TTP are taught at the small unit and company levels. Units fire organic weapons and practice MOS skills in the environment. If required, phase II incorporates enhanced mobility training events. This training may include advanced mountain and over-the-snow mobility training, driver training, medical training, and animal packing.

Phase III: Marine Expeditionary Brigade/Marine Expeditionary Unit Field Exercise

10-16. This training is conducted over four to five days. The final phase is to exercise the entire MAGTF. The following exercises test MAGTF dispersed operations in complex, compartmentalized, mountainous terrain that replicates elevations and climates found in the operational environment:

- The command element tests its ability to effectively plan, command, and control the conduct of anticipated dispersed mission profiles across all elements of the MAGTF.
- Ground forces test their ability to shoot, move, and communicate.
- The aviation element conducts air missions; maintenance of aircraft; logistic support; LZ use at high altitude, on ridgelines, and in snow; and the establishment of FARPs.
- The logistics element tests its ability to provide support to the MAGTF that is focused on the use of aerial resupply, CASEVAC or MEDEVAC, and ground resupply over restricted terrain using animals or over-the-snow vehicles.

INDIVIDUAL TRAINING

10-17. Individuals may be specially trained for one or more of the functions discussed in the following subparagraphs. While the training is intended for Marines, Soldiers have attended these courses.

Tactical Rope Suspension Technicians

10-18. A tactical rope suspension technician (TRST) is a Marine trained in the skills necessary to establish all rope systems used in tactical operations. Skills include high tension rope installations, rappelling, water obstacle crossing, fixed ropes on steep earth, balance climbing, and top roping.

- A TRST can serve as a number two climber to the lead climber (assault climber).
- A TRST, who is an NCO or above, is certified as a rappel master to conduct rappelling operations on a tower.
- A TRST is the minimum certification for NCOs and above to conduct TRST training on vertical to near vertical terrain for rappelling, top roping, and fixed ropes.
- Two TRSTs per rifle squad are recommended.

Assault Climbers

10-19. An assault climber is a TRST-qualified Marine who receives additional training and is certified to lead climbs on vertical to near vertical terrain. Two per platoon (with six TRSTs) are recommended to enhance the vertical obstacle maneuver capabilities of the unit.

Scout Skier

10-20. Scout skiers are scouts and reconnaissance Marines who are trained and qualify as military skiers. They possess the skill to negotiate arduous snow-covered and avalanche-prone terrain on skis and are skilled in basic tracking/counter-tracking, avalanche assessment, and avoidance. Reconnaissance, scout snipers, and other designated scouts (one platoon per Rifle Company or one company per battalion) should receive this advanced, over-the-snow mobility training.

Mountain and Cold Weather Medical Training

10-21. Some corpsmen, doctors, and medics receive training in mountain, cold weather, and altitude-related environmental illnesses and casualty handling. Four per company are recommended for each seasonal skill set.

Animal Packing

10-22. Animal packers are trained to care for, pack, and lead pack animals through arduous and often inaccessible terrain in order to conduct resupply, transport crew-served weapons, and handle CASEVAC. Four per platoon are recommended.

Mountain Communicators

10-23. Mountain communicators are communications personnel who have been trained in radio communications in complex, compartmentalized, mountainous terrain. Four per company are recommended.

Mountain Scout Snipers

10-24. Mountain scout snipers are snipers who receive additional training in high-angle marksmanship, stalking, tracking, and counter-tracking in snow-covered and rock-covered terrain. These special skills are required in order to execute long-range reconnaissance and surveillance patrols in high altitude, complex, compartmentalized, and mountainous terrain. Four per scout sniper platoon are recommended.

Mountain Operations Staff Planners

10-25. These planners are staff personnel who have been specifically trained in the considerations for planning mountain warfare operations across the six warfighting functions and aviation planning using the Marine Corps Planning Process. This course is recommended for battalion level and higher staff planners.

Mountain Machine Gunners

10-26. These personnel are machine gunners who have learned TTP used in highly compartmented, mountainous terrain, both mounted and dismounted. Training includes machine gun employment in talus, deep snow, and ice; high-angle firing; defilade firing; and ridgeline and cross-compartment movement.

Summer Mountain Engineers

10-27. These personnel are combat engineers who have learned engineer operation TTP used in highly compartmented, mountainous, high altitude terrain. Training includes rigging, engineer reconnaissance, cave reconnaissance, counter-mobility, and survivability. Two per engineer platoon are recommended or the platoon itself can be trained as a unit/class.

Winter Mountain Engineers

10-28. These personnel are combat engineers who have learned engineer operation TTP used in highly compartmented, mountainous, high altitude terrain in a snow covered cold weather environment. Training includes engineer reconnaissance, snow/ice roads training, avalanche initiation, ice reconnaissance and breaching, counter-mobility, and survivability. Two per engineer platoon are recommended or the platoon itself can be trained as a unit/class.

Mountain Leader (Company Grade Officers and Staff Noncommissioned Officers)

10-29. The mountain leader's current training is divided by season. A completely trained mountain leader has attended both the summer and winter mountain leader courses. The summer trained mountain leader is a qualified TRST and an assault climber. He is also skilled in alpine movement and glacier travel. The winter mountain leader is a scout skier and certified as a military skier. He is skilled in all aspects of warfighting in a cold-weather and snow-covered environment. The primary role of the mountain leader is to train, advise, and plan company- and platoon-level dispersed operations in those parts of complex compartmentalized terrain that would otherwise be inaccessible to the unit commander. Mountain leaders have the knowledge and skills to operate in all types of mountainous terrain and weather conditions (high to very high altitude, wet to extreme cold, rock- and snow- and ice-covered slopes to vertical terrain). Recommendations are two per infantry company, two per scout sniper platoon, and three per reconnaissance company for a reconnaissance battalion.

NAVY SEA-AIR-LAND (SEAL) TEAM COLD WEATHER MARITIME COURSE

10-30. The SEAL team cold weather training is located at Kodiak, Alaska. It is a 28-day course covering basic cold weather survival, navigation and movements, and cold water training.

ARMY NATIONAL GUARD HIGH ALTITUDE AVIATION TRAINING

10-31. The Army National Guard High Altitude Aviation Training Site trains rotary-wing pilots in power management in mountainous terrain. The center is located in Gypsum, Colorado and is seven days long. Flying is conducted at elevations ranging from 1,981 to 4,267 meters (6,500 to 14,000 feet).

INTERAGENCY TRAINING

10-32. Department of State training with provisional reconstruction team counterinsurgency operations focuses on scenarios that show ways each agency can benefit the other’s mission.

COALITION TRAINING IN MOUNTAIN WARFARE

10-33. Coalition countries that are mountainous often have training courses but few are taught in English. These courses can expand the base of knowledge and experience of Soldiers but are not a substitute for standardized mountain warfare training. The language of instruction should be verified prior to training. Coalition exercises in mountainous terrain are the best means to mutually exchange TTP, such as–

- Slovenia: Slovenian Armed Forces Mountain Warfare School is a training opportunity for United States European Command and special operations forces units. The course mirrors AMWS courses and is 15 days long.

10-34. Exchange programs exist in mountain warfare that are concentrated on the northern North Atlantic Treaty Organization requirement (British, Dutch, and Norwegian). There may be additional training and subject matter expert exchange opportunities with other partner nations. The experience gained from these programs applies to all mountain warfare environments as well as interoperability.

