Wilderness Search & Rescue Level I

Curriculum Manual

Revised – January 2014

Wilderness Search & Rescue – Level I

This edition of the Wilderness Search & Rescue – Level I course was prepared by the RESET technical rescue subcommittee. This committee compiled this curriculum between April 2013 and January 2014. This material was the work of the committee members with input from various sources including members of the Search and Rescue community in Central Texas with input from outside technical specialists.

Purpose

This curriculum is not meant to cover all methods acceptable for Wilderness SAR operations. The purpose is to standardize those methods taught during this course. All the learning material in this document is intended to cover the Knowledge, Skills, and Abilities (KSA) needed by Level I Wilderness SAR rescuers as defined by NFPA 1006.

Scope

The organization of the knowledge, skills and abilities (KSA's) within this curriculum is designed to follow the Job Performance Requirements (JPR) outlined by the National Fire Protection Association (NFPA) 1006 – Standard for Technical Rescuer Professional Qualifications 2014 edition. Standardized organization following NFPA 1006 is intended to allow the rescuer's training to be consistent with other emergency response organizations. Each JPR will be accomplished by using techniques specified in this curriculum and adopted by RESET as the authority having jurisdiction. RESET participating agencies include:

Austin Fire Department
Lake Travis Fire Rescue
San Marcos Fire Department
Pflugerville Fire Department
Austin/Travis County EMS
Cedar Park Fire Department
Westlake Fire Department
Oak Hill Fire Department
Pedernales Fire Department
Round Rock Fire Department
Willamson County EMS
George Town Fire Department
Leander Fire Department
Travis County Search & Rescue

Instructor Obligation
It is the responsibility of all instructors delivering any part of this curriculum to cover all of the learning material covered in the lesson plans. No instructor has the authority to delete, omit or otherwise leave out any content within the curriculum. Anyone assigned the task of covering any part of this curriculum should build his/her class in such a manner that optimizes instructor style while at the same time maximizing the learning for the students.

RESET Subcommittee Members
Stuart Heater
Mike Wofford
Casey England
Les Ward
John Marney
Ed Teran
DJ Walker
James Patterson

Wilderness Search & Rescue – Level I
Course Schedule

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Wilderness Search & Rescue – Level I

Class Title:
Wilderness Search & Rescue Response

NFPA 1006 JPR's:
16.1.1, 16.1.2 & 16.1.8

Time:
1 ½ Hours

Scheduling Suggestions:
First Session

Materials / Equipment Needed: N/A

Instructor Requirements:
1:15 Instructor to Student Ratio

Objectives:
At the end of this lesson the rescuer should be able to:

- Recognize the various types of Search & Rescue response
- Understand the need and procedures for Search & Rescue response
- Understand the interview witness process; in order to develop a subject profile
- Recognize the process for clue interpretation and documentation
- Recognize the need for specialized resources and their capabilities
- Understand the various Search & Rescue responsibilities

Course Overview

A Search & Rescue response encompasses a wide variety of topics with an equally wide array of skills and techniques. It would be impossible to effectively cover all of these in a single course, let alone gain proficiency in each. As such, this course offering has been limited to a specific response type and objective:

- Single Operational Period
  The skills and techniques presented in this course are best suited to the initial response within the first Search Operational Period (12 hours). If it is likely that the search will extend beyond such, it is strongly recommended that additional / specialized search resources are requested to assist in these efforts.

- Wilderness / Urban Interface Parks & Greenbelts
  A large and unrestricted search area greatly increases the scope and complexity of the search effort, even within the first Operational Period. As such, again, it would be recommended to request additional / specialized search resources to assist in such efforts.

However, while these 'limitations' are placed upon this course offering; every effort will be made to familiarize the students with the common search concepts and techniques in order to provide an introduction to these specialized fields.

Various Types of Search & Rescue

Search & Rescue (SAR) utilizes various acronyms; one such is 'L.A.S.T.' meaning to 'Locate, Access, Stabilize and Transport.' This principle serves as a foundation for Search & Rescue operations. This course will focus primarily upon the search (or 'Locate') portion of that foundation.

- Search (Locate) – is an emergency response operation utilizing the available personnel, equipment and facilities to locate persons in distress.
- Rescue (Access & Transport) – is an emergency response operation to retrieve persons in distress; providing for their initial medical needs and delivering them to a place of safety.
- Recovery – is an operation to retrieve persons whom are deceased.

Before we can discuss the specifics of Search & Rescue response, we should first introduce the various types of Search & Rescue incidents that may exist. While there is typically some overlap in each of these, the categorizations should assist in developing a better understanding of each:

Wilderness Search & Rescue (WSAR)

Wilderness SAR typically consists of a known number of missing persons within an unknown / undefined search area. For example; a single hunter (known number of subjects) does not return from his hunt (unknown / undefined hunting area).

Technically, a 'Wilderness Area' is defined as an uninhabited region devoid of any synthetic (man-made) amenities. However, this term is generically applied to the SAR criteria, as referenced above. Wilderness SAR will typically be redefined to include not only true 'wilderness areas;' but also urban interface parks, suburban neighborhoods, etc.

Note: this type of Search & Rescue response will be the main focus of this course.

Wide Area Search & Rescue

Wide Area SAR is a relatively new term, actually pioneered in Texas (TEEX / TX-TF1). Wide Area SAR typically consists of an unknown number of missing persons within an unknown / undefined Search Area. For example; Hurricane Katrina (the source of this category) impacted an unknown number of persons (requiring SAR assistance) across a large and undefined (no obvious boundaries) search area.

Urban Search & Rescue (USAR)

Urban SAR typically consists of an unknown number of missing persons within a known / defined Search Area. For example, the World Trade Center attacks impacted an unknown number of persons, yet were limited to known / specific geographic search area.

	Subjects	Search Area
Wilderness SAR	Known	Undefined
Wide Area SAR	Unknown	Undefined
Urban SAR	Unknown	Defined

Wilderness Search & Rescue Response

Now that we have established a basic understanding of the various Search & Rescue categories; we can begin discussing the specifics of the Wilderness Search & Rescue response and the knowledge, skills and abilities necessary for an effective and efficient response.

Need for Search & Rescue Response

Obviously, the first question becomes "What Happened." In the wilderness search response, typically this occurs when an individual (or group of individuals) is determined to be lost or missing; which may be caused by an array of possibilities, including:

- Wander Away – child, elderly, etc.
- Overdue – hiker, hunter, etc.
- Despondent – seeking solitude
- Crime Victim – involuntary

All of this to say, the wilderness search response begins upon notification to emergency responders of the missing person. Upon receipt of such notification, the emergency responders will initiate their various emergency response protocols.

Pre-Planning

However, in order to be prepared for a Search & Rescue response, efforts must begin well before a person is ever reported missing (as is common in all forms of emergency response). An effective Pre-Plan should be:

- Simple and easy to read, understand and update
- Flexible and adaptable to various situations
- Recognize the Authority Having Jurisdiction (AHJ)
- Establish a Response Plan

- Establish and maintain credentialing (training) requirements

An effective Pre-Plan can be brief or may be very detailed, containing such things as pre-determined Command Post locations, personnel, pre-positioned equipment, etc. Additionally, work may be focused upon "Pre-SAR" in an effort to minimize the 'Need for Search & Rescue Response.' For instance, by conducting an effective Vulnerability Assessment it may be possible to determine where persons are likely to go missing or have gone missing before. Then, working to minimize this risk; for example by improving trail markings.

Initiating the Search / Dispatch

Depending upon the Agency's specific Dispatch System protocols, the particulars of the dispatch process will vary. However, in all cases, once the subject has been reported missing emergency responders will receive dispatch notification. The information initially received, by the dispatchers, will assist in determining the initial search management approach (immediate search and/or additional investigation prior thereto). Any combination of the following resources, and others, may be dispatched in response:

- Law Enforcement
- Fire Department
- EMS
- Professional Volunteer SAR

The critical component is that dispatch promptly notifies and requests all appropriate resources. Or, that the initial responders promptly identify and request the additional resources that may be needed. As typical with all emergency response calls, limited information will be available upon dispatch. Provided the basic information is available (location, reporting party, event) the specific details can be determined upon on-scene arrival.

Lost vs. Missing

Technically, there is a distinction between 'Lost' (unintentional unknown location) vs. 'Missing' (intentionally 'concealed' location). But, for purposes of this course, these distinctions are of little significance and will be used interchangeably.

However, it should be stated that there is a significant and important difference between lost / missing disappearance and that of criminal evasion. This course is strictly limited to search responses NOT knowingly involving search for a criminal assailant. While many of these same techniques may apply, that type of search should be strictly limited to properly trained and equipped Law Enforcement personnel.

Initial Search Planning

"Search is an Emergency"

One of the first actions is to begin obtaining information regarding the missing subject and the circumstances surrounding their disappearance. This effort begins immediately upon notification, prior to on-scene arrival, and continues throughout the entire search effort. Primarily, this is the function of Search Management (which is beyond the scope of this course), but the general concepts should be understood by all Search Team Members. The process of Information Gathering will lead to the creation of a Subject Profile and a Search Plan / Incident Action Plan (IAP).

Information Gathering

This process works to obtain ALL data that may be useful in locating the missing subject. This is a continual and on-going process, but initially only the most pertinent data is needed:

- Who is Missing? Name, age, physical description, etc.
- What Happened?
- Potential Clues? Clothing, equipment, etc.

However, as the search continues to progress; increasingly more information and more specifics should be obtained from various sources including family, friends, witnesses, etc. Yet, it should be noted that all information obtained must be 'filtered' in order to ascertain what information is actionable intelligence as opposed to simply extraneous information.

Interview

"Search is the Classic Mystery"

Though Law Enforcement will often conduct witness, it is important that all searchers are familiar with the various techniques; as participation may be helpful in obtaining search specific information. So, while effective interview skills take much experience and practice, a few main points and questions can guide any interviewer:

- Ask open ended questions – allow the interviewee to 'tell their story,' avoid narrow and/or leading questions.
- Watch for subtleties – significant information can be obtained by carefully listening to the response; potentially gleaning critical information from seemingly irrelevant.
- Maintain open and continuous communication – remain available for the interviewee to provide additional information / thoughts at any time.

Additionally, given the composition of the interview process varied information may be obtained. Many times, it is advantageous to interview persons individually; in order to ensure each person reports 'their story' as opposed to the collective agreement. However, following these initial independent interviews it may be beneficial to 're-interview' the persons as part of a small collective group.

The interview process is one step in the Information Gathering process; it is not the time to 'filter' the information and/or to make judgments on how to utilize such information / intelligence, this time will come later. Further, this information is one of the first 'clues' discovered in the search response. As will be reinforced throughout this course, documentation of any / all potential clues is critical. Some of the information gathered in the interview process may seem irrelevant and extraneous, however as the search develops such may become highly valuable and would have been lost had such not been documented.

Lost Person Questionnaire

In order to assist in the interview process, it is recommended that a standard reporting form be utilized. The "Lost Person Questionnaire (ICS 302)" is a readily available and detailed form that serves as a guide for the collection and documentation of the most pertinent data regarding the missing subject(s). Utilization of such form will serve to guide in development of a better Subject Profile than discovered in the initial steps of Information Gathering. This form works to obtain such data as:

- Subject(s) name and/or 'nicknames'
- Physical description – age, gender, race, etc. (Is a photograph available?)
- Medical status – mobility, illnesses, mental / emotional, medications, etc.
- Clothing description – including footwear (tracking)

- Physical possessions – phone, wallet, candy, etc. (possible clues)
- Communications – is the subject able / likely to communicate (respond), language, etc.
- Has this ever happened before? What was the result?
- Places they may have gone? Family, friend, favorite spot, etc.
- Reporting Party – contact information and relationship to the missing subject

Reference the end of this lesson for a copy of the Lost Person Questionnaire form.

Subject Profile
The Subject Profile is a composite 'picture' of both the missing subject and the circumstances of their disappearance as determined by the various pieces of gathered information. In addition to the information gathered, the subject profile also includes information from various search statistics (Lost Person Behavior), planning data, etc. as compiled by the Search Managers.

Development of the Subject Profile begins to 'filter' all of the information previously obtained. However, caution should be stated to not 'underestimate' the capabilities of the missing person. It is common for people to underestimate the abilities of both the young and the old; which could result in inaccurate limitations of the determined search area, techniques, etc.

Lost Person Behavior
Lost Person Behavior is the scientific study of the statistical behavior of various lost persons and their respective 'behavioral categories.' This data provides statistical probabilities for the behavior and likely travel distances of the missing individuals. By utilizing such information, both Search Managers and searchers are better able to focus their efforts.

Search Managers utilize this data in order to create and prioritize search segments; then deploying the most appropriate resources. Searchers utilize this data to guide them on specifically where / how to search given their assignment. Additional information regarding this topic will be provided later in this course.

Search Urgency
While we have previously established that "Search is an Emergency," but not all 'emergencies' are created equally. Simply put, a potential 'rescue' is of more urgency than that of a 'recovery.' But, even within 'rescues,' there remain various degrees of urgency. Determining the Search Urgency takes a variety of factors into consideration, as summarized in the diagram below:

- Number of Subjects – fewer subjects are higher Urgency
- Age of Subject – very young and very old are higher Urgency
- Medical Condition – known medical would be higher Urgency
- Subject Punctuality – time reliable people are higher Urgency
- Circumstances – higher risk would be higher Urgency
- Experience – less experience would be higher Urgency
- Physical Condition – unfit would be higher Urgency
- Clothing – insufficient would be higher Urgency
- Weather – existing or impending hazard would be higher Urgency
- Terrain / Hazards – known hazards would be higher Urgency
- Equipment – inadequate would be higher Urgency

Each of these categories is awarded a 'score,' between 1 and 4, with 1 being the most Urgent. The resulting combined score determines the Search Urgency, with the lower the score indicating the higher Search Urgency.

By utilizing this form, we are able to quantify the adage:

- "Risk a Lot . . . to Save a Lot"
  It may be reasonable to accept a higher level of risk if there is a reasonable expectation of rescue, that would not otherwise be accomplished.
- "Risk a Little . . . to Save a Little"
  Or, put another way, "don't get someone hurt in an unlikely rescue attempt or recovery."
- Rescue vs. Recovery

Reference the end of this lesson for a copy of the Search Urgency form.

Initial On-Scene Response

"Actions taken during the initial report, the callout of resources, and the first hour or two of on-scene activities will often determine the ultimate outcome of the search," MLPI.
Upon receiving the search dispatch, personnel begin their activation and mobilization to the scene where they will employ the search tactics covered later in the course. In addition to these search tactics some key factors should be considered and addressed to improve the likelihood of a successful outcome.

Site Control and Scene Management
Given the large scale and vast acreage involved in a search operation, conventional site control (complete exclusion of all civilians) is typically not a realistic objective. However, it is still necessary to create some degree of Site Control; in order to minimize interference, clue creation / destruction, etc. Site Control may be limited to isolating the Command Post and other critical Operational Facilities; thereby helping to isolate the searchers from the media, family and/or other civilians.

Safe management of the scene requires maintaining accountability of all resources. As such, it is imperative that procedures are instituted to facilitate an easy and effective 'check-in / check-out' procedure for all personnel and other resources. These procedures could be as simple as a 'sign-in' sheets, accountability tags, etc.

Scene Size-up and Safety
Scene size-up begins immediately upon initial approach to the scene. By carefully observing the area, the Search responder is able to gain a general understanding of not only safe zones and escape routes, but also the common terrain and vegetation. Additionally, upon arrival on-scene, the responder should quickly determine the location of the Command Post and other Operational Facilities, as these will guide their initial steps towards accountability, briefing and assignment.

Situational Awareness should be maintained by all responders in order to promote safety for both themselves and their team members. Safety is achieved by maintaining a clear and concise decision making process; one acronym to assist is such is S.T.O.P.:

- S – Stop – stop / cease your current actions
- T – Think – once stopped, no begin thinking of various options
- O – Observe – observe the various options available
- P – Plan – having thought about the options observed; determine and execute a Plan

Potential hazards exist within the wilderness Search & Rescue environment. Search responders should be aware of both the common hazards and any specific known hazards at the particular incident. This awareness is beneficial in helping to both identify and mitigate such risk. Some of the common wilderness search hazards would include:

- Terrain
- Vegetation
- Wildlife
- Weather / exposure
- People – preventing property access, weapons, etc.

Communications is a vital component of any emergency response; not only as a means to report clues and observations, but primarily for maintaining Searcher safety and accountability. An effective Communications Plan should be understood by each searcher, such should include both a primary and a secondary communication options.

Search Assignment

To this point, all discussion has been on 'preparing' to conduct an actual field search assignment. Whereas, specific search tactics will be discussed later in the course, this portion will introduce some of the common expectations for this portion of the Search & Rescue response; as experienced by the typical ground search personnel.