TRAINING CHARTS

10-35. Tables 10-2 through 10-5 provide an abstract of available instruction by individual, collective, and aviation summer and cold weather training, certified and instructed by U.S. personnel.

Table 10-2. Summer Individual Mountain Training

Course Name	***Location***	***Duration***	***Level***	***Equivalent***
TRST	MCMWTC, SOTGs	15 days	1	Basic mountaineer
BMS	NWTC	15 days	1	Marine Corps TRST
BMS	AMWS	14 days	1	Marine Corps TRST
Assault climber (TRST is first 2 weeks)	MCMWTC, SOTGs	4 weeks	2	USA assault climber (summer)
Assault climber	NWTC	15 days (+BMS)	2	ACC
Assault climber, summer (prerequisite is BMS)	AMWS	14 days (+BMS)	2	ACC
Mountain leaders course (summer)	MCMWTC	6 weeks	3	USA basic mountaineer and assault climber (summer)
SF senior mountaineer	10th SF Group Instructor Cadre	6 weeks	2	TRST portion of SMLC
SF master mountaineering	10th SF Group Instructor Cadre	3 weeks	3	Alpine portion of SMLC
Mountain communications	MCMWTC	15 days	S	None
Animal packers	MCMWTC	18 days	S	10th SF Mountain Animal Packers Course
Mountain scout snipers	MCMWTC	17 days	S	None
Mountain operations staff planners	MCMWTC	8 days	S	None
Mountain medicine	MCMWTC	12 days	S	None
Summer mountain engineers	MCMWTC	21 days	S	None
Mountain machine gunners	MCMWTC	14 days	S	None

Legend
ACC – assault climber course
AMWS – Army Mountain Warfare School
BMS – basic mountaineer, summer
MCMWTC – Marine Corps Mountain Warfare Training Center
NWTC – Northern Warfare Training Center
S – supporting (specialized training for a certain MOS or unique skill)
SF – Special Forces
SMLC – Summer Mountain Leader Course
SOTG – Special Operations Training Group
TRST – tactical rope suspension technician
USA – United States Army

Table 10-3. Cold Weather/Mountain-Individual Training

Course Name	***Location***	***Duration***	***Level***	***Equivalent***
BMW	AMWS	14 days	1	Portion of WMLC
Assault climber, winter (prerequisite is BMW)	AMWS	14 days (+BMW)	2	Portion of SMLC
WMLC	MCMWTC	6 weeks	3	AMWS and NWTC basic mountaineer and assault climber, winter
Scout skier	MCMWTC	14 days	1	USA CW leaders
CW orientation	NWTC	4 days	1	PET
CW leaders	NWTC	13 days	S	Scout skiers
Winter mountain engineer	MCMWTC	21 days	S	None
CW medicine	MCMWTC	12 days	S	None
SEAL CW maritime	SEAL Detachment, Kodiak, AK	28 days	S	Portion of WMLC, maritime is unique

Legend
AMWS – Army Mountain Warfare School
BMW – basic mountaineer, winter
CW – cold weather
MCMWTC – Marine Corps Mountain Warfare Training Center
NWTC – Northern Warfare Training Center
PET – pre-environmental training
S – supporting (specialized training for a certain MOS or unique skill)
SEAL – sea -air-land team
SMLC – Summer Mountain Leader Course
USA – United States Army
WMLC – Winter Mountain Leader Course

Table 10-4. Marine Corps Mountain Collective Training

Course Name	***Location***	***Duration***	***Equivalent***
PET	MCMWTC	3 days	None
Basic mobility training	MCMWTC	9 days	None
Field exercise	MCMWTC	9-15 days	None

Legend
MCMWTC – Marine Corps Mountain Warfare Training Center
PET – pre-environmental training

Table 10-5. Mountain Aviation Training

Course Name	***Location***	***Duration***	***Equivalent***
Power Management Mountain Qualification	High Altitude Training Site	7 days	None

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Appendix A

Altitude and Environmental Hazards

HIGH ALTITUDE ILLNESSES

A-1. Operating in mountains stresses the human body. To become acclimated, the human body must go through physiological changes that will vary from person to person. Successful acclimatization depends on three factors:

- The degree of hypoxic stress (altitude).
- The rate of onset of hypoxic stress (ascent rate).
- Individual physiology (genetic differences between individuals).

A-2. The following subparagraphs discuss seven illnesses, and effects (see Table A-1. Altitude Effects), caused by high altitude.

ACUTE MOUNTAIN SICKNESS (AMS)

A-3. AMS is caused by ascending too rapidly to high altitude. Symptoms may include headache, nausea, vomiting, fatigue, irritability, insomnia, or dizziness. Symptoms generally appear four to 24 hours after ascent to high altitude, reaches peak severity in 24 to 48 hours, and subsides over three to seven days at the same altitude.

A-4. To treat AMS, stop further ascent and descend. Continuing an ascent puts individuals at risk for more severe high-altitude illnesses. Acetazolamide or dexamethasone may be used for the prevention of AMS. Aspirin, ibuprofen, or acetaminophen may be used to treat headaches and prochlorperazine, promethazine, or Alka-Seltzer may be used to treat nausea. Acetazolamide can also be administered to help speed up the acclimatization process, which, in turn, helps to relieve symptoms. The use of aspirin, ibuprofen, acetaminophen, or other nonsteroidal anti-inflammatory drugs for an AMS headache should be avoided or minimized during combat operations because of their detrimental effect on blood coagulation. AMS alone does not mean that descent is absolutely necessary. Stopping the ascent to rest and acclimatize to the same altitude will resolve AMS in three days or less (in most individuals) and may be the best option for mild cases. Medical therapy is crucial when descent is not possible. Use of any medication should be discussed with a physician prior to administration.

A-5. Once symptoms have gone away, troops can resume gradual ascent. Those who continue to show signs of AMS must be observed for development of high altitude pulmonary edema (HAPE) or high altitude cerebral edema (HACE), both of which could be fatal.

A-6. All troops are susceptible to high altitude illness. A staged or graded ascent that allows time for Soldiers to acclimate to altitude can help prevent AMS. Limiting operations to a lower altitude, can also prevent AMS. Leaders consider these factors when planning operations in mountainous terrain.

Table A-1. Altitude Effects Table

Altitude	*Approximate Elevation*	*Effects of Acute Altitude Exposure*
Low	Sea Level – 1,200 m (4,000 ft.)	None
Moderate	1,200–2,400 m (4,000–7,870 ft.)	Mild altitude illness and decreased performance may occur
High	2,400–4,000 m (7,870–13,125 ft.)	Altitude illness and performance decrements are more common and greater
Very High	4,000–5,500 m (13,125–18,000 ft.)	Altitude illness and decreased performance is the rule
Extreme	5,500 m (18,000 ft.) and higher	With acclimatization, humans can function for short periods of time
Legend ft. – feet m – meters		

HIGH ALTITUDE PULMONARY EDEMA

A-7. HAPE occurs when individuals ascend too rapidly to high altitude or ascend too rapidly from a high to a higher altitude. HAPE normally begins within 24 to 72 hours after rapid ascent to 2,438 meters (8,000 feet) or more. Symptoms include coughing, noisy breathing, wheezing, gurgling in the airway, difficulty breathing when at rest, and deteriorated behavioral status, such as confusion or vivid hallucinations. HAPE occurs in two to 15 percent of people brought rapidly to altitudes above 2,438 meters (8,000 feet).

A-8. Troops experiencing AMS who are not treated and continue to ascend to higher altitudes are at significant risk for HAPE. If untreated, HAPE can be fatal within six to 12 hours. It is the most common cause of death among altitude-related illnesses.

A-9. Preventive measures include to drink plenty of water, eat regular meals high in carbohydrates, staged and graded ascent, proper acclimatization, sleeping at the lowest altitude possible, avoiding cold exposure, and avoiding strenuous exertion until acclimated.

A-10. Immediate descent is the best treatment for HAPE. If available, a hyperbaric chamber, such as the Gamow Bag (a portable hyperbaric chamber weighing 14 pounds), can take a patient from 4,267 to 2,134 meters (14,000 to 7,000 feet) in four to six hours if evacuation to lower altitudes is not possible. Operated by a foot pump, the bag is pressurized to an internal pressure of two pounds per square inch.

HIGH ALTITUDE CEREBRAL EDEMA

A-11. HACE is the most severe illness associated with high altitudes. Individuals with HACE frequently have HAPE. As with other high altitude illnesses, onset of the cerebral edema is caused by ascending too rapidly without proper acclimatization. Troops experiencing AMS should be closely monitored for the development of pulmonary or cerebral edema and those who continue ascending are considered to be at high risk for onset.

A-12. In general, HACE occurs later than AMS or HAPE. If untreated, HACE can progress to coma in 12 hours and death within 24 hours. In some instances, death has occurred in less than 12 hours. The average onset time of symptoms following ascent is five days with a range of one to 13 days.

A-13. Symptoms of HACE often resemble AMS (severe headache, nausea, vomiting, and extreme lethargy). However, a more visible indicator of the onset of HACE is a swaying upper body, especially when walking. Early behavioral deterioration may include confusion, disorientation, and inability to speak coherently. Troops may appear withdrawn or demonstrate behavior generally associated with fatigue or anxiety.

A-14. Preventive measures for HACE are the same as for AMS and HAPE. Troops with symptoms of HACE should be evacuated immediately. Treatment of HACE is immediate descent at first sign of symptoms, such as swaying upper body and change in behavioral status. Decadron and oxygen are used to treat HACE. If available, a portable hyperbaric chamber (such as a Gamow Bag) can be used to stabilize patients if evacuation to lower altitudes is not possible, but should NOT be used as a substitute for descent. Portable hyperbaric chambers used for mountaineering are typically constructed as an air-impermeable bag that can be inflated to a pressure above that of the ambient atmosphere. A Soldier suffering from a severe altitude affliction can be placed on oxygen inside the chamber and then the chamber is pressurized to replicate a lower altitude. Use of a portable hyperbaric chamber should be supervised by a physician trained in high altitude medicine.

CAUTION

The preferred step in treating any high altitude illness is to evacuate affected individuals to a lower altitude. Under no circumstances should troops with severe AMS symptoms or suspected HAPE or HACE be allowed to continue their ascent.

HIGH ALTITUDE SYSTEMIC EDEMA

A-15. High altitude systemic edema is the swelling of tissue and joint discomfort that may occur due to rapid ascent. Persons with high altitude systemic edema may not exhibit any other symptoms of high altitude sickness.

HIGH ALTITUDE RETINAL HEMORRHAGING

A-16. High altitude retinal hemorrhaging only occurs at extremely high altitudes (almost always found above 4,572 meters or 15,000 feet). Signs can only be seen with an ophthalmoscope. Vision can be blurred in severe cases.

SUB-ACUTE MOUNTAIN SICKNESS

A-17. Sub-acute mountain sickness occurs in some troops during prolonged deployments (weeks to months) at elevations above 3,474 meters (11,400 feet). Symptoms include sleep disturbance, loss of appetite, weight loss, and fatigue. This condition reflects a failure to acclimate adequately.

POOR WOUND HEALING

A-18. Poor wound healing may occur at higher elevations and results from lowered immune functions. Injuries, such as burns or cuts, may require descent for effective treatment and healing.

ENVIRONMENTAL THREATS

A-19. The following subparagraphs address conditions that are not unique to mountainous environments but commonly occur at high elevations.

NON-BATTLE INJURIES

A-20. Exhaustion, dehydration, lower limb orthopedic injuries, lower back injuries, frostbite, diarrhea, malaria, and weight loss are the most common non-battle related injuries in the mountains. Hypoxia, an inadequacy in the oxygen reaching the body’s tissues, and cold can impair judgment and physical performance, resulting in a greater risk of injury while operating in rugged terrain.

COLD INJURIES

A-21. Once a Service member has acclimated to altitude, cold injuries are generally the greatest threat. Frequent mountain winds may prove dangerous due to wind chill effects. Because hypoxia-induced psychological effects can result in poor judgment and decision making, a higher incidence of cold injuries should be anticipated. Preventive measures for cold injuries include command emphasis on maintaining nutrition, drinking plenty of fluids, and dressing in layers.

HEAT INJURIES

A-22. Standard heat injuries, such as heat cramps, heat exhaustion, and heat stroke, can occur in the mountains. They occur during movements, especially upslope with heavy loads or at high altitude with heavy loads. Personal protection equipment can restrict evaporation of sweat (body cooling) and also cause heat injuries. Commanders need to balance the load, personal protection equipment, and pace with the altitude and degree of slope.

INJURIES CAUSED BY SUNLIGHT

A-23. The potential for solar radiation injuries caused by sunlight increases at high altitudes due to higher ultraviolet radiation in the thinner atmosphere and the reflection of light on snow and rock surfaces. Solar radiation injuries will occur with less exposure at high altitude than at low altitude and include sunburn and snow blindness.

Sunburn

A-24. Sunburn is more likely to occur on partly cloudy or overcast days when troops are unaware of the threat and fail to take appropriate precautions. Applying sun block (at least 15 SPF [sun protection factor]) to all exposed skin helps to prevent sunburn. Some medications, such as acetazolamide, increase the danger of sunburn.

Snow Blindness

A-25. Snow blindness results from ultraviolet light absorption by the external parts of the eyes, such as the eyelids and cornea. Initially, there is no sensation, other than brightness, as a warning that eye damage is occurring. Sunburn-like damage can occur in a matter of hours. Sunglasses or goggles with ultraviolet protection will prevent snow blindness. Sunglasses with side protectors are recommended. In the event of lost or damaged sunglasses, emergency goggles can be made by cutting slits in dark fabric or tape folded back onto itself.

A-26. Treatment for snow blindness includes covering the eyes with a dark cloth if the casualty is not needed to perform the mission. The cloth will prevent light from reaching the eyes and it will help to keep the casualty from moving his eyes, which could result in additional pain. A muslin bandage may be folded into a cravat and used to keep the cloth in place or the cravat may be used as a blindfold. Do not put ointment in the eye.

TERRAIN INJURIES

A-27. Troops should be aware of the dangers of high altitude, including snow avalanches and rock falls. Poor judgment at high altitude increases the risk of injury. The potential for being struck by lightning is also increased at higher altitudes, especially in areas above the tree line. Protective measures include taking shelter in solid-roofed structures or vehicles; laying in depressions, such as creek beds; and avoiding tall structures or large metal objects.

CARBON MONOXIDE POISONING

A-28. Carbon monoxide poisoning is a frequent hazard. Heavier than oxygen, carbon monoxide settles in the bottom of tents and enclosures. Tent ventilation should be at the lowest point in the tent to ensure carbon monoxide is able to escape. The following can lead to increased carbon monoxide levels:

- Inefficient fuel combustion.
- Combustion heaters and engines in enclosed, poorly ventilated spaces.
- Cigarette smoking.