Briefings – General & Tactical

Upon creation of the Subject Profile and Search Plan, Search Management will typically conduct a General Briefing of all available search resources. This briefing will serve to summarize, for the individual searchers, the pertinent information as determined by Search Management. Such, information will then be utilized by the searchers to guide their search efforts.

The various search personnel will be subdivided into Search Squads. Each squad will then be given a Tactical Briefing where their particular assignment, objectives and expectations are conveyed by Search Management. Typically, the expectation for a Search Squad is to conduct the most effective and efficient search within the limits of their given assignment.

Clue Interpretation

During the course of field search various clues may be discovered, while clue specifics will be discussed later in the course; a few key points should be noted now. Within reason, it is not the responsibility of the field searcher to determine the relevance of a discovered 'clue.' The field Searchers may not have access to the 'full picture' of the search and/or such 'picture' may further develop throughout the search. That being said, if a particular item is obviously unrelated (for example, an extremely aged piece of clothing on a short time missing person search) such should be recorded, but not highlighted as a critical clue. Yet, it is imperative that all potential clues are properly handled and documented:

- Minimize handling / disturbance of any clues
- Thoroughly document all clues – location, photograph, etc.
- Protect and/or mark all clues for possible collection

Debriefings

Search resources should remember that they are the **"eyes in the field"** for Search Management. As such, it is critical that ALL search activities are carefully documented and reported back to

Search Management, as soon as possible. Ideally the given assignment / search segment was completed, however it is more important to accurately record what was and was not accomplished. Additionally, while obviously finding the lost person is the ultimate goal, it is just as important to document if nothing was discovered. Debriefings should include, at a minimum the following information:

- What / where did the Team actually Search?
- What areas were not Searched? Why? Hazards?
- What was / was not found?

A lack of clues can provide just as valuable of information as does the presence of such clues.

Search & Rescue Resources

Search & Rescue response is a specialized type of emergency response that encompasses a large variety of response characteristics. As such, an effective response should involve preparations and familiarity with the various tools that may be utilized to positively impact the search outcome.

Wilderness SAR Limitations

Due to the unique nature of wilderness SAR response, certain limitations of a typical emergency response should be addressed. These limitations necessitate flexibility and adjustment within the Emergency Response Plan.

Conventional Emergency Response vs. Specialized SAR Response

Conventional Emergency Response provides ready access both to and from established man-made infrastructure; i.e. roads, buildings, vehicles, etc. As a result, personnel and equipment can be 'easily' accessed, rehabilitated, rotated, etc. Further specialized vehicles and/or extended hikes are not commonly necessary to access the emergency response scene.

However, given the potential variety of search scenes, there could be a considerable distance between the physical infrastructure and the primary response area. As such, vehicular access may be limited or excluded, thereby necessitating either specialized vehicles and/or long hikes. In addition to the limitations of access, responders should be flexible to alternative solutions; including such items as communications, rehabilitation, documentation, etc.

While conventional emergency response provides beneficial contribution to a wilderness SAR response, careful consideration should be given to the appropriate utilization of such. The objective should remain to provide an increased benefit, to the search response, not an increased burden.

Specialized Medical Care

Conventional emergency response typically provides virtually immediate access to advanced medical care, transportation and hospital admission. However, in the austere wilderness environment, it may be a considerable amount of time simply to provide certified (EMT, Paramedic, etc.) medical care to the patient. Then, given the limitations of physical access, medical treatment and evacuation (transport) may be protracted. Such evacuation may necessitate extraordinary efforts; such as litter carries, helicopter transport, etc. Medics must be prepared to provide medical care for an extended period of time; stabilization (patient comfort) and ongoing monitoring will be of critical importance.

Recognizing Team / Responder Limitations
Limitations exist not only between conventional and specialized emergency response, but also within the limitations of specific agencies and personnel. Recognition of these limitations is important to ensure both a safe and successful outcome. Given the remote nature of the wilderness area direct access and/or evacuation may not be readily available. As such, it is of greater importance that each searcher is well prepared and capable of responding in such environments. A portion of this preparedness includes the importance of maintaining one's own physical fitness, in order to be able to care for both themselves and the missing person.

Additionally, it may not be readily possible to rotate and rehabilitate individual responders, squads or teams. Therefore, each should be prepared to maintain self-sufficiency for a minimum of 24 hours, which will be discussed later in the course. This would include not only maintaining preparations at the Command Post, but also ensuring appropriate equipment to maintain positions within the field.

Searcher Fatigue
It is typical for searchers to be given multiple search assignments with only short rehabilitation breaks in between. Searcher fatigue can occur in as little as 4-6 hours of search time; thereby significantly reducing not only the search effectiveness but also the potential safety of the searchers. Search fatigue can be combatted by maintaining one's physical and mental health, but is most effectively minimized with a positive search attitude.

"The missing person IS IN my search segment and I WILL FIND THEM"

Specialized SAR Resources

We previously introduced the limitations between conventional emergency response resources and that of specialized SAR resources. We will now discuss some of the various specialized SAR resources that may be available to participate in a Search & Rescue operation. It is beneficial if all search responders understand the potential benefits and limitations of these resources in order to be able to most effectively work with such in the field.

While most of these specialized SAR resources can provide a considerable benefit to the search operation. It is strongly recommended that coordination and joint training with such be conducted prior to the search response. This will facilitate increased familiarity and a working knowledge between the various resources and personnel.

Aircraft
Aircraft can have a significant and beneficial impact on the search response, if properly utilized. Such benefits may include search observation, transportation, etc.

- Fixed Wing – Airplanes
  Airplanes typically have a longer available flight time and can travel at higher speeds. As such, they can be beneficial for long range transportation, assisting communications (high altitude repeater), etc. While they can be used for physical search applications, this usage may be limited due to the increased speed and reduced maneuverability of the aircraft.

- Rotary Wing - Helicopter

Helicopters typically do not have the extended flight time and/or speeds as that of fixed wing aircraft. However, their decreased speeds and increased maneuverability serve to provide different benefits. Helicopters can be effectively utilized not only for physical search, but additionally for general reconnaissance and observation. Helicopters may be able to land directly on-scene, thereby facilitating transportation of various resources and/or the missing subject. Additionally, some helicopters may be equipped with hoist capabilities which serve to increase their rescue abilities by reducing / eliminating the need to land directly on-scene.

- Unmanned Aerial Vehicles ("Drones")
  While this is a relatively new and emerging usage of this technology, it is anticipated that such will have a significant and beneficial impact. These aircraft may be able to provide much of the same aerial search capabilities as that of helicopters (due to their limited speed and highly increased maneuverability), at a significantly lower cost. However, much additional work will be needed prior to the large-scale integration; in large part due to the changing FAA regulations currently under review.

Watercraft

Watercraft can be utilized not only for search, but also to support and facilitate rescue access. There is a large variety of watercraft types; but we will focus generically upon two types, rigid hull and inflatable hull. As with all specialized resources, responders should be familiar with the particular risks of watercraft. While these specifics are beyond the scope of this course, proper training and equipment (PFDs) should be utilized at all times.

- Rigid Hull
  These watercraft provide a stable base capable of supporting larger loads (weight capacity). This watercraft is ideally suited for use in flat water environments, due to the decreased maneuverability. Additionally, the rigid hull makes the watercraft more resilient and protected against damage.

- Inflatable Hull
  While these watercraft are not a stable as rigid hull, they make-up for such through their increased maneuverability, thereby making them ideally suited for operations in swift water environments.

Vehicles – 4x4, ATV / UTV, etc.

As with both aircraft and watercraft, there is a large variety of vehicular resources that may be utilized in support of search & rescue operations. However, each of these requires an additional level of training and attention to safety. Care should be taken to utilize these vehicles within the parameters of their capabilities and to not place them in a position where they cannot be safely and effectively utilized, thereby become an increased hazard to the operation.

Communications

We have previously addressed the importance of communications within the search response, but we should also keep in mind the various methods of communication that may be available / that may be needed. The primary function of communication tools is to facilitate the clear and concise conveyance of important information. There are various tools to assist in this effort; including hand signals, whistles, notes, radios, phones, etc. As each tool has its own benefits and

limitations, there is no 'perfect' solution; as such effective responders should have familiarity with the various options and a flexible plan to change to suit the particular need.

Personal Protective Equipment
Personal Protective Equipment (PPE) is the necessary equipment used to provide protection to each individual search responder. PPE is unique to the specific environment and response; but minimally includes appropriate clothing (pants, boots, etc.), safety equipment (glasses, leather gloves, helmets, etc.). Attention should be given to the appropriate selection and implementation of such equipment; taking into consideration such items as potential heat stress, decontamination needs, etc.

Emergent Volunteers
An emergent volunteer is an unaffiliated individual whom either calls to offer assistance or arrives at an emergency response scene without official request. While typically readily available, these individuals are commonly untrained. As such, ANY utilization of such individuals should be weighed with extreme caution.

Professional Volunteer Search & Rescue
Professional Volunteer Search & Rescue Teams can provide a significant benefit to most all Search & Rescue operations. These individuals and teams train continuously in order to maintain their preparedness for these unique emergency response operations. Given the willingness of most of these teams to travel great distances, the majority of the area is serviced, however response time limitations may occur due to proximity. While most all of the Professional Volunteer SAR Teams strive to serve their communities in the most beneficial means, various means to accomplish such may be utilized. As such, it is strongly recommended that the various agencies take the time to become familiar with and participate in joint training sessions prior to real-world Search operations.

These Professional Volunteer SAR Teams serve to <u>enhance and supplement your Operation</u> and provide increased / specialized capabilities; they do not 'take over.' Listed below are some of the resources that your local Professional Volunteer Search & Rescue Team may be able to provide:

- Search Management
  The skills associated with Search Management go well beyond simple ICS Command and Control. During this course we will touch on some of the terminology, search theory, etc. associated with search. However, it is its effective implementation into actual search operations that makes this a valuable and significant resource. Additional training and experience, specific to Search Management, is necessary to provide organization to the search effort in order to maximize the effectiveness and efficiency of such. Lastly, effective Search Management will produce thorough and complete documentation of all stages of the Search & Rescue operation.

- Ground Search Personnel
  Specifically, these are the skills being taught in this course; Professional Volunteer Search & Rescue Teams are composed of individuals whom have already obtained this knowledge, skills and abilities. As this is the primary focus of those individuals, these skills are routinely practiced and maintained at a high level of proficiency. As a result, this resource provides not only additional '<u>eyes in the field</u>,' but personnel whom are highly trained and experienced in working these types of operations.

'Man Trackers' are highly experienced and detail oriented searchers who may be able to further supplement the search effort. These individuals are able to focus on minute clues in order to assist in determining the path and direction of travel for the missing subject.

- Canine Search

  Most emergency responders are generally familiar with the use of canines in Search & Rescue operations. As this is an extensive topic, we will not attempt to cover all points in detail, but rather will introduce a few major categories and address some common points of confusion. While canine search is not the perfect solution in all cases, commonly it is a significant 'force multiplier' in the effectiveness and efficiency of Search operations.

  Live Wilderness Search

  Live Wilderness Search canines search for any person(s) located downwind of their position, or within their assigned search segment. They routinely work large land areas and follow airborne scent to locate the missing subject. It is not necessary that the first search is conducted with the canine, the canine resource can 'sort through' prior search efforts and focus simply upon the missing individual. Additionally, it is possible for the canines to work simultaneously with other searchers in the field. However, all prior and simultaneous search activities should be communicated with search management and the canine handler. It is possible for the search canine to effectively search an area in a fraction of the time as would be required by a ground search team alone.

  Human Remains (Cadaver) Detection (HRD)

  HRD canines are trained to locate deceased people and/or the remains thereof. As dead animals are common within all wilderness areas, these canines are trained to ignore these distractions and identify only signs of deceased persons. In addition to ground based search, these canines can be utilized in water / boat based searches to assist in locating drowned victims; thereby significantly limiting the 'target area' for the recovery divers.

  Tracking / Trailing

  Technically, there is a difference in these two skill sets, but we will not worry about such for the purposes of this discussion. Fundamentally, these canines utilize a scent article (preferably collected by the canine handler) of the missing individual. These canines will begin at a 'known starting point' for the missing subject and work to follow the subject's path. By doing such, they are highly beneficial in determining the subject's direction of travel, thereby significantly limiting the potential size of the Search Area. While it is ideal that the 'starting point' and other tracks not be contaminated, it is not absolutely necessary that prior searchers avoid such; the canine can work through such distractions.

  Disaster

  Disaster canine search can encompass both live and HRD search, depending upon the specific need and the canine utilized. This resource can serve to limit the disaster exposure to other personnel by limiting the extent of physical search that would be required. Disaster search would include not only collapsed buildings, but also post fire search (as was done following the Bastrop Wildfires) and other unstable areas with limited accessibility.

- Special Operations

This category would include items such as Technical Rope Rescue, Swiftwater Rescue and Cave SAR. While these resources may be readily available within many fire departments, they are not available in all jurisdictions. Additionally, by providing these resources 'in-house' the Professional Volunteer Search & Rescue Team is able to provide additional search capabilities, through increased access, to locations that may otherwise have been inaccessible. Lastly, as with all other SAR resources, Special Operations can serve to simply support the operation of the Authority Having Jurisdiction (AHJ).

Search & Rescue Responsibilities

In the last section, the concept of Authority Having Jurisdiction (AHJ) was briefly mentioned. Simply put, this is the agency having legal responsibility for the Search & Rescue operation. While most emergency responders are familiar with this concept, they may not be familiar with the legal responsibilities and means for 'escalation' of such within Search & Rescue operations.

The "State of Texas Emergency Management Plan, Annex R – Search & Rescue," revised March 2013, outlines the specific details for control of Search & Rescue operations within the state. As with all forms of emergency response, Search & Rescue should be handled at the lowest level capable of mitigating the issue.

Local Response

"Local governments have the primary responsibility for initial Search & Rescue (SAR) operations." Specifically, this authority actually falls directly to the local County Sheriff. While agreements and local response protocols may distribute the responsibility to other law enforcement agencies and/or fire departments, ultimately / legally it is the Sheriff's responsibility. It may seem that this has little impact upon our actual operations, but it becomes critically important as the incident expands beyond the capabilities of the local responders and escalation becomes necessary.

Regional Response

"State assistance to local governments begins at the Disaster District Committee (DDC) level." The DDC Chairman is a local Texas Highway Patrol Commander, regional resource requests must be elevated through the DDC by a County Judge.

State Response

State Search & Rescue response is managed by the Texas Department of Emergency Management (TDEM), specifically Emergency Support Function 9 (ESF #9). As mentioned above, the State SAR Plan, Annex R outlines the specifics of this agreement; but simply put ground search operations become the responsibility of TEEX / TX-TF1.

National / Federal Response

Federal Search & Rescue response is the responsibility of FEMA, specifically the Federal Emergency Management Agency under the U.S. Department of Homeland Security. FEMA has a variety of resources available, most familiar are the twenty-eight (28) USAR Task Forces.

We have not yet begun to address the various nuances associated with the responsibilities associated with Search & Rescue response, nor the multitude of mutual aid venues that may be available. The important thing to know is that there are always additional resources available to

assist in most any search response. For instance, the U.S. Air Force can provide support for search operations through the Air Force Resource Coordination Center (AFRCC). However, there are specific methods required to request such resources; as such, it is recommended that search responders become familiar with such avenues prior to the immediate on-scene need for such.

"The missing person IS IN my search segment and I WILL FIND THEM"

MISSING PERSON QUESTIONNAIRE	TASK #	DATE PREPARED: TIME PREPARED:	PAGE # 1 OF 3
TASK NAME:		REVISED (DATE/TIME):	
SUBJECT # ___ OF ___	INTERVIEWED BY (PLANNING):		POLICE FILE #

INFORMANT IDENTIFICATION				
FIRST NAME:		STREET ADDRESS:		
LAST NAME:		CITY:		
RELATIONSHIP TO SUBJECT:		PROVINCE:	POSTAL CODE:	
HOME PHONE #:		ALT. PHONE #		
ADDITIONAL INFORMANTS/ WITNESSES	NAME:	NAME:	NAME:	
	PHONE:	PHONE:	PHONE:	

SUBJECT INFORMATION				
FIRST NAME:		STREET ADDRESS:		
MIDDLE NAME:		CITY:		
LAST NAME:		PROVINCE:	POSTAL CODE:	
ANSWERS TO:		HOME PHONE #:		
VEHICLE MAKE:		EMPLOYER:		
VEHICLE MODEL:		STREET ADDRESS:		
VEHICLE COLOUR:		CITY:		
LICENSE PLATE #:		PROVINCE:	POSTAL CODE:	
COMMENTS (e.g. **'CODE' NAME IF CHILD**):		WORK PHONE # :		
		WORK FAX #:		
		SUPERVISOR'S NAME:		
DATE OF BIRTH (Y/M/D):	AGE:	SEX:	HEIGHT:	WEIGHT:
HAIR COLOUR:	EYES:	HAIRSTYLE/LENGTH:		
COMPLEXION:		FIRST LANGUAGE:		
DISTINGUISHING MARKS:				
MEDICAL DISABILITIES:				
MEDICATION REQUIREMENTS/QTY ON HAND/DURATION OF SUPPLIES:				
RECENT/CURRENT ILLNESS(ES):				
FITNESS LEVEL:		SMOKER (Y)	BRAND:	**ICS 302**

MISSING PERSON QUESTIONNAIRE (CONT.)	PAGE # 2 OF 3

ALLERGIES:

FEARS/PHOBIAS:

MENTAL ATTITUDE:

FINANCIAL SITUATION:

CRIMINAL HISTORY:

HOBBIES/INTERESTS:

CLOTHING/EQUIPMENT

SHOE TYPE:	COLOUR:	SIZE:

SHOE SOLE DESCRIPTION:

SOCKS:	PANTS (TYPE & COLOUR):

TOP (TYPE & COLOUR):	SWEATER (TYPE & COLOUR):

JACKET (TYPE & COLOUR):

RAINGEAR (TYPE & COLOUR):

HAT (TYPE & COLOUR):	GLOVES (TYPE & COLOUR):

PACK (MAKE & COLOUR):

FOOD & DRINK (TYPE/BRAND/QUANTITY):

POINT LAST SEEN

DATE LAST SEEN:	TIME LAST SEEN:

POINT LAST SEEN:

MAP # GRID REF:

MISSING PERSON QUESTIONNAIRE (CONT.)	PAGE # 3 OF 3

NAME OF OTHER PERSON(S) WHO SAW OR MIGHT HAVE SEEN THE SUBJECT AT OR NEAR THIS TIME:	#	NAME OF INFORMANT	LOCATION SUBJECT SEEN	TIME SEEN
	1			
	2			
	3			
	4			
	5			

LOCATION OF VEHICLE (TRANSPORTATION):

INTENDED ROUTE:

WEATHER AT TIME LAST SEEN:

COMMENTS (DISPOSITION/PERSONALITY, RELATIONSHIP WITH SPOUSE/FAMILY/FRIENDS ETC.):

SUBJECT NEXT OF KIN			
FIRST NAME:		STREET ADDRESS:	
LAST NAME:		CITY:	
RELATIONSHIP TO SUBJECT:		PROVINCE:	POSTAL CODE:
HOME PHONE #:		ALT. PHONE #	
ADDITIONAL INFORMANTS/ FRIENDS	NAME:	NAME:	NAME:
	PHONE:	PHONE:	PHONE:
AVAILABILITY OF PHOTOGRAPH(S) ?			

Date:_____
Time:_____

SEARCH URGENCY CHART

Remember that the lower the number the more urgent the response

A. NUMBER OF SUBJECTS

1 Person ---------- 1
2 People ---------- 2
3 or more ---------- 3
(Unless separation suspected)

B. AGE

Very young ---------- 1
Other ---------- 2-4
Very old ---------- 1

_____ → _____ → _____

C. MEDICAL CONDITION

Known illness requiring medication ---------- 1
Suspected illness or injury ---------- 2
Healthy ---------- 3
Known fatality ---------- 4
Potential vision impairment ---------- 1

_____

D. TIME

Reliable, punctual, *(being late is out of character)* ---------- 1
Usually reliable, on time ---------- 2
Reliability, punctuality questionable ---------- 3
Completely unreliable ---------- 4

_____

E. CIRCUMSTANCES

At risk for any reason ---------- 1
Adequate information, low risk ---------- 2
Questionable information ---------- 3
High probability not in the area ---------- 4

_____

F. EXPERIENCE PROFILE

Not experienced, not familiar with the area ---------- 1
Not experienced, knows the area ---------- 2
Experienced, not familiar with area ---------- 3
Experienced, knows the area ---------- 4

_____

G. PHYSICAL CONDITION

Unfit ---------- 1
Fit ---------- 2
Very fit ---------- 3

H. CLOTHING PROFILE

Inadequate or insufficient - 1
Adequate ---------- 2
Very good ---------- 3

_____ → _____ → _____

I. WEATHER PROFILE

Existing hazardous weather ---------- 1
Hazardous forecast (8 *hours or less)* ---------- 2
Hazardous forecast (more *than 8 hours)* ---------- 3
No hazardous weather forecast ---------- 4

_____

J. TERRAIN & HAZARDOUS PROFILE

Known hazards ---------- 1
Difficult terrain ---------- 2
Few hazards ---------- 3
Easy terrain, no known hazards ---------- 4

_____

K. EQUIPMENT PROFILE

Inadequate for activity/environment ---------- 1
Questionable ---------- 2
Adequate ---------- 3
Very well equipped ---------- 4

_____

If any of the eleven categories are rated as (1), regardless of the total, the search may require an immediate response.

10-15	16-27	28-41
URGENT RESPONSE	MEASURED RESPONSE	EVA;UATE AND INVESTIGATE

TOTAL _____

**** The total should range between 11 and 41 with 11 indicating the greatest urgency.****

Wilderness Search & Rescue – Level I

Class Title:
Land Navigation

NFPA 1006 JPR's:
16.1.4

Time:
3 ½ Hours

Scheduling Suggestions:
Prior to Navigation field session

Materials / Equipment Needed:
- Compass
- Topographic Maps
- Grid Reader
- GPS Units

Instructor Requirements:
1:15 Instructor to Student Ratio

Objectives:
At the end of this lesson the rescuer should be able to:
- Recognize basic map & compass navigational skills
- Recognize basic GPS navigational skills
- Demonstrate ability to both plot and read USNG coordinates on a topographic map

Course Overview

An emergency responder must possess many different skills and abilities to effectively respond to Search & Rescue incidents; one of the most critical being navigation. Because, ultimately, as searchers we are entering into an area where someone has become lost; without effective navigation the same can happen to each of us. Furthermore, to be successful in locating the lost individual, but then being unable to locate yourself to call for rescue and/or evacuation, is of little value.

Even in today's technological world, with GPS cell smart phones; it remains important to learn and practice the basics of map and compass navigation. At a minimum, these skills provide a foundation to efficiently implement more advanced means of navigation, including both GPS units and cell phones.

Introduction to Maps

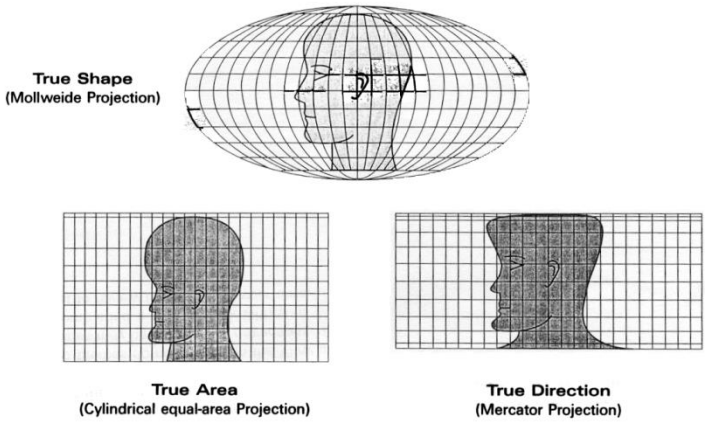
Both maps and compasses are foundational tools for the navigator and must be used in conjunction with one another, but we will begin with maps. Without maps, the navigator is unable to relate their position and/or their compass information to the real-world. This section will provide an introduction to maps and develop a familiarity thereto.

Definition of a Map

A map is a scaled representation of another object, in this case, the earth's surface. It is typically displayed on a flat surface. A map shows both natural and artificial (man-made) features. Primarily a map is used as a form of communication, a scaled reference to accurately convey land (natural) and artificial (man-made) features. However, be warned, a map is only accurate at the time of its creation.

Map Projections

Since a map is a flat representation of a round object (the earth's surface) some distortion (warping) will exist between the real world and the mapped image. There are many different types of map projections; we will not take the time to go into each of these. But, the most common projections result in severe distortion towards the poles (top / bottom of the earth); as such it has little actual impact upon our maps and use thereof.



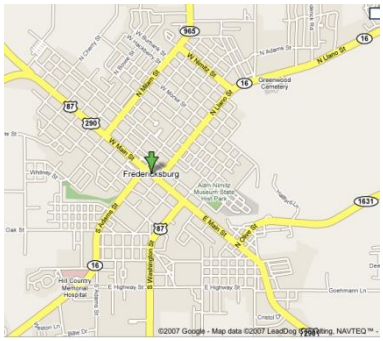
For example; imagine the 'distortion' that would result from attempting to wrap a flat piece of paper around a basketball.

Different Types of Maps

There are a variety of different types of maps, each with their own advantages and disadvantages. We will discuss the most commonly used types and provide observations related to their integration into Search & Rescue work.

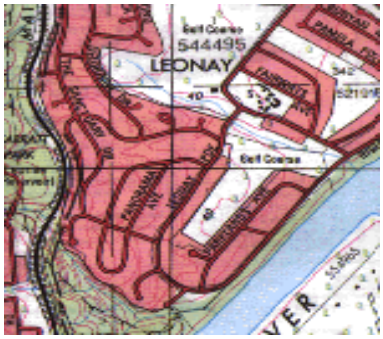
Planimetric Map

This style of map is most commonly thought of as a 'Road Map.' It displays map information without regard to terrain features (no contour lines); as such it displays roads, buildings, bodies of water, etc. This can be a beneficial map to Search & Rescue operations when terrain is not a significant factor; such as in a suburban streets and neighborhoods search.



Topograhic Map

This style of map displays information as overlaid onto contour lines representing various terrain features, which will be discussed in more depth later. A topographic map displays both natural (slopes, water, vegetation, etc.) and artificial (roads, buildings, etc.) features. While this map is not as commonly understood, it is critical in Search & Rescue operations when working in areas where terrain can become a significant factor; such as in a wilderness search. *Primarily, this training will focus on this type of map as it is the least familiar.*

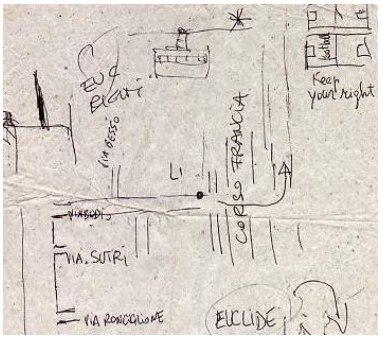


Aerial Photographs

This style of map displays information as visible from the sky, either aerial (plane, helicopter, UAV, etc.) or satellite. With the proliferation of cell phone technology, these maps are becoming more available and useful. These maps are beneficial in helping to develop a mental image of the area, but can be somewhat limited in advanced navigational work.

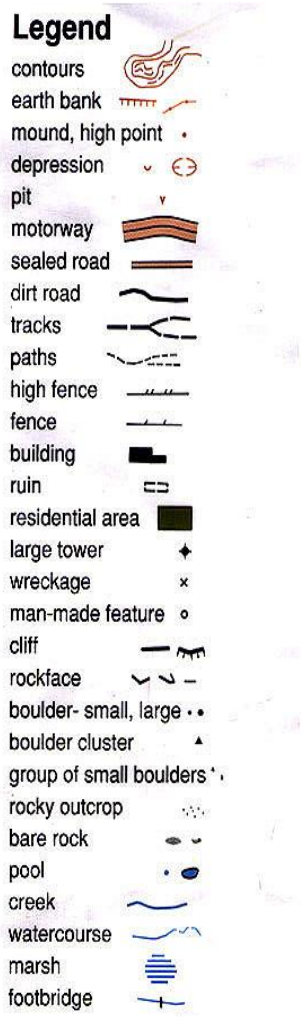
Hand-Drawn Map

This style of map is personally customized to demonstrate the critical relationships, between objects, as defined by the map maker. While it is only as good as the information drawn, with a few simple tips these maps can be highly beneficial to convey site / time specific information. *Do not neglect the importance of this style of map.*



Map Symbology

As a map is a representation of a real-world place, it does not perfectly replicate the actual conditions of a space. For example, a heavily tree covered area is shown as a 'green swath' as opposed to a multitude of individually drawn trees. So, while there is an extensive set of possible map symbols, there are some common symbols that should be familiar to all map users.



Natural Features

Natural features would include any objects that occur naturally; these map features are indicated through the use of the following colors:

- Green – vegetation
- Blue – bodies of water (lakes, rivers, etc.)
- White – open space (non-vegetated)

Artificial Features

Artificial features would include any objects that do not occur naturally, man-made objects. These map features are indicated through the use of the following colors:

- Black – buildings, fences, power lines, etc.
- Red – roads (may also be black)

Contour Lines

Topographic maps utilize contour lines to illustrate changes in elevation. Whereas these 'lines' are not visible in the real-world, they do represent real-world terrain. Contour lines are indicated through the use of the following colors:

- Light Brown – intermediate contours
- Dark Brown – index contours

Map Scales

As a map is a scaled representation of the earth's surface, the map must be 'scaled' down in order to be of such as size that it is useful. As such, it is necessary that we develop some understanding of map scales; each indicating a different level of detail and therein functionality.

A map scale may be displayed as a representative fraction:

1:24,000 Scale

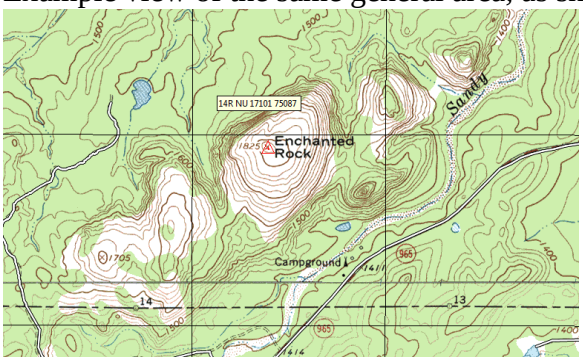
1" (on the map) equals 24,000" or 2,000' (in the real-world)

This is the most commonly utilized map scale in ground based Search & Rescue operations as it provides a large enough area to visualize the search area context while still providing enough detail to be useful. This is the scale used in the United States Geological Survey (USGS) 7.5 minute quadrangle maps.

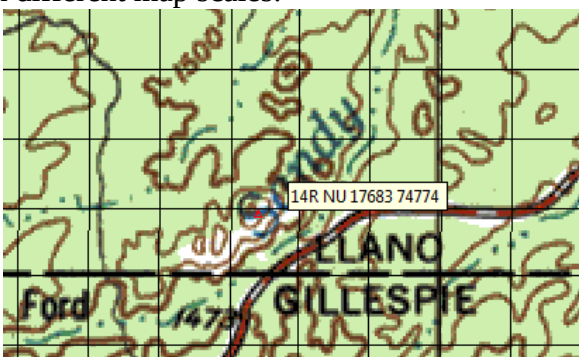
1:100,000 or 1:250,000 Scale
While this scale of map covers a much larger area they sacrifice a great deal of detail. As such, this scale is not particularly useful for ground based operation. However, this is the scale commonly utilized by aerial search assets.

Note: as the second number increases, the map detail decreases.

Example view of the same general area, as shown on different map scales:

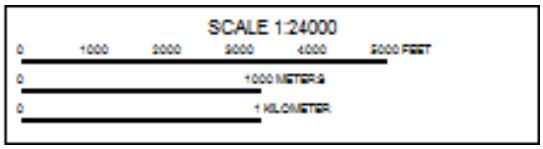


1:24,000



1:250,000

Or, a map scale may be displayed as a scaled ruler:



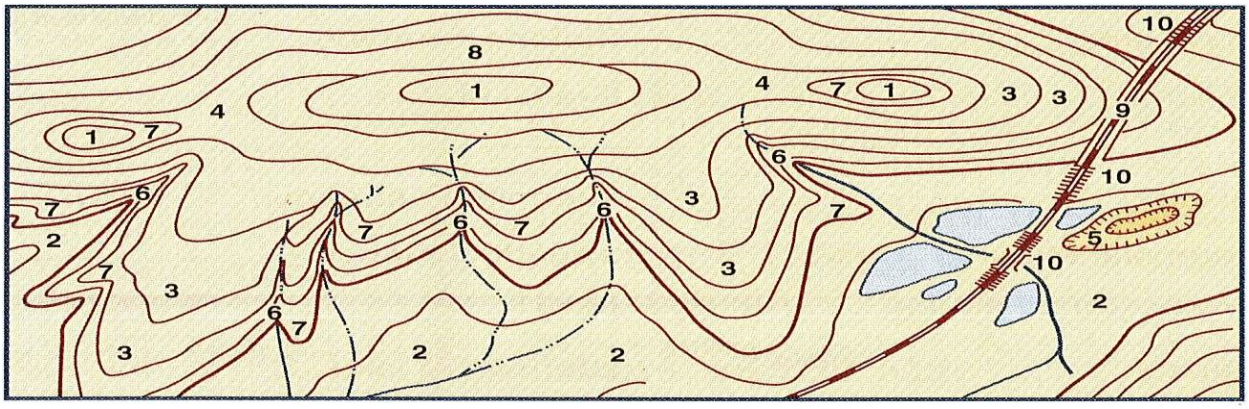
The scaled ruler is particularly helpful, because as the map is reproduced (photocopied) and/or re-sized (shrunk / enlarged) scale representation is maintained. Additionally, it can be helpful in measuring map distance, as will be discussed later.