A-29. Preventive measures include ensuring that troops do not sleep in vehicles with the engine running, ensuring heaters and stoves work properly, and ensuring tents have adequate ventilation.

INFECTIOUS DISEASES

A-30. Although there is generally a reduced threat of disease at higher elevations, troops should take precautions to avoid diseases caused by insects, plants, and animals and diseases transmitted from person to person.

A-31. At moderate to high altitudes, insect-borne disease (from mosquitoes, ticks, and flies) is common. In some areas, malaria-bearing mosquitoes live as high as 1,828 meters (6,000 feet). The threat of diseases transmitted from person to person is increased at higher cold climates because troops will spend more time inside tents and huddling to stay warm. Crowding and poor ventilation in tents and other shelters increase dissemination of respiratory infections. The influenza (flu) vaccination is a preventive measure.

HIGH ALTITUDE OPERATIONAL IMPACTS

A-32. The effects of altitude on the mind and body impact operations in several ways.

REDUCED PHYSICAL PERFORMANCE

A-33. Hypobaric hypoxia causes a reduction in physical performance. Troops cannot maintain the same physical performance at high altitude that they can at low altitude, regardless of their fitness level. Measures to prevent disease and injury include acclimatization, adjusting work rates and load carriage, planning frequent rests during work and exercise, and planning and performing physical training programs at high altitude.

PSYCHOLOGICAL EFFECTS

A-34. Altitude exposure may result in changes in vision, taste, mood, and personality. These effects are directly related to altitude and are common above 3,048 meters (10,000 feet). Some effects occur early and are temporary, while others may persist after acclimatization or even for a period of time after descent.

VISION

A-35. Vision is generally the sense most affected by altitude exposure. Dark adaptation is significantly reduced, affecting troops as low as 2,438 meters (7,900 feet) and can affect military operations at high altitude.

BEHAVIORAL EFFECTS

A-36. Behavioral effects are most noticeable at very high and extreme altitudes and they include decreased perception, memory, judgment, and attention. To compensate for loss of functional ability, leaders should allow extra time to accomplish tasks.

A-37. Alterations in mood and personality traits are common during high altitude exposure. Within hours of ascent, many troops may experience euphoria that is likely to be accompanied by errors in judgment that may lead to mistakes and accidents. Use of the buddy system during this early exposure time helps to identify troops who may be more severely affected. Troops may become irritable, quarrelsome, anxious, apathetic, or listless. These mood changes reach a peak after 18 to 24 hours of altitude exposure and recede to normal after 48 hours at altitudes up to 4,724 meters (15,400 feet). Building esprit de corps and unit cohesion before deployment and reinforcing them during deployment will help minimize the impact of mood swings.

SLEEP DISTURBANCES

A-38. High altitude can have significant effects on ability to sleep. The most prominent effects are frequent periods of apnea (a brief pause in breathing) and fragmented sleep. Sleep disturbances occur in everyone above 3,048 meters (10,000 feet).

A-39. Reports of “not being able to sleep” and being “awake half the night” are common and may also contribute to mood changes and daytime drowsiness. These effects have been reported at elevations as low as 1,524 meters (5,000 feet) and are very common at higher altitudes.

A-40. During cold weather operations, eating a snack before bedtime is also helpful. Snacking before bedtime will help keep Soldiers warmer during sleep, prevent shivering, and allow for sounder and more restful sleep. Ensuring adequate insulation when sleeping is also important as the body's core temperature decreases naturally during sleep.

A-41. Acetazolamide has been found to improve sleep quality at high altitudes and reduce AMS and other altitude illnesses. Sleeping pills and other medications that promote sleep or drowsiness should be taken only with medical supervision.

DEHYDRATION

A-42. Dehydration is a very common condition at high altitude. Perspiration, vomiting, decreased thirst sensation (hypoxia-induced), under-consumption of calories, and increased energy needs due to exertion increase the risk of dehydration. Routine activities and chores performed at high altitudes, even the common activities such as walking, require increased exertion.

A-43. Dehydration increases the likelihood of hot and cold weather injuries, altitude illness, and decreased physical capabilities. Many symptoms of dehydration and HACE are similar.

A-44. Troops can prevent dehydration at high altitudes by consuming at least three to four quarts of water (including water consumed in food) or other non-caffeinated fluids per day and six to eight quarts during cold weather. Individuals can drink a variety of fluids, such as juice or sports drinks, as each is an equally effective aid in rehydration. At high altitudes or cold weather, thirst is not an adequate warning of dehydration. Commanders must monitor troops to ensure they drink enough fluids and do not become dehydrated (see Technical Bulletin Medical 505 and 508 for more information).

NUTRITION

A-45. Poor nutrition contributes to illness or injury, decreased performance, poor morale, and susceptibility to cold injuries. Influences that impact nutrition at high elevations include a dulled taste sensation (making food undesirable), nausea, lack of energy, or lack of motivation to prepare or eat meals. Poor eating habits (lack of fruits and vegetables or eating only a few MRE ration components) and dehydration may also lead to constipation or aggravation of hemorrhoids.

A-46. Troops can reduce the effects of poor nutrition at high elevations by increasing their consumption rates. Rations should be supplemented and frequent snacking encouraged. High carbohydrate snacks are recommended since they are easily carried and require no preparation. Technical Bulletins Medical 505 and 508 also have more information on the importance of proper nutrition in the prevention of cold weather injuries.

TOXINS

A-47. Other products that can seriously impact military operations include tobacco, alcohol, and caffeine. Tobacco smoke interferes with oxygen delivery by reducing the blood's oxygen-carrying capacities. Tobacco smoke in close confined spaces increases the amounts of carbon monoxide. The irritant effect of tobacco smoke may produce a narrowing of airways that interferes with optimal air movement. Smoking can effectively raise the "physiological altitude" as much as several thousand feet. Alcohol impairs judgment and perception, depresses respiration, causes dehydration, and increases susceptibility to cold injury. Caffeine from coffee and other sources may improve physical and mental performance but it also causes increased urination (leading to dehydration) and should be consumed in moderation.

Appendix B

Mountain Weather Data

COLD WEATHER CATEGORIES

B-1. Cold weather temperature extremes are seasonally associated with most mountainous environments and almost always associated with high altitude. Because of the impact cold temperatures can have on personnel and equipment, it is important for military planners to understand the unique characteristics associated with operating in this type of weather. The Army divides cold weather temperatures into the five categories shown in Table B-1. The climatic definitions outlined in the following subsections generally describe the impact on operations. North Atlantic Treaty Organization (NATO) and U.S. forces are operational down to -40° F or lower.

Table B-1 Cold Temperature Categories

Cold Temperature Categories	
Wet Cold	+39° F to +20° F
Dry Cold	+19° F to -4° F
Intense Cold	-5° F to -25° F
Extreme Cold	26° F to -40° F
Hazardous Cold	below -40° F

WET COLD

B-2. Wet snow and rain often accompany wet cold conditions. This type of environment is often more dangerous to troops and equipment than the colder, dry cold environments because the ground becomes slushy and muddy and clothing and equipment become wet and damp. Because water conducts heat 25 times faster than air, core body temperatures can quickly drop if troops become wet and the wind is blowing. Troops can rapidly become casualties due to weather if not properly equipped, trained, and led. Wet cold environments combined with wind can be even more dangerous because of the wind's effect on the body's perceived temperature. Wet cold can quickly lead to hypothermia, frostbite, and trench foot. Wet cold conditions are not only found in mountainous environments but also in many other environments during seasonal transition periods. Under wet cold conditions, the ground alternates between freezing and thawing because the temperatures fluctuate above and below the freezing point. This makes planning problematic. For example, areas that are trafficable when frozen could become severely restricted if the ground thaws.