Note: the edge of many maps is marked with 100m 'ticks;' these may serve as the map scale.

Contour Lines

Contour lines are noted on topographic maps; these maps and their contour lines provide important information in Search & Rescue operations. Wilderness Search & Rescue operations may occur in any and every variety of areas; ranging from flat and open park land to steep and rugged mountains. If we are unable to read and understand topographic maps and contour lines, we will have little situational awareness of what to 'expect' from the terrain. So, by developing knowledge of the various contour shapes, we can begin to visualize these shapes in the real-world terrain.

As the map is a scaled representation of real-world features, contour lines are representations of that real-world terrain. By understanding the meaning of these various 'brown lines,' we can understand and visualize the terrain features represented on the map. By simply observing the map, we are able to determine what is a hilltop, what is a valley, etc. This information is used in the decision making process; for instance in determining an intended route of travel and/or in warning of potential obstacles (bodies of water) or hazards (cliffs), etc.



1. Hill 3. Ridge 5. Depression 7. Spur 9. Cut
2. Valley 4. Saddle 6. Draw 8. Cliff 10. Fill

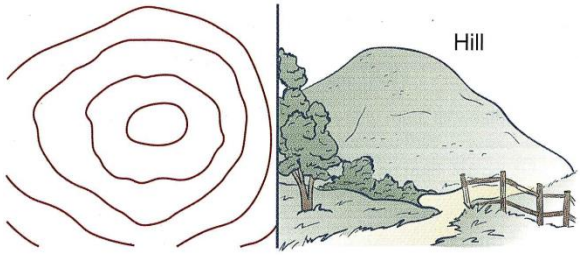


Figure 10–20 Hill.

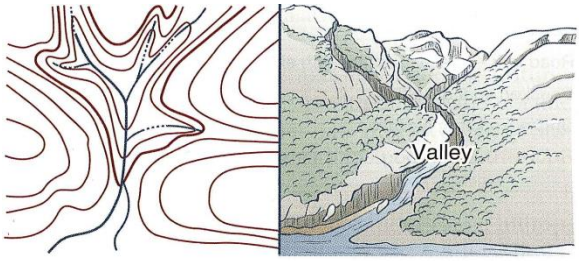


Figure 10–22 Valley.

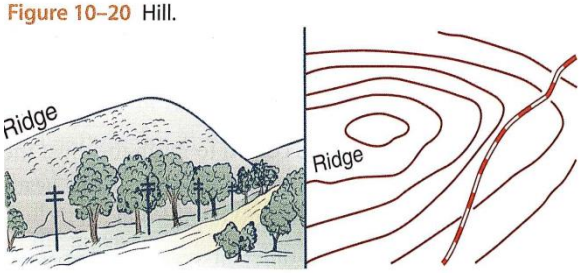


Figure 10–23 Ridge.

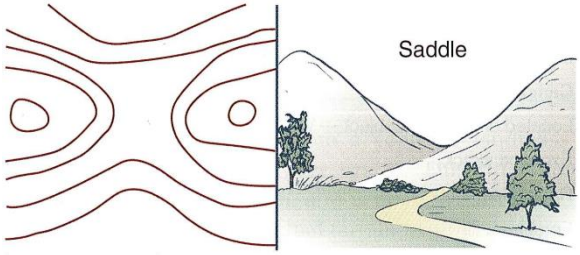


Figure 10–21 Saddle.

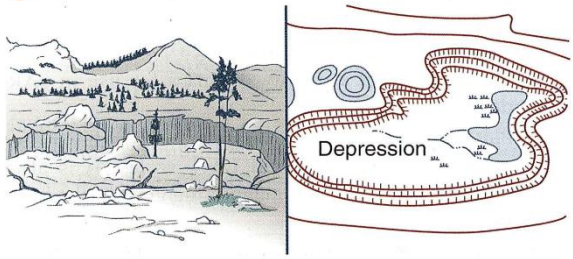


Figure 10–24 Depression.

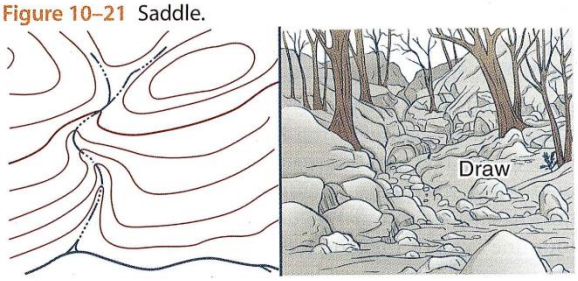


Figure 10–25 Draw.

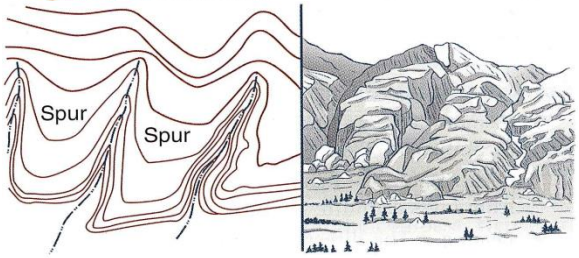


Figure 10–26 Spur.

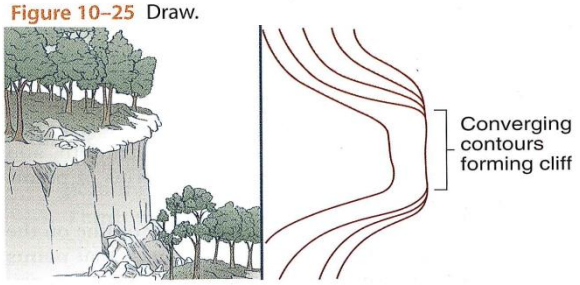
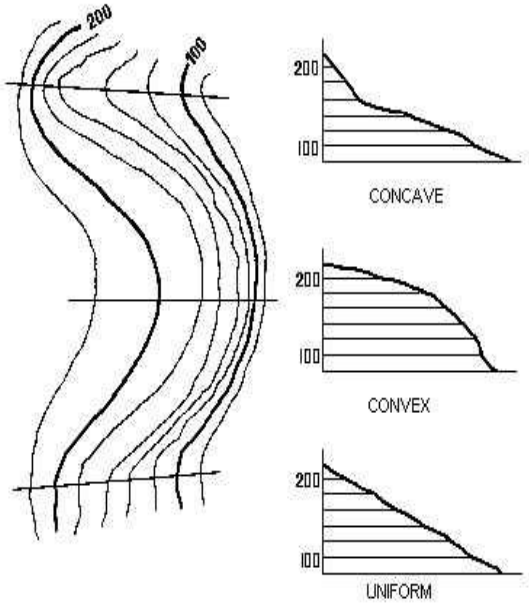


Figure 10–27 Cliff.

Contour Line Basics

A contour line is an imaginary line that connects all points of equal elevation. Imagine taking a 'deli slicer' and 'slicing' the tops off of the mountains; the resulting 'line' would be the contour of the mountain. If this process is repeated, a series of contours become visible.



As a contour line represents all points of equal elevation (i.e. if you walk along a contour line, you do not go either up or down in elevation); the closer contour lines are together, the steeper the terrain; the further apart, the flatter the terrain. This is the result of the elevation change (vertical distance) occurring in a shorter horizontal distance.

It should be noted that contour lines cannot cross one another; they may be 'stacked' one on top of another, as in a vertical cliff face, but they will not cross.

As we learned with the map symobology, contour lines are brown. The darker brown lines are 'index contour lines' and notate the specific elevation along that line. By comparing the various index contour line elevations, you can determine if the terrain is sloping up or down.

Contour Intervals

So, by understanding the relationship of one contour line to another, you begin to visualize the respective terrain. Close together contours indicate steep slope, whereas far apart contours indicate flat terrain. But, without an understanding of the contour interval, this relationship may be of minimal value. The contour interval is the vertical distance as represented by each contour line. The contour interval may be marked on the map or can be determined by calculating such from the index contours.

For example; an area with mountainous terrain (Colorado) may utilize a contour interval of 50'. But, an area with flat terrain (Houston) may utilize a contour interval of only 5'. If Colorado used a 5' contour interval, the map would be unusable, it would be solid brown; but if Houston used a 50' contour interval, there would be no advantage to the topographic map, as there would be 'no' contour lines shown.

Note: most maps in the Austin Texas area utilize a 20' contour interval (but confirm with your particular map).

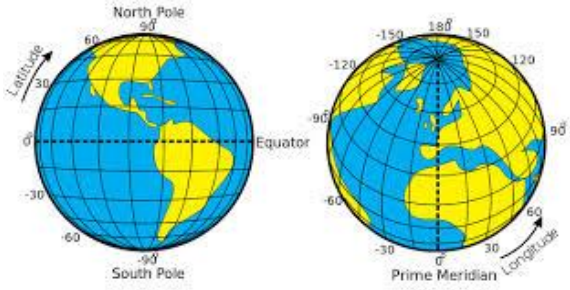
Geographic Reference Systems

The primary function of a map is to illustrate position and relationships with other objects / locations. So, while we have introduced the various symbology, we have not yet provided a

means to communicate a specific location / point on the map; particularly how that point relates back to the real-world.

There are a variety of methods and systems used to convey positional information; we will focus on the two types most commonly utilized in Search & Rescue operations. Each of the various methods has its own advantages and disadvantages; yet the most important feature is that a common system and language is used by all maps and individuals within a particular operation.

Latitude / Longitude



Most of us are at least vaguely familiar with latitude and longitude coordinate systems, yet very few people have a workable knowledge of how to utilize this reference system for navigation. The latitude / longitude reference system is composed of a few primary features:

- Coordinates
  Coordinates are conveyed via a series of degrees, minutes and seconds (or decimal minutes). Each degree is subdivided into 60 minutes and each minute into 60 seconds.

- Latitude
  Parallels of latitude run horizontally around the circumference of the earth, the Equator is 0° latitude. Each line of latitude runs parallel to one another at an even / equal spacing. Lines of latitude are called Northings and in a string of coordinates is read first.

- Longitude
  Meridians of longitude run vertically around the circumference of the earth, the Prime Meridian (through Greenwich England) is 0° longitude. Each line of longitude runs from pole-to-pole, where they intersect one another. Lines of longitude are called Eastings and in a string of coordinates is read second.

While there are several different styles of Latitude / Longitude, the most commonly used is 'degrees minutes.minutes' (DD°MM.MMM').

- Reading Coordinates
  Example – N 30° 16.296' / W 97° 45.234'
  North 30 degrees, 16.296 minutes / West 97 degrees, 45.234 minutes

As you can see, this can be a bit of a complex system, not only to utilize but just to read and understand. That is not to say that it is not a useful system; it is particularly useful in large scale mapping operations. That is why Latitude / Longitude is commonly utilized by aircraft (including STARFlight) employed in Search & Rescue Operations.

Grid Reference System

The primary difference between the latitude / longitude system and the various grid reference systems is the advantage of the grid system having sub-divided the earth into square and equally

sized grid segments. As such, these grids are easily utilized to both determine and convey positional information. The disadvantage with this system is the relatively small scale of the grids, hence aircraft's continued utilization of latitude / longitude.

While a large variety of grid reference systems exist, and are largely similar, FEMA has designated the United States National Grid (USNG) System as the National SAR Standard.

> *"The USNG is intended to create a more interoperable environment . . . by establishing a preferred nationally-consistent grid reference system."*
> *CATASTROPHIC INCIDENT SEARCH AND RESCUE (CISAR) ADDENDUM to the National Search and Rescue Manual – Version 1.1 (August 2008)*

- Coordinates
  The coordinate system is based upon the metric system whereas map and grid measurements are clearly and directly related to real-world measurements. As the coordinates are metric based, there is no complexity in dealing with 'minutes and seconds,' as in latitude / longitude. Each grid is square and equally sized, where the east-west units are measured the same as the north-south units.

  Typically, a map is marked with 1,000 meter grid squares and 100 meter 'ticks' along the edge of the map.

- Grid System
  The earth has been divided into 60 zones (each consisting of 6° of longitude), for example Austin is in grid zone 14R, and 20 horizontal bands.

  Then, each grid zone is divided into 100,000 meter lettered zones; downtown Austin is in lettered zone PU, or more specifically 14R PU.

After the lettered zones, the system transitions to metric digits, with each digit representing a single (1) meter on the ground / real-world.

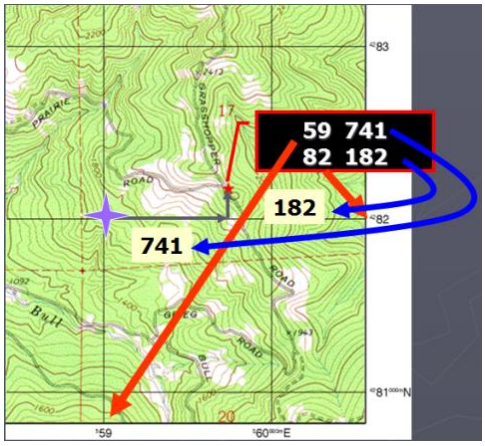
Similar to latitude / longitude, the USNG system is conveyed in Eastings (vertical) and Northings (horizontal).

Remember – *"Read right, then up"*

- Using and Reading Coordinates
  Each grid square is numbered starting from the bottom left. The position is read by counting the meters 'move' to the **right and then up** from the lower left corner.

Example – 14R PU 59741 / 82182

- The 14R represents the grid zone. The PU the 100,000 meter lettered zone.
- The 59741 indicates a line 59,741 meters east of the west edge of the PU grid.
- The 82182 indicates a line 82,182 meters north of the south edge of the PU grid.
- Where these two lines intersect is the precise location.



Typically, a map is broken down into 1,000 meter grid squares.

Given the large scale of both the lettered zone and grid zone, it is commonly unnecessary to read this portion of the coordinate system. As such, the coordinates are typically abbreviated to just the numbered five / five coordinates. Given the single meter accuracy of this system, it is commonly utilized and beneficial in ground-based Search & Rescue operations.

Map Datums

A datum describes the mathematical model that was used to match the location of features on the ground to coordinates and locations on the map. So, what this really means . . . a Survey and a Cartographer must start somewhere in creating a new map. This 'starting' point can be compared to a series of known points and essentially serves as the datum. Remember, a map is a flat representation of the round earth; the datum is the 'starting point' of "stretching" that piece of paper around the "ball."

There are many different map datums. And really, as long as the maps match the GPS settings (which


Offset of WGS84 (red line) on a NAD27 map

we will cover later) and everyone is using the same datum setting, like coordinate systems, it really doesn't matter which is used.

But, in an attempt to simplify things and reduce any confusion; a standard map datum has be determined for use in Search & Rescue operations.

The World Geodetic System of 1984 (WGS 84) has been set as this standard. WGS 84 is typically the default GPS datum setting. WGS 84 was adopted as a 'world standard' from what was previously North American Datum of 1983 (NAD 83); which is virtually the same. However, most USGS maps were based off of the North American Datum of 1927 (NAD 27); it should be noted that there is approximately 200 meters of difference between WGS 84 and NAD 27.

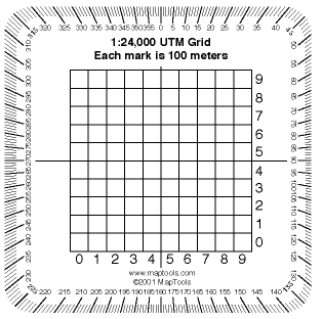
Metric System Measurements
In the United States we are not readily familiar with the metric system, rather more commonly statute (feet and inches) measurements. However, the USNG Grid Reference relies upon the metric system and its inherent benefits, as this can easily be broken into decimals. A basic understanding of simple metric conversions will assist in developing a workable knowledge of this system:

- 1 meter is approximately 1 yard or 3 feet
- 100 meters is approximately the length of a football field (with end zones) or +100 yards
- 800 meters is approximately ½ mile
- 1,000 meters / 1 kilometer (1km) is commonly called a 'click'
- 1,200 meters is approximately ¾ of a mile
- 1,600 meters is approximately 1 mile

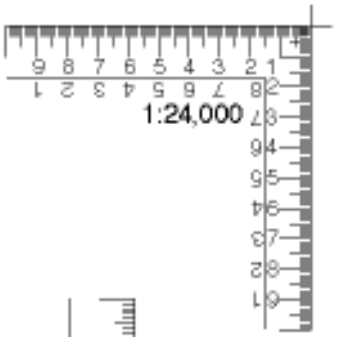
Reporting Map Location

Once you have determined your location it may be necessary to report your location to others, particularly in Search & Rescue operations. As we discussed with the Geographic Reference Systems, we are able to convey our position via coordinates which can then be marked onto the map. We will focus our discussions upon USNG as this has been established as the "preferred nationally-consistent grid reference system" for ground-based Search & Rescue operations.