DRY COLD

B-3. Although temperatures are colder, dry cold conditions are easier to live in than wet cold conditions. Like wet cold, proper equipment, training, and leadership are critical to successful operations. Wind chill is a complicating factor in this type of cold. The dry cold environment is the easiest of the four cold weather categories in which to survive because of low humidity and constant frozen ground. As a result, people and equipment are not subject to the effects of the thawing and freezing cycle and precipitation is generally in the form of dry snow.

INTENSE COLD

B-4. Intense cold exists from -5° F to -25° F and can affect the mind as much as the body. Intense cold has a rapid numbing effect. Simple tasks take longer and require more effort than in warmer temperatures and the quality of work degrades as attention to detail diminishes. Clothing becomes more bulky to compensate for the cold, so troops lose dexterity. Commanders must consider these factors when planning operations and assigning tasks.

Extreme Cold

B-5. When temperatures fall below -25° F, the challenge of survival becomes paramount. During extreme cold conditions, it is easy for individuals to prioritize physical comfort above all else. Personnel may withdraw into themselves and adopt a cocoon-like existence. Leaders must expect and plan for weapons, vehicles, and munitions to fail in this environment. Most military equipment is tested and required to perform only at temperatures above -25° F. As in other categories, leadership, training, and specialized equipment is critical to operate successfully.

Hazardous Cold

B-6. Commanders and planners are warned that operations below -40° F are extremely hazardous. Units must be extensively trained before undertaking an operation in these temperature extremes. The defense is normally recommended in hazardous temperatures. Significant problems with weapons, equipment, clothing, and personnel will likely occur.

PRECIPITATION

B-7. Mountain precipitation is a result of several factors, the most important being humidity and air flow. It is important for military planners and leaders at all levels to understand the causes of precipitation in mountains and why precipitation rates vary. Precipitation results from cloud formations that, when accompanied by a drop in barometric pressure, are the best indicators of approaching adverse weather. Planners need to understand how clouds form and why precipitation occurs in order to predict mountain weather and its effect on operations.

Appendix C

Army Cold Weather Uniform and Equipment Posture

C-1. These tables are recommendations for temperature ranges Soldiers encounter in cold regions. This recommendation covers clothing, equipment, training, nutrition, shelter and heat sources, and other additional control measures. Table C-1 covers the temperatures ranging from 55° F (13º C) to 33° F (0º C).

> ***Note***. The use or mention of any commercial or private organization's name or trademark and the organization's services or funds by the Army does not express or imply an endorsement of the sponsor or its products and services by the Army.

Table C-1 Temperature Zone 1: 55° F (15° C) to 33° F (0° C)

<table>
<tr><th>Area of Consideration</th><th colspan="3">Special Requirements and Recommended Actions</th></tr>
<tr><td rowspan="5">Available Personal Clothing and Equipment</td><td>Clothing Layer</td><td>ECWCS Generation II</td><td>ECWCS Generation III</td></tr>
<tr><td>Base</td><td>• Lightweight polypropylene top and bottom and
• Mid-weight polypropylene top and bottom</td><td>• Lightweight cold weather undershirt and drawers and
• Mid-weight cold weather shirt/drawers</td></tr>
<tr><td>Insulating</td><td>• Shirt, cold weather, black fleece and
• Liner, cold weather, coat</td><td>• Green fleece jacket</td></tr>
<tr><td>Outer</td><td>• Generation II GORE-TEX® jacket
• Generation II GORE-TEX® trousers</td><td>• Wind cold weather jacket (wind shirt)
• Extreme cold/wet weather jacket (hard shell)
• Extreme cold/wet weather trousers (hard shell)</td></tr>
<tr><td colspan="3">Other
• Issued GORE-TEX® gloves with liners
• Issued wool socks with synthetic liner sock
• Temperate boots; cold weather boots recommended (Belleville 795, Danner Ft. Lewis 400g Tan Military Boots)
• Balaclava and neck gaiter
• Suspenders
• Knife
• Arctic necklace (lighter and lip balm worn around neck)</td></tr>
</table>

Table C-1 Temperature Zone 1: 55° F (15° C) to 33° F (0° C) (continued)

Area of Consideration	***Special Requirements and Recommended Actions***
Training	• Knowledge of mountain and cold weather environmental hazards • Knowledge of cold weather clothing capabilities and limitations • Skill to use cold weather clothing and equipment to provide protection from the elements • Skill to prevent, recognize, and treat cold injuries
Food and Water	• Meals ready to eat • One hot meal daily as mission dictates • 3.5–5 quarts of water per day • Water filter (recommend: first need portable water filter)
Shelter and Heat	• Patrol bag • GORE-TEX® bivouac cover • Sleeping mat • Poncho • Poncho liner (optional)
Additional Control Measures	• Water re-supply plan • Sanitation plan
Legend C – Celsius ECWCS – Extreme Cold Weather Clothing System F – Fahrenheit g – gram	

Table C-2 Temperature Zone 2: 32° F (0° C) to 14° F (-10° C)

<table>
<tr><th>Area of Consideration</th><th colspan="3">Special Requirements and Recommended Actions</th></tr>
<tr><td rowspan="5">Available Personal Clothing and Equipment</td><td>Clothing Layer</td><td>ECWCS Generation II</td><td>ECWCS Generation III</td></tr>
<tr><td>Base</td><td>• Polypropylene undershirt and drawers
• Drawers cold weather, polyester, brown lightweight undershirt and drawers</td><td>• Lightweight cold weather undershirt and drawers
• Mid-weight cold weather shirt/drawers</td></tr>
<tr><td>Insulating</td><td>• Shirt and overalls, cold weather, black fleece and
• Liner, cold weather, coat and trousers</td><td>• Green fleece jacket</td></tr>
<tr><td>Outer</td><td>• Generation II GORE-TEX® jacket
• Generation II GORE-TEX® trousers</td><td>• Wind cold weather jacket (wind shirt)
• Extreme cold/wet weather jacket (hard shell)
• Extreme cold/wet weather trousers (hard shell)
• Extreme cold weather parka (puffy Jacket)</td></tr>
<tr><td colspan="3">Other
• Issued GORE-TEX® gloves with liners
• Issued wool socks with synthetic liner sock
• Cold weather boots (Belleville 795, Danner Ft. Lewis 400g Tan Military Boots)
• Arctic necklace (lighter and lip balm worn around neck)
• Trigger finger mittens with extra trigger finger liners Suspenders
• Contact gloves
• Knife
• Balaclava and neck gaiter
• Ski goggles</td></tr>
<tr><td>Training</td><td colspan="3">• Northern Warfare Training Center Arctic Light Individual Training Program or similar program</td></tr>
<tr><td>Food and Water</td><td colspan="3">• Meal, cold weather (MCW) 1 bag = 1 meal which provides about 1500 calories
• 34 ounces of heated water are required to hydrate one MCW
• Two hot meals per day as mission dictates
• 3.5–5 quarts of water per day
• One stove per team to heat water for rations and melt snow for water</td></tr>
</table>