Grid Reference System Tools
As the grid reference system is divided into equally sized square grids, positions can be accurately determined with a simple set of tools. These tools help to significantly improve the accuracy of mapping and reporting the designated point / location.



Grid Ruler

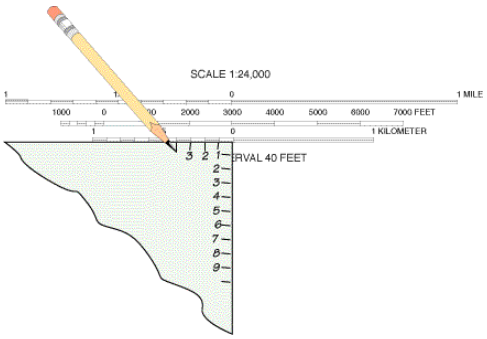


Corner Ruler

- Grid / Corner Ruler
  A grid ruler which matches the map scale is used; it consists of a 1,000 meter grid square that is further sub-divided into 100 meter squares.

A corner ruler is similar to the grid reader, except instead of being sub-divided into 100 meter grid squares; 100 meter and 10 meter 'ticks' are marked along two sides of the ruler.

- Improvised Ruler



Whereas a grid / corner ruler is the ideal tool, it is easily possible to 'improvise' a ruler using the corner of a piece of paper. Simply align the corner / edge of the paper with the map grid, marked with 100 meter 'ticks'. Place marks along the edge of the paper, aligning with the 'ticks' on the map. Then, repeat this process along the other edge of the map.

This improvised ruler can then be utilized identically to the corner ruler referenced above. The metric distance from the 1,000 meter bottom left corner of the grid is then read off of the ruler at the designated point.

Exercise – Improvised Ruler
Instructor Notes: Provide opportunity for the student to create an improvised ruler.
Utilizing the map provided, create an improvised ruler as instructed above.

Field Mapping

We have just discussed the basics of Grid Reference Systems and the various tools. We will now take this knowledge and apply it to gain a better understanding of how to actually utilize such for field mapping purposes. Primarily, there are two exercises in which we should become proficient; plotting coordinates on a map and reading coordinates from a map.

Reading Coordinates from a Map

Given a specific point on the map, the navigator is able to determine the coordinates for that location; therein, providing ability to communicate those coordinates for other uses. Reading coordinates can be accomplished as follows:

1. Start at the point indicated on the map.
2. Determine the distance from the lower left-hand corner of nearest 1,000 meter grid square.
3. The distance to the RIGHT is the first set of digits.
4. The distance UP is the second set of digits.
5. These digits compose the grid reference coordinates for the point indicated.

Exercise – Reading Grid Coordinates
Instructor Notes: Provide opportunity for the student to practice determining and reading Grid Coordinates from a map.
Utilizing the maps provided, select a variety of points and have the student determine and read the coordinates for the selected point.
Exercise: 1. Enchanted Rock Map – determine the coordinates for the summit of Enchanted Rock: 14R NU 17392 / 74931 2. Enchanted Rock Map – determine the coordinates for the campground? 3. Emma Long Map – determine the coordinates for the gravel pit (center)? 4. Emma Long Map – determine the coordinates for hilltop 794 (center)?

Plotting Coordinates on a Map

Given a specific set of coordinates, the navigator is able to plot those coordinates onto the map in order to observe the mapped location and relationship to other objects indicated on the map. Plotting coordinates can be accomplished as follows:

1. Start with the Coordinates intended for plotting.
2. Find the 1,000 meter grid square which contains the Coordinates.
3. From the lower left-hand corner move RIGHT the prescribed coordinate distance, imagine a north-south line from this point.
4. Now, move UP along that line the prescribed coordinate distance.
5. This is the designated Coordinate Point.

Exercise – Plotting Grid Coordinates
Instructor Notes: Provide opportunity for the student to practice plotting Grid Coordinates on a map.
Utilizing the maps provided, determine a variety of coordinates. Have the student plot those coordinates to find what is at that location.
Exercise: 1. Enchanted Rock Map – what is located at coordinates 17759 / 76845? Dutch Mountain 2. Enchanted Rock Map – what is located at coordinates 16747 / 75207? 3. Emma Long Map – what is located at coordinates 11627 / 55967? 4. Emma Long Map – what is located at coordinates 12727 / 58367?

Determining Distance

As the map displays the relationship between various objects; it also displays the distance between those objects. But, given that the map is a scaled representation of such, we must learn the skills to convert the scaled map distance into real-world distances. It is important that we understand the distance between mapped objects in order to assist us in our navigational evaluation and decision making. Given our particular objective, we may need to determine distance in one of two ways, straight-line or curved.

Straight-line Distance

Straight-line distance provides the direct / straight ("as the crow flies") distance between two objects. This may be useful in getting a basic understanding of the area or in determined how far it is from one terrain feature to another. This can be accomplished in a few simple steps:

1. On your map, mark the objects that you wish to determine the distance between.
2. Utilizing a scrap piece of paper, place one corner at your starting point.
3. Rotate the paper until the edge is touching your end point (ensure the corner is still on your starting point).
4. Place a mark on your paper adjacent to the end point.
5. Remove the paper from the map. Now, the distance is represented by the distance between the corner and the mark.
6. Lay the edge of the paper along the side of the map scale, place the corner at 0.
   Note: if the map does not have a scale, the grid reference 'ticks' along the side serve the same purpose.
7. Using the scale, determine the distance as marked on the paper.
   Note: ensure the proper units (feet, miles, meters, kilometers) are used.
8. You have now determined the straight-line distance between these two points.

Exercise – Determining Straight-Line Distance
Instructor Notes: Provide opportunity for the student to practice determining the straight-line distance between two points.
Utilizing the maps provided designated two points (either with coordinates or features). Have the student determine the straight-line distance (in meters) between those points.
Exercise: 1. Enchanted Rock Map – what is the straight-line distance between the peak of Enchanted Rock and the peak of Dutch Mountain? 1,960 meters 2. Enchanted Rock Map – what is the straight-line distance between 16747 / 75207 and hilltop 1705? 3. Emma Long Map – what is the straight-line distance between the Cemetery (upper left) and the Campground? 4. Emma Long Map – what is the straight-line distance between the Manana Street bridge and the nearest water tank?

Curved Distance

Many times, determining the curved distance is more useful than determining the straight-line distance. This is particularly true, if this distance is a route; as we rarely travel in a straight-line in the wilderness. So, a curved distance provides a more accurate representation of the actual distance between the two points. Much like straight-line distance this can be accomplished in a few simple steps:

1. On your map, mark the objects that you wish to determine the distance between. Additionally, mark or visualize the intended route between these objects.
2. Utilizing a string (or some other flexible object – long blade of grass, shoelace, etc.) place one end at your starting point.
3. Carefully lay the string along the route, matching each curve along the way.
   Note: do not 'stretch' the string.
4. Place a mark on the string adjacent to the end point.

5. Remove the string from the map and straighten (do not stretch) it; this now represents the curved distance between the points.
6. Lay the string along the side of the map scale, place the corner at 0, or map edge.
7. Using the scale, determine the distance as marked on the string.
   Note: ensure the proper units (feet, miles, meters, kilometers) are used.
8. You have now determined the curved distance between these two points.

Exercise – Determining Curved Distance
Instructor Notes: Provide opportunity for the student to practice determining the curved distance between two points.
Utilizing the maps provided designated two points (either with coordinates or features). Have the student determine the curved distance (in meters) between those points.
Exercise: 1. Enchanted Rock Map – what is the distance along the creek from walnut spring to the pond to the south? 2,100 meters 2. Enchanted Rock Map – what is the distance along the road from one edge of the map to the other? 3. Emma Long Map – what is the distance along the road from the intersection of Pearce Road and Oak Shores Drive? 4. Emma Long Map – what is the distance along the river from one edge of the map to the other?

Introduction to Compasses

The compass provides the navigator with the ability to determine direction relative to magnetic north. This section will provide an introduction to compass and develop a familiarity thereto.

Compass Types

There are a variety of different types of compasses, each with their own strengths and weaknesses; we will discuss the most common of these and provide recommendations related to Search & Rescue operations. All compasses consists of common parts; we will reference these parts, but discuss each in greater detail later in the course.

Baseplate Compass

This is the basic compass; consisting primarily of a baseplate (preferably clear and square), a bezel and a magnetic needle.

- Advantages – given the flat, clear and square baseplate this compass is ideal for use in conjunction with a map.

- Disadvantages – as this compass only contains a baseplate, it is difficult to use in accurate orienteering.

Lensatic / Military Compass

This is a more advanced compass; consisting of an orienting sight, a bezel and a magnetic needle. This compass does not have a 'conventional' baseplate.

- Advantages – given the orienting sight, this compass is ideal for field orienteering; as it works well for shooting a precise heading.

- Disadvantages – as this compass lacks a conventional baseplate, it is difficult to use with a map.

Given the limitations (disadvantageous) of both the baseplate compass (poor at orienteering) and the lensatic compass (poor with maps); it is typically necessary that these compasses are used in conjunction with one another. One compass is used for mapping (baseplate) and the other is used for orienteering (lensatic). As a result of this dual need, the Orienteering Compass was developed.

Orienteering Compass

This compass provides a combination of the advantages of each of the compasses listed above with little disadvantage. This compass consists of a baseplate (preferably clear and square), an orienting sight and mirror, a bezel and a magnetic needle.

- Advantages – as this compass has both a baseplate and an orienting sight; it works equally well with a map and in the field, orienteering navigation work.

- Disadvantages – insignificant.

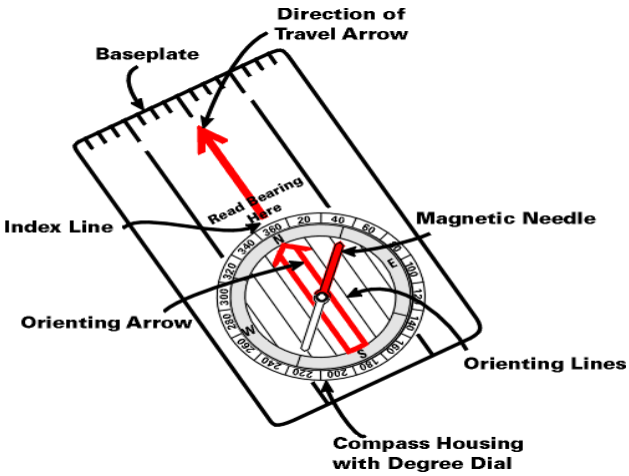
While there are many other types and styles of compasses; typically designed for specialized purposes; these are the basic and primary types. As your experience and education expands, you are encouraged to learn more of these other compass types; such as 'eye ball' compasses, monocular compasses, etc.

In addition to the various types of compasses; there is a wide range of 'quality' with the compasses available on the market. This is definitely a piece of equipment where you "get what you paid for" and given the importance of this item, you may rely upon it for your very life; it is worth paying a little more for something in which you can reliably trust.

But, even with the very best equipment, it is only as good as our knowledge in how to utilize such. So, we will now learn the various parts of the compass and therein begin to learn how to utilize such to our advantage.

Parts of a Compass

In order to have an effective discussion on how to use a compass, we need to develop a common language in order to discuss the various parts of a compass. While all compasses consist of a common set of parts, there are some variations to each model. So, while we will cover the most common features, everyone should take the time to become familiar with their particular compass.



Baseplate

The baseplate should provide a flat, solid surface in order for the compass to be used in conjunction with the map. It is strongly recommended that the baseplate be clear, in order to allow the map to be viewed through the baseplate. The baseplate may contain a variety of tools that the user may find useful; including measuring scales, magnifying glass, etc.

Magnetic Needle / North Arrow

This is arguably the most important part of the compass. In its simplest form, the main job of the compass is to determine north; this is accomplished by the magnetic needle. However, the user should be cautioned; the magnetic needle does not necessarily point north. We will discuss these potential sources of interference later in the course.

Bezel / Compass Dial

This is the circular dial surrounding the magnetic needle. The bezel is graduated (marked) into a 360° circle, with north being indicated as 0° / 260°. The bezel can be rotated to align with any angle / degree, as selected by the user. Typically, each ‘mark’ notates 2°; however the user must become familiar with their particular compass.

Housing

The housing is the portion of the compass containing both the bezel and the magnetic needle. The housing is typically filled with fluid in order to ‘dampen’ (slow) the movement of the magnetic needle, as it settles upon north.

Orienting Arrow and Orienting Lines

These parallel lines align with 0° on the compass bezel and are critical in using the compass with the map. These items will be discussed in greater detail later in the course.

Index Line / Pointer

The index line is the small ‘tick’ mark on the topside of the compass baseplate, adjacent to the bezel. The index line is used to mark / read the compass degree as set by the bezel.

Direction of Travel Arrow
This is the line / arrow that points from the index line straight out to the top edge of the compass. The direction of travel arrow is used to visualize and sight the user to the intended direction of travel.

Note: the direction of travel arrow is different from the orienting arrow.

Compass Interference

Typically, the magnetic needle of the compass points towards the earth's magnetic pole; however, if a 'stronger' magnetic source is located near the compass; such source will result in interference. Failure to recognize and account for this interference will result in a significant loss of accuracy and navigational ability.

To demonstrate and visualize this effect, move a compass near a local magnetic source (i.e. electronics and/or ferrous, magnetic metal, objects). The magnetic needle will begin to move and 'wobble' as it is influenced by this local magnetic source. There are a variety of potential sources of interference, some are mentioned here:

- Radio, GPS, Cell Phone – particularly when carried in a chest pouch
- Watch, jewelry, etc.
- Metal (barbed) wire fences – may affect the compass from up to 10 meters away
- Vehicles, tables, etc. – vehicles may affect the compass from up to 60 meters away
- Power lines, electrical sources, etc. – high voltage electrical lines may affect the compass from up to 80 meters away
- Naturally occurring sources / deposits – minerals (iron deposits) in the ground, nails, etc.

Exercise – Compass Interference
Instructor Notes: Demonstrate compass interference.
Utilizing a magnetic compass, demonstrate the interference that will occur with various objects.
Exercise: 1. Metal table 2. Radio (transmitting and not transmitting) and/or Cellular Phone 3. Vehicle 4. Etc.

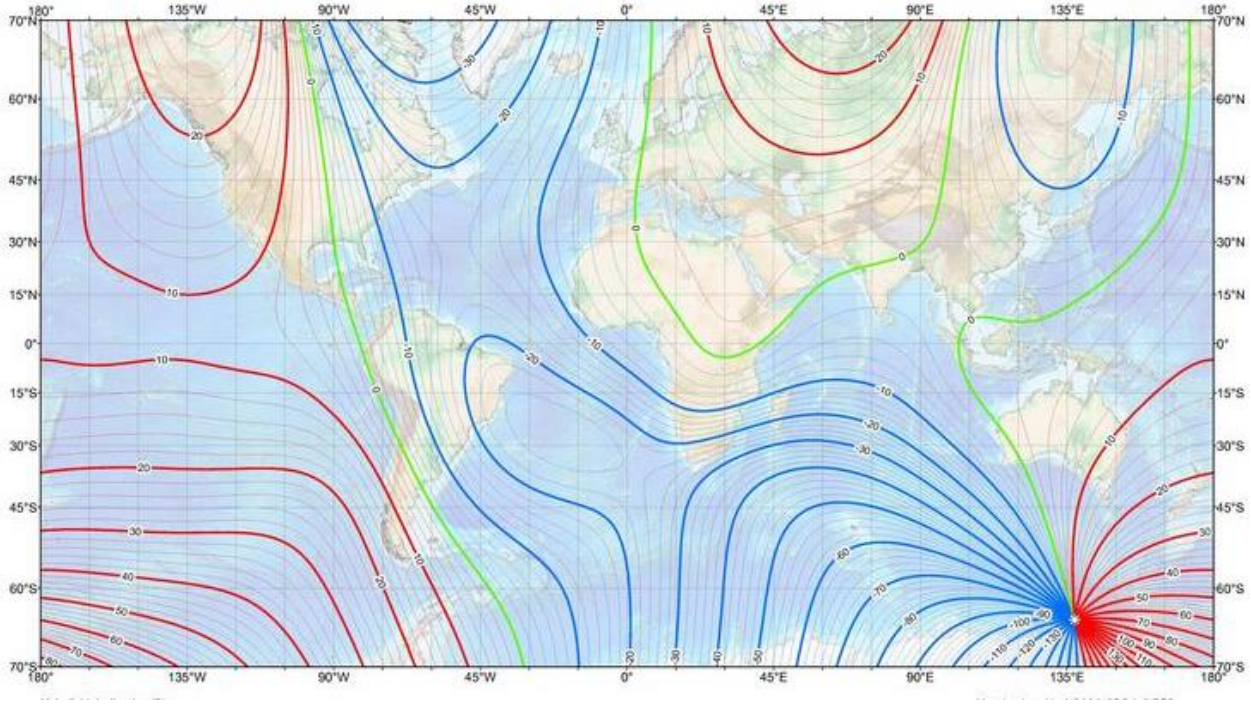
If a compass user suspects potential interference and/or compass error, careful observations shall be made in order to confirm or deny such error. This can be accomplished by moving away from the potential source of interference, while watching the magnetic needle for any movement adjustment. Or, confirmation of accuracy can be provided with a different compass, as observed from a different location.