Table C-2 Temperature Zone 2: 32° F (0° C) to 14° F (-10° C) (continued)

Area of Consideration	***Special Requirements and Recommended Actions***	
Shelter and Heat	Individual: • MSS, all components • Sleeping mat, poncho and poncho liner	Squad: • Ahkio group complete (see Appendix B) • Arctic 10-man tent • Space heater arctic
Additional Control Measures	• Begin leader/medic checks for cold injuries; 2-3 times daily at minimum • Water re-supply and storage plan (to prevent water from freezing) • Sanitation plan • No skin camouflage below 32 °F (0 ºC)	• Contact gloves must be worn when working outdoors • POL gloves must be worn when working with fuel • Consider four-season, 2-4 man shelters for personnel that work away from support base
Legend C – Celsius ECWCS – Extreme Cold Weather Clothing System F – Fahrenheit g – gram MCW – meal, cold weather MSS – medium shelter systems POL – petroleum, oil, and lubricants		

Table C-3 Temperature Zone 3: 14° F (-10° C) to -19° F (-20° C)

<table>
<tr><th>Area of Consideration</th><th colspan="3">Special Requirements and Recommended Actions</th></tr>
<tr><td rowspan="5">Available Personal Clothing and Equipment</td><td>Clothing Layer</td><td>ECWCS Generation II</td><td>ECWCS Generation III</td></tr>
<tr><td>Base</td><td>• Polypropylene undershirt and drawers
• Drawers cold weather, polyester, brown lightweight undershirt and drawers</td><td>• Lightweight cold weather undershirt and drawers
• Mid-weight cold weather shirt/drawers</td></tr>
<tr><td>Insulating</td><td>• Shirt and overalls, cold weather, black fleece and
• Liner, cold weather, coat and trousers</td><td>• Green fleece jacket</td></tr>
<tr><td>Outer</td><td>• Generation II GORE-TEX® jacket and
• Generation II GORE-TEX® trousers</td><td>• Wind cold weather jacket (wind shirt)
• Soft shell cold weather jacket (soft shell)
• Soft shell cold weather trousers (soft shell)
• Extreme cold weather parka (puffy jacket)
• Extreme cold weather trousers</td></tr>
<tr><td colspan="3">Other:
• Suspenders
• Issued wool socks with synthetic liner sock
• Cold weather boots (Belleville 795, Danner Ft. Lewis 400g Tan Military Boot) for short duration outdoor work
• White vapor barrier boots
• Trigger finger mittens with extra TF liners
• Contact gloves
• Issued GORE-TEX® gloves with liners
• Balaclava and neck gaiter
• Arctic mittens
• Knife
• Arctic necklace (lighter and lip balm worn around neck)
• Ski goggles</td></tr>
<tr><td>Training</td><td colspan="3">Northern Warfare Training Center Arctic Light Individual Training Program or similar program</td></tr>
<tr><td>Food and Water</td><td colspan="3">• Meal, cold weather (MCW) 1 bag = 1 meal which provides about 1500 calories
• 34 ounces of heated water are required to hydrate one MCW
• Two hot meals per day as mission dictates
• 3.5–5 quarts of water per day
• One stove per team to heat water for rations and melt snow for water</td></tr>
</table>

Table C-3 Temperature Zone 3: 14° F (-10° C) to -19° F (-20° C) (continued)

Area of Consideration	***Special Requirements and Recommended Actions***	
Shelter and Heat	Individual: • MSS, all components • Sleeping mat, poncho and poncho liner	Squad: • Ahkio group complete (see Appendix B) • Arctic 10-man tent • Space heater arctic
Additional Control Measures	• Implement all control measures from Temperature zone 2 and change/add: • Increase frequency of leader/medic checks for cold injuries • Rotate Soldiers in static positions frequently	• Provide warm tents and vehicles for Soldiers • Provide four-season shelters for personnel that work away from support base
Legend C – Celsius ECWCS – Extreme Cold Weather Clothing System F – Fahrenheit g – gram MCW – meal, cold weather865 MSS – medium shelter systems		

Table C-4.Temperature Zone 4: -20° F to -40° F

Area of Consideration	***Special Requirements and Recommended Actions***		
Available Personal Clothing and Equipment	Clothing Layer	ECWCS Generation II	ECWCS Generation III
	Base	• Polypropylene undershirt and drawers • Drawers cold weather, polyester, brown lightweight undershirt and drawers	• Lightweight cold weather undershirt and drawers • Mid-weight cold weather shirt/drawers
	Insulating	• Shirt and overalls, cold weather, black fleece and • Liner, cold weather, coat and trousers	• Green fleece jacket
	Outer Shell	• Generation II GORE-TEX® jacket • Generation II GORE-TEX® trousers	• Wind cold weather jacket (wind shirt) • Soft shell cold weather jacket (soft shell) • Soft shell cold weather trousers (soft shell) • Extreme cold weather parka (puffy jacket) • Extreme cold weather trousers
	Other: • Suspenders • Issued wool socks with synthetic liner sock • Cold weather boots (Belleville 795, Danner Ft. Lewis 400g Tan Military Boot) for short duration outdoor work • Black or white vapor barrier boots in the field • Balaclava and neck gaiter	• Contact Gloves • Issued GORE-TEX® gloves with liners • Trigger finger mittens with extra TF liners • Arctic mittens • Knife • Arctic necklace (lighter and lip balm worn around neck) • Ski goggles	
Training	NWTC ALIT Program or similar program		
Food and Water	• Meal, cold weather (MCW) 1 bag = 1 meal which provides about 1500 calories • 34 ounces of heated water are required to hydrate one MCW • Two hot meals per day as mission dictates	• 3.5–5 quarts of water per day • One stove per team to heat water for rations and melt snow for water	

Table C-4.Temperature Zone 4: -20° F to -40° F (continued)

Area of Consideration	***Special Requirements and Recommended Actions***	
Shelter and Heat	Individual: • MSS, all components • Sleeping mat, poncho and poncho liner	Squad: • Ahkio group complete (see Appendix B) • Arctic 10-man tent • Space heater arctic
Additional Control Measures	• Implement all control measures from Temperature zone 3 and change/add: • Limit outdoor operations and training; closely scrutinize operations and training by leaders	• Perform hourly leader/medic checks for cold injuries • Recognize risk level is high • Cover all exposed skin • Avoid static duty
Legend ALIT – Arctic Light Individual Training ECWCS – Extreme Cold Weather Clothing System F – Fahrenheit g – gram MCW – meal, cold weather MSS – medium shelter systems NWTC – Northern Warfare Training Center		

Table C-5.Temperature Zone 5: Below -40º F (-40° C).

Area of Consideration	***Special Requirements and Recommended Actions***		
Available Personal Clothing and Equipment	Clothing Layer	ECWCS Generation II	ECWCS Generation III
	Base	• Polypropylene undershirt and drawers • Drawers cold weather, polyester, brown lightweight undershirt and drawers	• Lightweight cold weather undershirt and drawers and • Mid-weight cold weather shirt/drawers
	Insulating	• Shirt and overalls, cold weather, black fleece and • Liner, cold weather, coat and trousers	• Green fleece jacket
	Outer	• Generation II GORE-TEX® jacket • Generation II GORE-TEX® trousers	• Wind cold weather jacket (wind shirt) • Soft shell cold weather jacket (soft shell) • Soft shell cold weather trousers (soft shell) • Extreme cold weather parka (puffy jacket) • Extreme cold weather trousers
	Other • Suspenders • Issued wool socks with synthetic liner sock • Cold weather boots (Belleville 795, Danner Ft. Lewis 400g Tan Military Boot) for short duration outdoor work • Black or white vapor barrier boots in the field	• Contact gloves • Issued GORE-TEX® gloves with liners • Trigger finger mittens with extra TF liners • Arctic mittens • Knife • Arctic necklace (lighter and lip balm worn around neck) • Balaclava and neck gaiter	
Training	NWTC ALIT Program or similar program		
Food and Water	• Meal, cold weather (MCW) 1 bag = 1 meal which provides about 1,500 calories • 34 ounces of heated water are required to hydrate one MCW	• 3.5–5 quarts of water per day • Two hot meals per day as mission dictates • One stove per team to heat water for rations and melt snow for water	

Table C-5.Temperature Zone 5: Below -40º F (-40° C) (continued)

Area of Consideration	*Special Requirements and Recommended Actions*	
Shelter and Heat	Individual: • MSS, all components • sleeping mat, poncho and poncho liner	Squad: • Ahkio group complete (see Appendix B) • Arctic 10-man tent • Space heater arctic
Additional Control Measures	• Implement all control measures from Temperature zone 4 and change/add: • Recognize risk level is extremely high	• Limit outdoor operations and training to critical life support tasks only • Warm tents and vehicles for all personnel

Legend
ALIT – Arctic Light Individual Training
C – Celsius
ECWCS – Extreme Cold Weather Clothing System
F – Fahrenheit
g – gram
MCW – meal, cold weather
MSS – medium shelter systems
NWTC – Northern Warfare Training Center

Appendix D

Army Compatible Heaters and Tents

D-1. This appendix discusses the space heaters and tents used by military forces in mountain and cold weather environments. Fire teams working in a cold region of 32° F (0º C) and below should use a small stove such as the Mountain Safety Research (MSR) Whisperlite™ International or XGK EX. Both of these models of stoves are suitable for high altitude cold weather operation and are multi-fuel capable.

> ***Note***: The use or mention of any commercial or private organization's name or trademark and the organization's services or funds by the Army does not express or imply an endorsement of the sponsor or its products and services by the Army.

D-2. Table D-1 lists available space heaters for the mountain and cold weather environments. The table includes not only a picture of the space heater but a detailed description of its name, stock number, dimensions, weight, and output.

Table D-1 Heater Descriptions

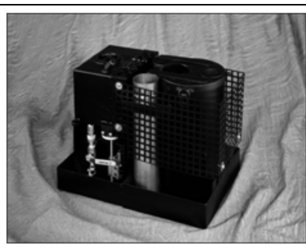
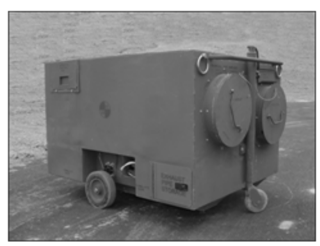
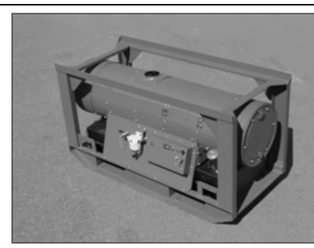
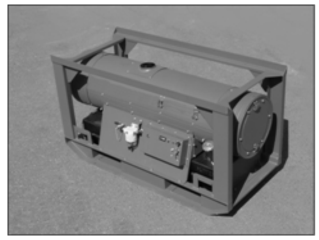
Item	***Description***	***Item***	***Description***
	Space Heater Small 4520-01-478-9207 16"L x 9"W x 14"H 32 pounds 12,000 BTU/Hr.		Heater, Tent (UH68ODH) PN 168325 30"L x 11"W x 24"H 125 pounds 60,000 BTU/Hr. 110 VAC, 450 Watts
	Space Heater Arctic 4520-01-444-2375 17"L x 9"W x 17"H 41 pounds 25,000 BTU/Hr.		Large Capacity Field Heater 4520-01-500-1534 62"L x 40"H x 44.5"W 622 pounds 400,000 BTU/Hr. Self-Powered, Diesel Engine
	H45 Space Heater 4520-01-329-3451 18" diameter x 24" H 65 pounds 45,000 BTU/Hr.		Multi-fuel Tent Heater (MTH150) PN 15000 56"L x 26"W x 31"H 200 pounds 120,000 BTU/Hr. 110 VAC, 12 amps

Table D-1 Heater Descriptions (continued)

Item	*Description*	*Item*	*Description*
	Space Heater Convective (SHC 35) 4520-01-431-8927 40"L x 14"W x 18"H 74 pounds 35,000 BTU/Hr. Self-Powered		CBRNE Multi-fuel Tent Heater (MTH150CP) PN 15000-1 56"L x 26"W x 31"H 200 pounds 120,000 BTU/Hr. 110 VAC, 12 amps
	Space Heater Convective (SHC 60) 4520-01-520-6477 44 ¾"L x 17"H x19"W 98 pounds 60,000 BTU/Hr. Self-Powered		MV60S-1 Space Heater PN 53457-1 51"L x 16.5"W x 25"H 115 pounds 60,000 BTU/Hr. 110VAC, 4.75 amps
	UH68G1 Space Heater 4520-01-203-4410 26"L x 22"H x 10"W 110 pounds 60,000 BTU/Hr. 110 VAC, 450 Watts		A20 Space Heater/CBH 4250-01-396-2826 27"L x 8"diameter 38 pounds 60,000 BTU/Hr. 24 VDC, 20 amps
Legend BTU – British Thermal United States Army H -- height Hr. – hour L – length PN – part number VAC – volt, alternating current W – width			

D-3. Tables D-2 and D-3 list the different shelters available. Table D-2 lists the smaller shelters whereas Table D-3 lists the larger shelters. These tables include the abbreviated name of each shelter, a brief description, and the floor dimensions. Tables D-4 and D-5 use the abbreviated names.

Table D-2 Shelter Specifications

Shelter Type	*Abbreviation*	*Floor Dimensions (total square feet)*
Soldier Crew Tent	SCT	10' x 10' 100 sq. ft.
Five Man Arctic	5 Man Arctic	8'9'' octagon 200 sq. ft.
Ten Man Arctic	10 man Arctic	17'6" x 17'6" 306 sq. ft.

Table D-2 Shelter Specifications (continued)

Shelter Type	*Abbreviation*	*Floor Dimensions (total square feet)*
Modular Command Post System	MCPS	11' x 11' 121 sq. ft.
Modular General Purpose Tent System, Medium	MGPTS Medium	36' x 18' 648 sq. ft.
Modular General Purpose Tent System, Small	MGPTS Small	18' x 18' 324 sq. ft.
Tent, General Purpose, Medium	GP Medium	32' x 16' 512 sq. ft.
Tent, General Purpose, Small	GP Small	17'6" x 17'6" 306 sq. ft.
Small Shelter System	SSS	20' x 32' 650 sq. ft.
Tent, Extendable Modular Personnel	TEMPER	32' x 20' 640 sq. ft.
Base-X Expeditionary Shelter	305	18' x 25' 450 sq. ft.
Legend ft. – feet sq. – square		

Table D-3 Large Shelter Specifications

Shelter Type	*Abbreviation*	*Floor Dimensions (total square feet)*
Modular General Purpose Tent System, Large	MGPTS Large	18' x 54' 972 sq. ft.
Medium Shelter System	MSS	52' x 29.5' 1500 sq. ft.
Lightweight Maintenance Enclosure	LME	32' x 25' 800 sq. ft.
Base-X Expeditionary Shelter	6D31 Dome	27' x 31' 615 sq. ft.
Legend ft. – feet sq. – square		

D-4. Table D-4 lists the heater types that heat the smaller shelter types. In the table, the number 1 means that one heater will suffice to heat that particular shelter. The number 2 means that two heaters are required to heat that particular shelter.