North Points

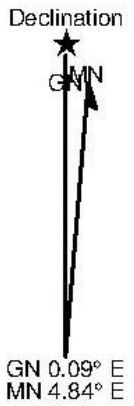
In the world of navigation there are a variety of 'north points.' Each of these exist and are used for a specific purpose, as such it is important that the navigator understand such in order to avoid confusion. The various 'north points' may be indicated by the compass rose, included on the map.

True North
This is the 'North Pole' or more accurately stated the axis on which the earth rotates. Typically, when someone refers to 'north,' this is the direction in which they are referring. This is a geographically stable (non-moving) point located at the 'top of the earth.'

Magnetic North
This is the point which the compass magnetic needle points towards, ignoring possible sources of magnetic interference. Specifically, this is the point where the earth's magnetic field points downward (into the earth). Geographically, the magnetic north pole is currently located near the Canadian Artic, but is constantly moving; at present in a northwesterly direction, towards Russia, at a rate of approximately 35 miles per year. While the specific rate of movement is not important, it is important that one recognizes that this movement exists; particularly in regards to declination, which will be discussed later.



Grid / Map North
Typically, Cartographers (map makers) attempt to align the top edge of the map with True North ("north is up"); however in some instances this may not be practical. In these rare cases, Grid / Map North is at the top of the page, with the degree of deviation marked between such and True North. This deviation is typically very small, only 1°-2°. The vertical, north-south, lines on a map align with Grid / Map North.



Declination

Typically, True North is the desired location; however the compass magnetic needle does not point to True North, but rather to Magnetic North. This variance between True North and Magnetic North is called declination and must be accounted for in navigation; particularly in areas of greater angles of declination.

Angle of Declination

As the Geographic North Pole and the Magnetic North Pole are not aligned with one another, the angle of declination varies depending upon where in the world the navigator is located. Additionally, as the Magnetic North Pole is in a constant state of motion, this angle of declination will change, slowly, over time.

At present, 0° declination (no deviation between True North and Magnetic North) is located approximately along the Mississippi River; this is called the Agonic Line. All points west of this line are said to have positive / east declination and all points east are said to have negative / west declination; the declination deviation is OPPOSITE the side of the agonic line. It is the adjustment 'direction' to get back to the agonic line. The various lines of magnetic declination are called Isogonic Lines.

As such, Austin Texas has a POSITIVE / EAST declination / variation; at present this is approximately 005°.

As such, the navigator must make navigational 'corrections' to their compass in order to account for the declination. There are a variety of methods to accomplish these corrections, two such will be presented here, but the navigator is encouraged to find the method that works best for them.

Note: some compasses have a declination adjustment (typically a small metal screw on the backside of the housing). It is recommended that this is NOT adjusted, as inconsistent use of such can result in a compounded error.

It should be noted that declination may at first seem somewhat confusing. But, if the navigator will keep a 'general perspective' of what they are trying to accomplish and not get 'lost in the math,' it will be made much easier. Additionally, this is one of those skills that take much practice in order to gain confidence.

- "East is Least and West is Best"
  Basically, this means to subtract an East variation (Austin Texas) and add a West variation. We will use Austin Texas as our example location.

Note: this mnemonic assumes the navigator is taking information from a map (True North) and applying it to the compass (Magnetic North). If a navigational 'sighting' is being applied to the map, the adjustment is opposite.

To adjust for declination you would do the following:
1. Take the True North bearing from the map (in this case 045°).
2. Given that your location (Austin Texas) has an Easterly declination of 005°, you would subtract the declination from the True North bearing.
3. 045° (True North) – 005° (Declination) = 040° magnetic

- Map / Compass Rotation Adjustment

Most maps are provided with a compass rose, visually indicating the compass declination / deviation. We will use Austin Texas as our example location.

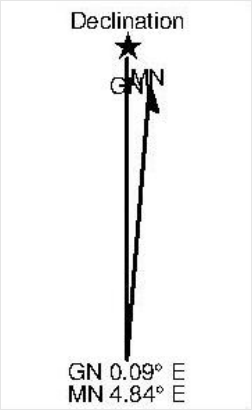
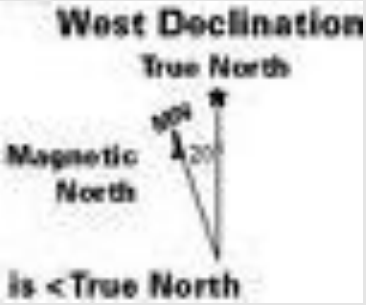
To adjust from the map (True North) to the compass (Magnetic North):

Rotate the bezel in the same direction as moving from the True North arrow towards the Magnetic North arrow. So, given our example of Austin Texas, this rotation would be clockwise.

To adjust from the compass (Magnetic North) to the map (True North):

Rotate the bezel in the same direction as moving from the Magnetic North arrow towards the True North arrow. So, given our example of Austin Texas, this rotation would be counter-clockwise.

Note: the rotation degrees should match the angle (degrees) of declination.

Exercise – Declination	
Instructor Notes: Provide opportunity for the student to make declination adjustments in order to determine the bearing designated.	
Given the instructions below, convert the bearings to the bearing indicated.	
Exercise: Austin Texas – 005° positive / easterly declination: 1. What is the Magnetic bearing from an 82° True North bearing? 77° M 2. What is the True North bearing from a 264° Magnetic bearing?	
Maine – 020° negative / westerly declination: 3. What is the Magnetic bearing from a 356° True North bearing? 4. What is the True North bearing from a 264° Magnetic bearing?	

Introduction to GPS

Global Positioning Systems (GPS) have become more and more prevalent in the past several years, with such technology commonly available in vehicles, hand-held models and even cellular phones. Yet, the technology remains much the same, regardless of the specific device. We will discuss some basic features and usage, primarily of hand-held GPS units. But, all GPS users should take the time to read and understand the User Manual and familiarize themselves with the particulars of their specific device.

GPS Basics

Originally intended and restricted for military purposes, civilian use of GPS technology became operational on January 17, 1994. The Global Position System consists of a series of 24 geostationary satellites in constant orbit. Additionally, these satellites are supplemented by a series of land-based transmitters, the Wide Area Augmentation System (WAAS), which serves to increase the accuracy of the GPS signals.

Prior to May 2, 2000 the government utilized Selective Availability or 'Dithering' to intentionally scramble GPS signals; thereby serving to decrease their accuracy. This Selective

Availability has been turned off; as such hand-held GPS units can now be expected to obtain position accuracy of 2-5 meters.

There is a large variety of tasks that can be accomplished with a GPS unit; but the most common and frequently utilized, in Search & Rescue operations, includes tracking location, marking position (waypoints) and navigating (finding) key features. This course will focus upon these common items, but again you are encouraged to learn more about the additional features and capabilities of your GPS unit.

GPS Signal
The hand-held GPS unit acts primarily as a receiver, receiving information from the various satellites and WAAS stations. Given the source of the information (satellites) the GPS signal may be affected by a variety of factors. While GPS units have become better, they still rely upon a 'clear view of the sky' in order to provide accurate and reliable information. Additionally, the GPS signal may be negatively affected by other sources of interference, such as high-voltage electricity. It is always best to 'double-check' a GPS unit when conveying critical information.

GPS Setup

Before a GPS unit can be effectively utilized for Search & Rescue operations, it must be correctly setup to match the operational protocols. As we have previously discussed with maps, there is a large variety of Geographic Reference Systems (coordinates) and Datums available. It is imperative that the GPS unit is accurately setup to match the map and all other GPS units. Failure to coordinate this setup will result in significant errors and confusion within the Search & Rescue operation.

The most important thing is that all GPS units be setup to match one another and the search maps. This is easily confirmed by comparing the positional information between units and the search map. Each of these GPS set-up items can be accessed through the GPS Main Menu.

Position Format and Datum
Remember, a standard grid reference system and datum has been designated:

> *United States National Grid (USNG) and the World Geodetic System of 1984 (WGS84)*
> *USNG / WGS84*

The position format should be set to 'USNG,' note some older models do not have USNG, in this case such should be set to the Military Grid Reference System (MGRS) which for our purposes is identical. The datum should be set to 'WGS84.'

Units
While this setting is not as critical, it will not affect the accuracy of the entire operation, it is recommended that this be set to ease the GPS user's interface with the particular device. As the USNG Grid Reference System is a metric based coordinate system, the GPS units (horizontal) should be set to metric. However, the elevation (vertical) shall remain set to feet, as this is the unit of measure represented by the map contour lines.

Exercise – GPS Setup
Instructor Notes: Provide opportunity for the student to setup their GPS Unit.
Setup your individual GPS unit to match the settings outlined.
Specifically: 1. Position Format – USNG 2. Datum – WGS84 3. Units – metric

GPS Pages

GPS units have a wide variety of page options that can be utilized for a variety of functions. It is beyond the scope of this course to discuss each of these; however we will explore a few of the main pages and their basic usage.

Main Menu

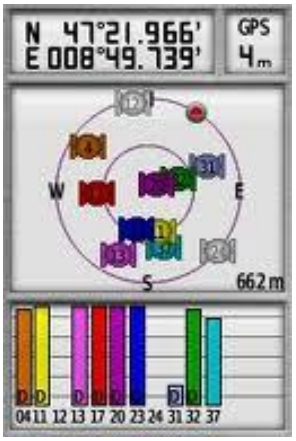
The Main Menu is exactly as it sounds; it contains the full menu of each of the various GPS functions. However, one of the most critical items, within the Main Menu is this is how / where the Position Format (USNG) and Datum (WGS84) is selected.

Typically, the Main Menu may be accessed by pressing the 'Menu' button twice. Pressing the 'Menu' button once will open the sub-menu for that particular page.

Note: if an item is selected as a 'page,' it will likely not appear within the Main Menu.

Satellite Page

The Satellite Page contains a view of the various GPS satellites that are 'visible' to the particular GPS unit. Simply put, the more satellites that are 'visible,' the more accurate the GPS position information. While this is not a frequently used page, during navigation, it does display some information that is important to the GPS navigator.



Note: three (3) satellites are required in order to determine a horizontal position and four (4) satellites are required to determine a vertical (elevation) position.

- Accuracy
  Accuracy is the potential difference between the exact actual position and the reported (GPS) position. No GPS unit is 100% accurate, rather they are typically accurate between 3-10 meters; the better (clear sky view of more satellites) the more accurate the GPS position. This variation in accuracy is important to understand as a GPS does not provide a perfect 'point' of a particular position; rather it defines a small 'range.' As such, the GPS navigator should assist in further determining the specific point by using simple marking (flagging tape) to support the GPS position.

It should be noted that Accuracy is different from Precision. But, this difference is of little actual significance to our navigation and use of the GPS unit at this time.

Map Page
The Map Page contains a view of the GPS map. Many GPS units can be downloaded with any variety of maps; including street maps, topographic maps, etc. The Map Page can be one of the most useful pages in GPS navigation, but it should be setup and customized to the navigator's preferences. Setup of this page can be accomplished by pressing the Menu button once, thereby accessing that particular page's sub-menu.

It is recommended that a data field be shown on the map page and that such data field shows the current position; thereby allowing the user to easily observe their current GPS position. Another common user setup feature is selecting between North Up and Track Up; this feature should be explored to determine the user's personal preference.

Trip Computer
The Trip Computer is the 'dashboard' or 'heads-up display' for the GPS unit. It can be setup with a variety of data fields, each set to the navigator's preference. It is recommended that this page be setup with two different position format fields. This setup allows the user to simultaneously see their current position in both USNG Coordinates and Latitude / Longitude (for communicating with aircraft).

Compass Page
The Compass Page can be setup to act just like a conventional compass; however this feature is one of the most variable functions between different GPS models. Some newer GPS units have compasses that act identical to a magnetic hand-held compass; however older units may have a digital compass, which functions off of satellite data. As such, it is important that the user become familiar with their particular GPS unit. Additionally, the compass can be set to either magnetic north (as a conventional compass) or true north; both have their advantages and should be determined by the user's preference.

Regardless, it is very important that the Compass is calibrated prior to each use. Calibration can be accomplished very simply and quickly by following the instructions provided when starting calibration; which can be selected through the sub-menu (press the Menu button once).

Dispatch / Aircraft Interface

One of the common concerns in utilizing USNG coordinates is the dissimilar language between Dispatch and aircraft, given their common use of Latitude / Longitude coordinate systems. Yet, as the efficiency and ease of use with the USNG system has already been demonstrated, it

becomes reasonable to accept this necessary conversion. This conversion can be accomplished with a few simple steps:

1. Set the GPS Position Format to the coordinate system in which the coordinates will be provided:
   - *From Ground Search – USNG*
   - *From Dispatch and/or aircraft – Latitude / Longitude*
2. Enter the coordinates, into the GPS in the format provided. Name and mark that waypoint.
3. Then, to convert those coordinates into a different format; simply reset the GPS Position Format to the desired units.
4. Select the particular waypoint (Find button) and read / record the coordinates in the newly indicated units. The GPS unit automatically converts all coordinates into whatever Position Format is currently selected.

GPS and Computer Mapping Interface

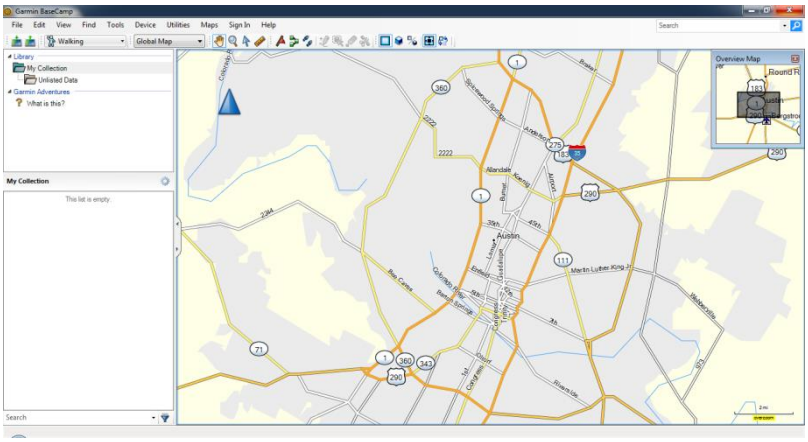
The greatest advantage to GPS use, beyond simplification of Field Navigation, is the ability to interface and visualize GPS information onto a Computer Mapping program. In so doing, one is able to observe, on the Search Map, the progress (tracks and waypoints) of the various search squads. While not all searches will have the capability to utilize such technology, it is used in many searches and can be of significant benefit.

As there are several Computer Mapping programs that facilitate GPS interface, we will not go into the details of each; but a couple will be mentioned for further personal investigation. Each of these programs allows the computer user, typically Search Management, to observe the actual progress (not real-time) of the search squads. Such information can be used to provide greater accuracy to assignment debriefings and documentation.

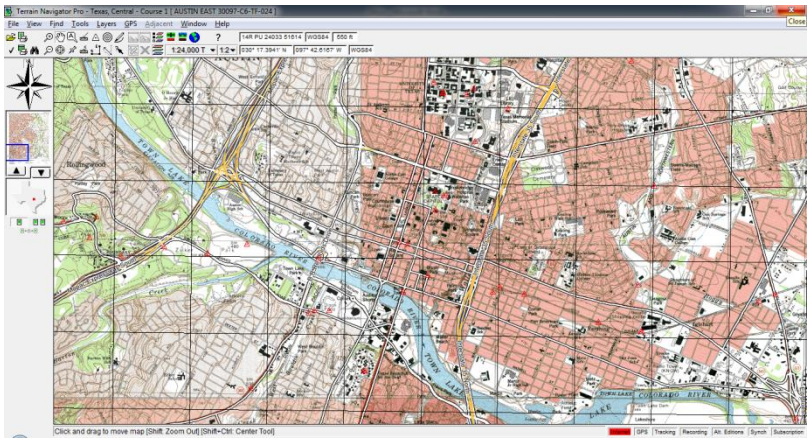
Note: it is important that any downloaded GPS information be tied back to the respective search squad's documentation; hence track and waypoint naming is important.

Garmin Basecamp

This program is a free download from Garmin and specifically intended to provide a simple means to download and utilize the GPS information. The unique feature of this program is that it facilitates easy editing (correction) of any of the GPS information.