Table D-4 Heaters Needed By Small Shelters

Heater	*Shelter*									
	SCT	*5 and 10 Man Arctic*	*MCPS*	*MGPTS Small*	*MGPTS Small*	*GP Medium*	*GP Small*	*SSS*	*TEMPER*	*305*
Space Heater, Small	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table D-4 Heaters Needed by Small Shelters (continued)

Heater	*Shelter*									
	SCT	***5 and 10 Man Arctic***	***MCPS***	***MGPTS Small***	***MGPTS Small***	***GP Medium***	***GP Small***	***SSS***	***TEMPER***	***305***
Space Heater, Arctic	N/A	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
H45	N/A	N/A	2	1	N/A	2	N/A	2	2	1
SHC 35	N/A	N/A	1	1	N/A	2	1	2	2	1
SHC 60	N/A	N/A	1	1	N/A	1	1	1	1	1
UH68ODH	N/A	N/A	1	1	N/A	1	1	1	1	1
MV60S-1	N/A	N/A	1	1	N/A	1	1	1	1	1
MTH150	N/A	N/A	N/A	N/A	1	N/A	N/A	1	1	N/A
MTH150CP	N/A	N/A	N/A	N/A	1	N/A	N/A	1	1	N/A

Legend
SCT – Soldier Crew Tent
MCPS – Modular Command Post System
MGPTS – Modular General Purpose Tent System
GP – General Purpose
SSS – Small Shelter System

D-5. Larger shelters consist of tents, hard shelters, and vehicles. Table D-5 lists the heater types and compatibility with the larger and mobile shelter types.

Table D-5 Heaters Needed by Large Shelter

Heater	*Shelter*								
	MGPTS Large	***MSS***	***LME***	***6D31 Dome***	***CBRN***	***Expansible Van Body***	***Hard Wall Shelter***	***Cargo***	***Vehicle***
Large Capacity Field Heater	X	X	X	X	N/A	N/A	N/A	N/A	N/A
MTH150CP	X	X	X	X	X	N/A	N/A	N/A	N/A
A20/CBH	N/A	N/A	N/A	N/A	X	N/A	X	X	X
UH68G1	N/A	N/A	N/A	N/A	N/A	X	X	X	N/A

Legend
MGPTS – Modular General Purpose Tent System
MSS – Modular Sleep System
LME – Lightweight Maintenance Enclosure
CBRN – Chemical, Biological, Radiological, Nuclear

Appendix E
Military Mountaineering Equipment

ASSAULT CLIMBER TEAM KIT

E-1. The Assault Climber Team Kit is used by a trained three-person assault climber team in support of an infantry brigade combat team, infantry platoon. It contains mountaineering harnesses, chocks, and camming devices in a wide variety of sizes, locking and non-locking carabiners, dynamic climbing rope, webbing and accessory cord, ascenders, and belay devices. The NSN is 8465-01-604-6235.

HIGH ANGLE MOUNTAINEERING KIT

E-2. The High Angle Mountaineering Kit is used by a minimally-trained infantry brigade combat team, infantry platoon or similarly structured element of 40 personnel. It contains mountaineering harnesses, locking and non-locking carabiners, belay devices, static installation rope, webbing and accessory cord, a rope washer, and an electric rope cutter. The NSN is 8465-01-604-6325.

SNOW AND ICE MOBILITY KIT

E-3. The Snow and Ice Mobility Kit supports a minimally trained infantry brigade combat team, infantry platoon, or similarly structured element of 40 personnel. It contains snow and ice anchors, avalanche shovels and probes, ice axes, snowshoes, crampons, and avalanche transceivers to aid in locating personnel trapped underneath snow. The NSN is 8465-01-604-6077.

SQUAD MOUNTAIN LEADER KIT (SMLK)

E-4. The Squad Mountain Leader Kit supports a Special Forces mountain team of 12 personnel. It contains a large variety of equipment from the other kits as well as pitons, additional ice screws, and mountaineering pulleys. The NSN is 8465-01-604-6406.

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Glossary

SECTION I – ACRONYMS AND ABBREVIATIONS

AMS	acute mountain sickness
AMWS	Army Mountain Warfare School
BCT	brigade combat team
CAB	combat aviation brigade
CAS	close air support
CASEVAC	casualty evacuation
CDS	container delivery system
COP	combat outpost
FAC	forward air controller
FAC(A)	forward air controller (airborne)
FARP	forward arming and refueling point
FDC	fire direction center
FET	female engagement teams
FOB	forward operating base
FSR	first strike ration
GPS	Global Positioning System
HACE	high altitude cerebral edema
HAPE	high altitude pulmonary edema
HF	high frequency
IED	improvised explosive device
IPB	intelligence preparation of the battlefield/battlespace
ISB	intermediate staging base
JTAC	joint terminal attack controller
LAW	lubricating oil arctic-weapons
LNO	liaison officer
LOC	line of communications
LOS	line of sight
LZ	landing zone
MAGTF	Marine air-ground task force
MCMWTC	Marine Corps Mountain Warfare Training Center
MEDEVAC	medical evacuation
METT-TC	mission, enemy, terrain and weather, troops and support available, time available and civil considerations [mission variables] (Army)
MOS	military occupational specialty
MRE	meal, ready to eat
MSR	main supply route
MTSQ	mechanical time super quick
NCO	noncommissioned officer

NSN	national stock number
NTTP	Navy tactics, techniques, and procedures
NWTC	Northern Warfare Training Center
PZ	pickup zone
SATCOM	satellite communications
SCR	single-channel radio
SIGINT	signals intelligence
SUSV	small unit support vehicle
TACSAT	tactical satellite
TOE	table of organization and equipment
TRST	tactical rope suspension technician
TTP	tactics, techniques, and procedures
UAS	unmanned aircraft system
UHF	ultrahigh frequency
U.S.	United States
USASOC	United States Army Special Operations Command
VHF	very high frequency

SECTION II – TERMS

logistics

Planning and executing the movement and support of forces. It includes those aspects of military operations that deal with: design and development, acquisition, storage, movement, distribution, maintenance, evacuation and disposition of materiel, acquisition or construction, maintenance, operation, and disposition of facilities, and acquisition or furnishing of services. (ADP 4-0)

maneuver

(DOD) 1. A movement to place ships, aircraft, or land forces in a position of advantage over the enemy. 2. A tactical exercise carried out at sea, in the air, on the ground, or on a map in imitation of war. 3. The operation of a ship, aircraft, or vehicle, to cause it to perform desired movements. 4. Employment of forces in the operational area through movement in combination with fires to achieve a position of advantage in respect to the enemy. (JP 3 0)

stability operations

(DOD) An overarching term encompassing various military missions, tasks, and activities conducted outside the United States in coordination with other instruments of national power to maintain or reestablish a safe and secure environment, provide essential government services, emergency infrastructure reconstruction, and humanitarian relief. (JP 3-0)

tempo

The relative speed and rhythm of military operations over time with respect to the enemy. (ADRP 3-0)

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