Terrain Navigator



Primarily this program is a topographic mapping software; however it can additionally function to interface with GPS units. The background file of this program is the USGS maps, which can be overlaid with the selected coordinate system and datum. By utilizing this program, Search Management is able to provide search squads with topographic maps and be able to download and see the GPS information on those same topographic maps.

GPS Limitations

Thus far, we have focused upon the multiple benefits of GPS usage; and while there are many benefits, there are some important limitations. It is due to these limitations that the basics of Map and Compass Navigation are critical to all navigators. But, with each of these limitations, there are means to mitigate and avoid their effects and therein continue to take advantage of the GPS benefits.

Electronic

As GPS units are electronic, they can be relatively expensive and breakable *(they are not 'fire fighter proof' or waterproof)*. Additionally, training and experience is needed to effectively and efficiently utilize such equipment. Primarily this training is needed to ensure the GPS unit is properly setup to work in conjunction with the Search & Rescue operation, as previously discussed.

Battery Life

As GPS units rely upon batteries for their power source, frequent usage will shorten the workable life of those batteries. The largest strain on the batteries is the backlight, as such minimal use is recommended (use a flashlight). But, the easiest method to overcome the effects of battery life is to ensure that a fresh set of batteries is utilized and that an extra set is immediately available.

Signal Reception

GPS units rely upon signal reception from satellites, as such an 'obstructed view' of those satellites can dramatically decrease the accuracy of the GPS information. While newer GPS units are improving in their ability to obtain a signal, it should still be considered. While it may not be possible to eliminate this problem, such issues can be minimized by working to maintain a 'clear view of the sky;' outside of buildings, out from under heavy tree cover, etc.

Documentation

GPS units only document a portion of a critical search assignment's information, typically just tracks and waypoints. Yet, this information must be combined with the search squad's debriefing

documentation to make a complete record. As such, any / all GPS data should be written and recorded with the search squad's documentation record.

User's Manual
Lastly, as previously stated, the GPS navigator should become familiar with the specifics of their particular GPS unit. This is accomplished both through an understanding of the User's Manual, but also with regular practice and field use.

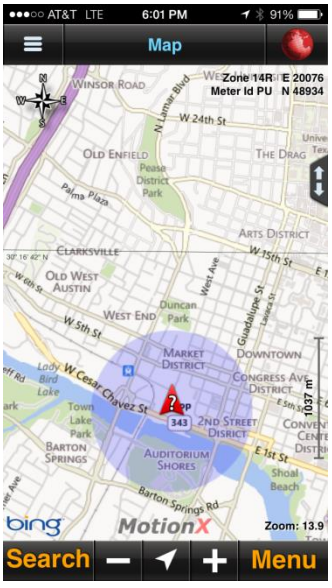
Cellular Phone Mapping & GPS

With the significant and rapid developments in cellular phone technology, this is a rapidly changing item; one which cannot be easily contained within the scope of this course. Rather, we will mention a few key functions and provide a brief recommendation on the critical features that should be explored when selecting these various technologies. Beyond the various applications that can be utilized, the critical feature is that the Search & Rescue operation utilize a common system.

Cellular phones provide the ability to put digital maps easily into the hands of virtually everyone. In addition to the typical 'road maps,' users can access aerial maps to help provide a visual image of the particular area. Additionally, some GPS information can be obtained directly from the cellular phone; including coordinates, tracks, waypoints, etc. However, all of this is predicated upon maintaining a consistent cellular signal and battery life.

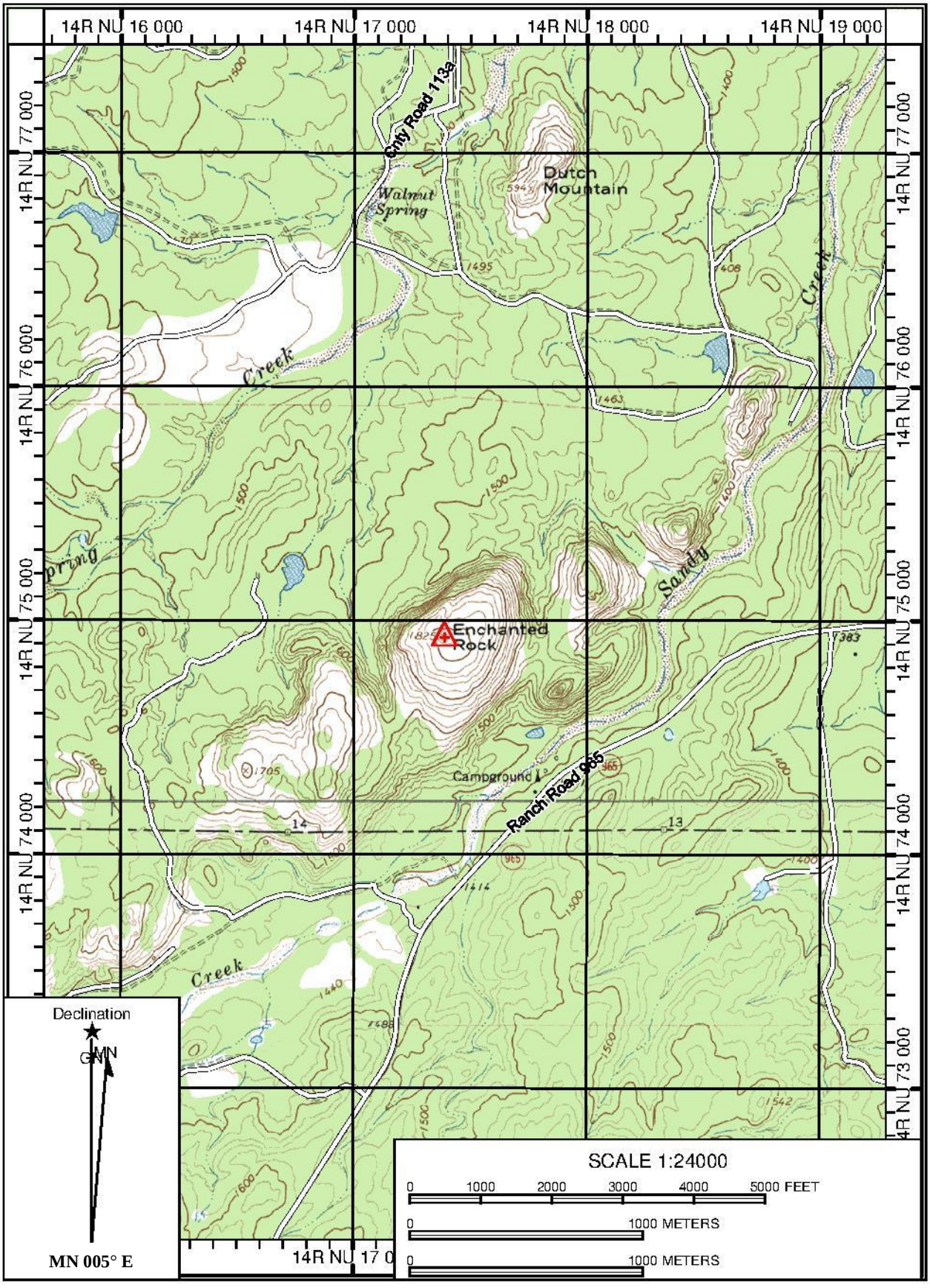
Cellular Phone Applications
It is important when selecting an application, that such can be customized / programmed to interface with the search operation information; such as coordinate system and datum. Additionally, unless such information can be downloaded (typical email) to the Search Management documentation, little Search operation benefit will be achieved.

- Mapping and Navigation
  "Motion X" provides a means to create and view both tracks and waypoints. Essentially, this app works similar to a basic GPS unit; the primary advantage being the ability to email such information; however this is also one of the limitations, as cellular data transmission may not always be available.

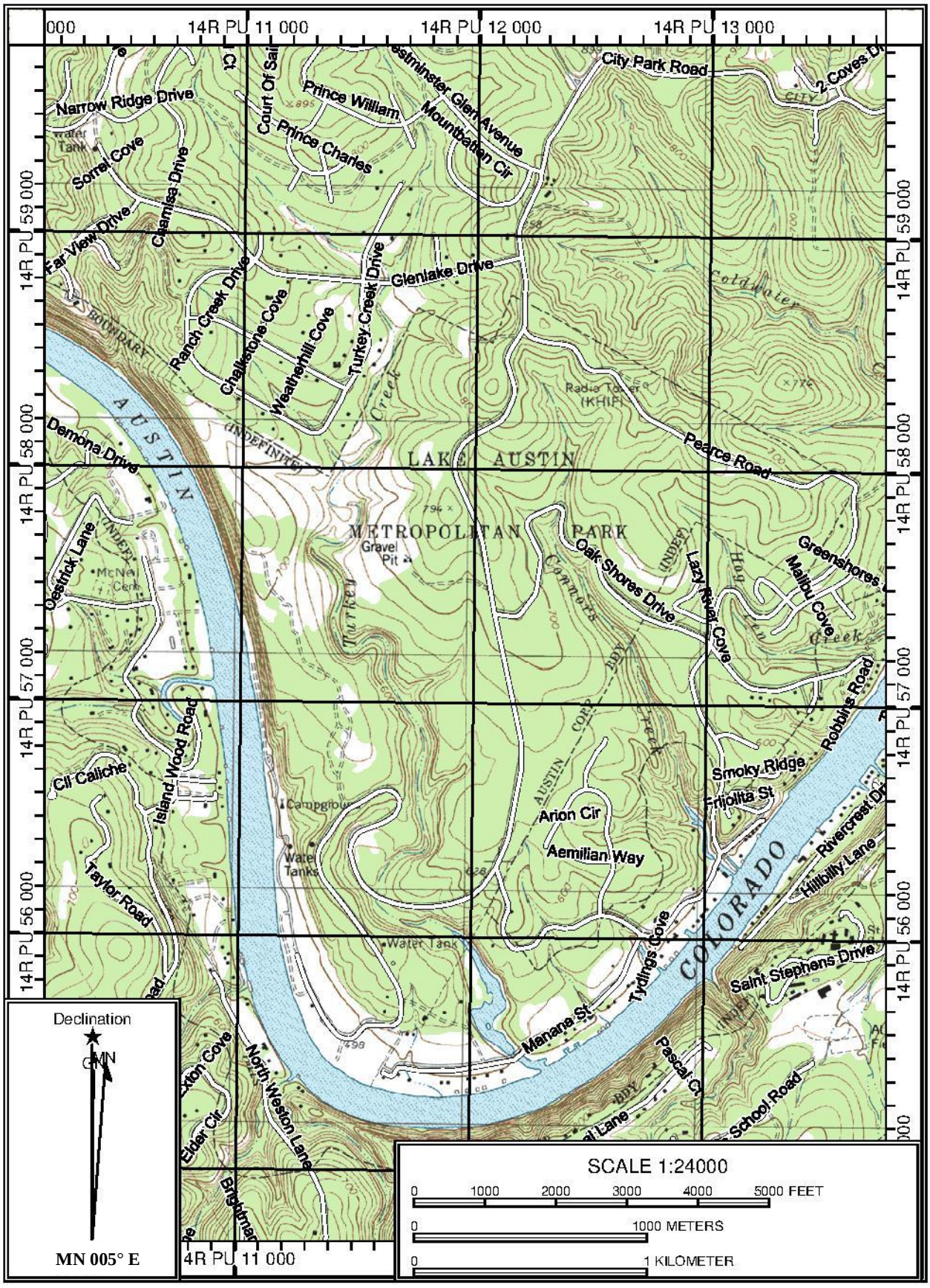


- Photo Documentation
  "Theodolite" is a photographic documentation tool. The benefit being that photos are geographically referenced ('geo-tagged'); such that the specific location (coordinates), time, etc. are displayed on each photograph. This information can provide a significant supplement to any search report, by providing photographic evidence documentation.

- Ongoing Development
  The ideal app for Search & Rescue operations would provide many of the benefits of a typical GPS unit, while providing real-time reporting of such information to Search Management. So, while there are some apps that allow for real-time data transfer (track data) these are fairly limited. But, it should be noted that there is ongoing application and program development to accomplish these objectives.



Map: Enchanted Rock



Map: Emma Long Park (west Austin)

Wilderness Search & Rescue – Level I

Class Title:
Land Navigation – Field Course

NFPA 1006 JPR's:
16.1.4

Time:
4 Hours

Scheduling Suggestions:
Following Navigation classroom session

Materials / Equipment Needed:
- Navigation Course
  - Flagging Tape
  - Course Assignments
- Topographic maps – examples and of the immediate area
- Compasses
- Grid Readers
- GPS Units

Instructor Requirements:
1:5 Instructor to Student Ratio

Objectives:
At the end of this lesson the rescuer should be able to:
- Demonstrate basic map & compass navigational skills
- Demonstrate basic GPS navigational skills
- Demonstrate ability to navigate in the wilderness environment

Course Overview

Earlier in this course we developed a basic understanding of maps, compasses and GPS units; we will now discuss how to apply that knowledge for actual field navigation. While there are many ways to accomplish field navigation, we will focus on just a few of the basics. But, please note, that navigation is a very perishable skill and should be practiced frequently in order to gain experience and proficiency.

Note: the student is encouraged to reference back to the "Land Navigation" curriculum for additional detailed instructions.

Wilderness Travel

There are various methods and tips for traveling in the wilderness environment; such tips will assist the navigator in moving through the terrain. Because we must remember, we are here and traveling through the environment in which another person has become lost; if we are not diligent the same can happen to us. We should not make the same mistake out of arrogance thinking, "that could never happen to me;" because, if it does, we have now become "part of the problem as opposed to part of the solution." Lastly, if we are uncomfortable in the terrain and solely focused upon not becoming lost; then we have lost our reason for being there, search effectiveness.

Avoid Getting Lost

By far, the easiest way to know your location is to never get 'lost' in the first place. This sounds obvious, but is a little more difficult than it may at first seem. In order to accomplish such, you must first know from where you are 'starting,' otherwise you are already 'lost.'

Then, by knowing your starting location, you are able to travel along a particular route, making note of your direction of travel and distance. Such information can be marked onto the map, thereby showing your new / current location. Typically, this is the method we use (without realizing such) when using a 'street map.'

Study the Map

Later, in Land Feature Navigation, we will discuss this as a method of navigation. But, it is not only that; rather it is a necessary skill for all navigators. The navigator should take the time to study the map and make a plan, therein recognizing what terrain features and other key points will be encountered. This serves to not only prepare the navigator, but also to provide periodic 'check points,' which will be discussed later.

Bail-Out Bearing

But, even with the best planning and preparation, sometimes events will occur beyond our control; requiring decisive and immediate action. We should all be familiar with acronym L.C.E.S. (Lookout, Communicate, Escape, and Safe Zone). In the course of Search, and navigation, it may become necessary to utilize that 'Escape' feature. The bail-out bearing is a simple and pre-determined heading by which the navigator can 'escape' from their current position out to an area of safety.

A bail-out bearing is typically not a specific numeric bearing, but rather a general direction (north, south, east, west). But, more importantly, it is directed to a clear and obvious structure (road, river, lake, etc.) that cannot be missed.

Avoiding Obstacles

Later we will discuss the specifics of how to navigate around certain obstacles. But, with careful study of the map, it may be possible to completely avoid said obstacles (provided those are not part of your search assignment. Yet, as mentioned with studying the map; the navigator should be aware of potential hazards (swift water, cliffs, etc.) and take steps to mitigate and/or avoid such hazards.

Vegetation

There is a tendency for vegetation to grow thicker in valleys than on ridges and thicker on the south facing slops than the north. Recognition of such may help to influence the search tactics and strategy or may simply provide the navigator with the easiest and most efficient route through a particular area.

Land Feature Navigation

The primary navigational method used throughout this course will be Orienteering, but first we will introduce another form of navigation, Land Feature Navigation. While this method is more quicker than Orienteering, it sacrifices accuracy. Additionally, it requires a significantly greater level of experience in order to achieve the necessary accuracy; as a result, this is provided as an introduction only as the course will focus upon orienteering.

Land feature navigation relies upon a high degree of execution of both map and compass skills, particularly regarding land feature recognition (contour lines). In this form of navigation, the navigator is not specifically concerned with precise point-to-point navigation, bearings and distances, but rather with moving in the general direction towards a general catching feature. Then, upon arrival at such feature a navigational 'correction' is made to determine the exact location and new direction of travel.

Catching Features

Topographic maps clearly indicate various terrain features and other symbology that will be observed in the real-world. As such, we should be able to view the map and determine what will be encountered along our specific route of travel. Some features are more easily recognized in the real-world than would be others; i.e. rivers, ridgelines, etc. These readily recognizable objects can be thought of as 'catching features,' because as we travel towards them, we will easily recognize our arrival. This will then allow us to move quickly and efficiently through the field until arrival at said catching feature. Then, we can conduct a detailed review of such feature in order to determine our exact location.

Check Points / Progress Checks

In addition to the destination check point, the navigator should familiarize themselves with what features will be encountered throughout the course of travel. These 'check points' serve to create

progress checks that the navigator uses to confirm the accuracy of their travel. Simply this is familiarizing one's self with the topographic map.

For example, the map indicates the course of travel will be downhill with a ridgeline to the navigator's right-hand side. If along the course of travel, the navigator notices the ridgeline on their left-hand side, somewhere the navigator has deviated from the intended course.

Advanced Navigation

In addition to navigation by terrain features, there are other more advanced forms of navigation. These may include section / resection (triangulation), navigation by the sun, night navigation (by the stars) and various forms of improvised navigation.

Field Navigation – Map & Compass

As we have already learned, both maps and compasses are powerful navigational tools. But, it is only in using them together that we can achieve their true benefit. We are able to combine and apply this knowledge to accomplish various navigational skills.

Be aware that anytime the navigator is working with both maps and compasses, adjustments will be required for declination. Maps will provide true north bearings, whereas compasses will result in magnetic north bearings.

Determining Map Location

There are a variety of ways in which to determine your location on the map. While we will discuss the basics of this skill, it is best learned and practiced with actual field experience.

Observing Terrain / Land Features

Assuming you already became 'lost,' you must now determine your current location. Each of the various types of maps can be used to assist in this process, but we will focus upon recognition in the wilderness environment and therein use of the topographic map. As topographic maps indicate both natural and man-made there is a wealth of information available for our analysis.

Through careful and precise observations of the surrounding area we are able to make comparisons between the real-world objects observed and their mapped representations. Take caution to compare real-world objects with the map, being critical in ensuring an accurate match; don't just 'make it fit.'

For instance; you may notice that you are at the top of a hill; this same feature can be observed from the various map contour lines. That said, it will take more additional analysis of the surrounding terrain to determine exactly which hill, but the observations are the same.

Or, this can be as simple as noticing that you are at a road intersection and finding the matching condition on the map. The possible options are endless, but can only be accomplished through careful observation and comparison.

Exercise – Observing Terrain / Land Features
Instructor Notes: Provide opportunity for the student to practice determining the straight-line distance between two points.
Utilizing the maps provided designated two points (either with coordinates or features). Have the student determine the straight-line distance (in meters) between those points.
Exercise: 1. Hilltop 2. Valley 3. Road 4. Building

GPS / Cell Phone Technology
This can be the easiest and most efficient way to determine location, but as with any technology it is limited. These will be discussed later in the course, but considering their limitations and potential failures, should not be solely relied upon for this critical information.

Determining a Bearing (direction) from a Map

This skill allows the navigator to determine the bearing (direction / angle) from any point on the map to any other point. This would allow the navigator to determine the bearing between map points. This skill can be accomplished through a few simple steps:

Note: the compass magnetic needle is NOT used in this skill.

1. Mark both the starting point and the target point on your map.
2. Orient the map such that north is up.
3. Observe the two points and visually estimate the bearing from one point to another, making mental note of such.

   - *North = 0 / 360 degrees (up on the map)*
     Northeast = 45 degrees
   - *East = 90 degrees (right on the map)*
     Southeast = 135 degrees
   - *South = 180 degrees (down on the map)*
     Southwest = 225 degrees
   - *West = 270 degrees (left on the map)*
     Northwest = 315 degrees

4. Align the straight edge of the compass with these two points. Make sure the bottom of the compass is at the starting point and the top (direction of travel arrow) is towards the target point. Carefully hold your compass aligned with these two points.
5. Rotate the bezel until the orienting arrow and orienting lines lie parallel to the north-south gridlines marked on the map. Make sure the orienting arrow is pointing north (up on the map).
6. Remove the compass from the map and read the (true north) bearing from the index line.
7. If this bearing does not approximate the angle you estimated, then there is likely a problem. Rework the exercise.

8. You have now successfully determined the direction (true north) between these two points on the map. If the bearing is needed for field navigation, make the necessary declination adjustments.

   Note: there are other, more advanced skills, in which a bearing is taken from the field and plotted onto the map. Such as in section / resection (triangulation); but these skills are beyond the scope of this course.

Exercise – Determining Bearing from a Map
Instructor Notes: Provide opportunity for the student to practice determining map bearings.
Utilizing the maps provided designated two points (either with coordinates or features). Have the student determine the bearing between those points. Take note of True North vs. Magnetic North bearings.
Exercise: 1. Enchanted Rock Map – what is the Magnetic bearing from Dutch Mountain to Enchanted Rock? 186° M 2. Enchanted Rock Map – what is the True North bearing between 16747 / 75207 and hilltop 1705? 3. Emma Long Map – what is the Magnetic Bearing between the Cemetery (upper left) and the Campground? 4. Emma Long Map – what is the True North between the Manana Street bridge and the nearest water tank?

Orienting the Map

Orienting the map means to position the map in such a way that it directly relates to the current position and real-world; essentially making the map face the same direction as the real-world. So, this can be accomplished by turning the map such that north on the map (top) is facing north in the real-world. It is highly advantageous that this is done, in order to improve your situational awareness of the environment and provide a visual comparison between the map and the real-world. Orienting a map can be achieved in one of two ways:

Orienting the Map with Terrain / Land Features

If you do not have access to a compass, orientation must be accomplished in this manner. If this is the case, this becomes a critical skill as it would be one of the last means to successfully navigate. This can be accomplished with a few simple steps:

1. Observe the area and gain a preliminary estimate of which direction is north. Utilize observations such as the position of the sun and/or other improvised navigation techniques. Position your body such that you are facing north.
2. Observe what significant features are around you; features that would be visible on a map. Such as roads, buildings, waterways, terrain, etc.
3. Mark you current position on the map, by comparing the real-world features with those on the map.
   Note: if you are unaware of your current location, such can be determined as stated above. But, detailed review of such is beyond the scope of this course.

4. Observing both your location on the map and the real-world features surrounding that location; rotate the map until the map features are aligned with the same of the real-world.
   For example; if there is a body of water on your right hand side, it should be to the right of your position on the map.
5. The map is now oriented such that north, on the map, is aligned with north, in the real-world. This is verified by observing the relationship and alignment between several real-world features and their respective map representations.
   Note: this process is simplified if the navigator maintains continual situational awareness of the surrounding areas and terrain.

Exercise – Orienting the Map with Terrain / Land Features
Instructor Notes: Provide opportunity for the student to practice orienting their map utilizing terrain and land features. Setup positioning should be readily obvious.
Utilizing a map of the local area, orient the map utilizing terrain and land features.
Exercise: 1. Observe the surround features. 2. View the map and find the matching features. 3. Utilizing such, orient the map to match such. 4. Estimate your current location.

Orienting the Map with Compass

This is the easiest of the methods to orient the map, but it does require a compass (which is a basic navigation tool that should always be available). Orienting the map with compass can be accomplished with a few simple steps:

1. Set your compass bearing to 0 degrees.
   Note: as this skill relies upon the magnetic compass; it will be highly affected by magnetic interference (which will be discussed later) and should be avoided. As such, DO NOT perform this skill adjacent to metal objects (i.e. hood of a vehicle).
2. Place your compass on the map, such that the top of the compass (north) is facing north (up) on the map. One edge of the compass should be aligned with the north-south map gridlines.
   Note: if your map has a compass rose with the magnetic north arrow; place the edge of your compass along such for greater accuracy. Otherwise, declination adjustments would be necessary for precise alignment.
3. Maintaining the compass edge along the map gridlines; rotate the map and compass (together) until the magnetic needle is aligned with the compass orienteering arrow.
   Note: the map and compass should be held flat and level.
6. The map is now oriented such that north, on the map, is aligned with north, in the real-world.

Exercise – Orienting the Map with Compass
Instructor Notes: Provide opportunity for the student to practice orienting their map utilizing their compass.
Utilizing a map of the local area, orient the map utilizing your compass.

Compass Basics

One of the most basic, yet important, skills is how to properly hold the compass. It is necessary that this is done correctly, in order to obtain the most accurate compass readings. Simply put, the compass should be held flat, level and square to your body.

Holding the Compass

These steps will help to accomplish such, thereby ensuring accuracy and minimizing potential problems:

1. Remove any sources of potential interference; radio chest harness, jewelry, etc.
2. Creating a 'tripod' with your arms: lock your elbows into your sides and cradle the compass in the palm of both hands. This will assist in holding the compass flat, level and square to your body.
3. Hold the compass square to your body and at eye level.
4. Adjust the compass mirror (Orienteering style compass) such that you can see the reflection of the compass housing (bezel and magnetic needle) without tilting the compass.

   Note: the magnetic needle may not function properly if not held level.

Sighting the Compass

This skill allows the navigator to determine the bearing (direction / angle) from their current position to another location (visible). This would allow such angle to be plotted onto the map. This skill can be accomplished through a few simple steps:

Note: the compass magnetic needle is critical to this task, so any sources of magnetic interference must be avoided.

1. Determine which direction is approximately north and face that direction.
2. Visualize traveling from your location to the intended target. Observe this direction of travel and visually estimate the bearing, making mental note of such.

   - *North = 0 / 360 degrees (up on the map)*
     Northeast = 45 degrees
   - *East = 90 degrees (right on the map)*
     Southeast = 135 degrees
   - *South = 180 degrees (down on the map)*
     Southwest = 225 degrees
   - *West = 270 degrees (left on the map)*
     Northwest = 315 degrees

3. Properly hold the compass such that you can visualize the compass housing in the mirror.
4. Look / sight over the top of the compass; aligning the compass sight onto your target.
5. Maintaining this position, carefully rotate the bezel until the orienting arrow aligns with the magnetic needle.
   Put "Red Fred" (magnetic needle) in the "Shed" (orienting arrow).
6. Remove the compass from your sight and read the bearing (magnetic) from the index line.

7. If this bearing does not approximate the angle you estimated, then there is likely a problem. Rework the exercise.
8. You have now successfully determined the direction (magnetic) between your location and another point in the field.

Exercise – Sighting the Compass
Instructor Notes: Provide opportunity for the student to practice holding and sighting their compass.
Designated a variety of bearings and instruct the students to set their compass and then observe what is at the designated bearings.

Field Navigation – GPS

Having now developed a basic understanding of the GPS unit and having properly setup the unit for use, we can begin utilizing such in actual navigation. However, it is important that the GPS setup is confirmed and double-checked against another unit and against the map position.

Waypoints

A Waypoint is a 'mark' of a particular important point; this can be used for a variety of purposes, such as marking the Command Post or a clue. We will discuss some of the various Waypoint particulars and some tips:

Marking and Naming

With most GPS units it is very easy to 'mark' a waypoint, typically by pushing the 'Mark' button. Once a waypoint has been marked, a Waypoint Screen will be displayed. From this screen the user can observe and/or edit a variety of items.

There are a variety of methods to 'naming' waypoints; the desired method should be specified by the operational Command. The GPS will automatically assign a unique waypoint name, typically a three-digit sequential number. In many cases, particularly in terms of expediency, it may be preferable to maintain the automatically assigned name. However, in this case, it is very important that such name be written down with the particular important parts of the marked waypoint.

However, if expediency is not of the highest priority, it may be beneficial to rename the waypoint to something uniquely representative of the mark. This is accomplished by 'highlighting' the name field and editing the name.

Note: it is important that any / all critical points are marked; specifically the Command Post, vehicle, etc.

Exercise – GPS – Marking Waypoint
Instructor Notes: Provide opportunity for the student to practice utilizing their GPS unit to mark a waypoint.
Designated a variety of points and have the students mark such on their GPS unit. The student should then be able to read the coordinates of the various waypoints marked.

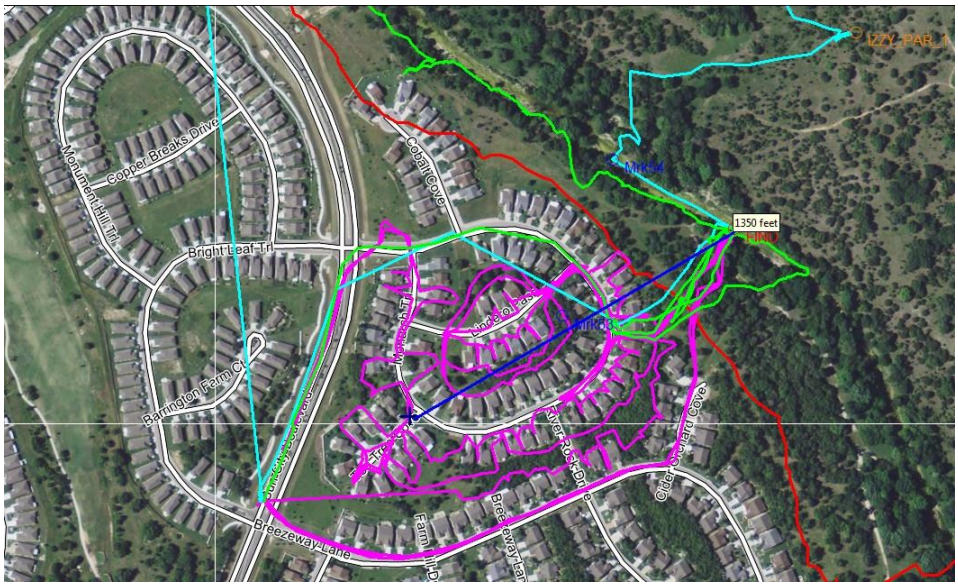
Current Location vs. Given Location
When marking a waypoint, the GPS unit automatically defaults to marking the current location of the GPS unit. However, from the Waypoint Screen, the navigator can edit the waypoint position coordinates to record the location of a different set of coordinates.

For example, in looking at the map, the navigator determines the coordinate location of an important point; these coordinates can then be input into the GPS unit and marked as a waypoint. This is accomplished by 'highlighting' the coordinate field and editing the coordinate position.

Exercise – GPS – Waypoint Naming
Instructor Notes: Provide opportunity for the student to practice re-naming various waypoints and entering the coordinates for alternative waypoints.
Instruct the students to re-name, to unique identifiers, the waypoints marked in the previous exercise. Then, provide the students with various sets of coordinates and have them create new waypoints from the coordinates provided. Utilize coordinates that mark obvious features relatively near (100m – 200m) the instruction area.

Tracks
GPS tracks essentially act as 'breadcrumbs' to track where the GPS unit has 'traveled.' However, in order to be effective, some basic setup is first required.

Start of Assignment
GPS tracks should be cleared prior to the start of any search assignments, otherwise tracks will exist from the previous usage. Also, it is absolutely critical that tracks are TURNED ON at the beginning of the assignment; it is not possible to retroactively 'retrieve' tracks if not previously recorded.



Example: observe the cyan line – it leads off to 'nowhere' because the GPS track was not 'cleared' prior to the start of the assignment.

End of Assignment
At the end of each search assignment, the tracks should be SAVED and/or TURNED OFF. This avoids creating random tracks to, from and around the Command Post in addition to transport routes and other non-search travel. Also, by saving the tracks, when tracks are cleared for the start of the next assignment, the previous tracks are not lost.

Exercise – GPS – Tracks
Instructor Notes: Provide opportunity for the student to practice utilizing the track feature on their GPS unit.
Instruct the students to utilize their GPS units.
Exercise: 1. Turn-on tracks 2. Clear tracks 3. Create (walk) tracks 4. Turn-off and save tracks

Find / Go-To Navigation

One of the most common usages of GPS units is to navigate back / 'Find' a waypoint that was previously marked. Yet, while this is one of the most common needs of the GPS, it is probably one of the least practiced and therefore most difficult for the GPS navigator. We will discuss some of the particulars of the Find / Go-To Navigation feature and provide some recommendations:

Navigating
Once the GPS navigator has selected the intended waypoint target, the GPS unit will display a route to that particular waypoint. Given that the GPS constantly points straight to the target waypoint, the navigator is able to walk around and avoid obstacles, with the GPS maintaining a path to the target. As such, the navigator can take the 'easier' route as opposed to the 'direct' route to the waypoint, as is typically required in compass orienteering, as will be discussed later.

In the course of GPS navigation, there are a variety of methods to accomplish this Find / Go-To Navigation; but primarily these are user preference and should be explored and practiced. In navigating to a particular waypoint, the navigator should walk in straight lines, as opposed to curving paths. Remember, the GPS relies upon satellite point information and works for effectively in straight ahead movement as opposed to curves.

Map Page
By observing the GPS Map Page, the navigator can visualize the route from the current position (arrow) to the target position; as displayed by a heavy line. So long as the navigator moves along this line, the arrow will remain pointed at the target / parallel to the line. If the arrow is not pointed parallel to the line, then the navigator should turn and walk until such is accomplished.

Compass Page
In this usage, the compass arrow is not pointing towards north (like a magnetic compass); rather it points towards the target position. Simply put, if the navigator walks such that the arrow is pointing straight ahead / up, they are walking directly towards the target.

However, you may occasionally notice that the arrow is offset from the center of the compass dial. This indicates that the navigator is traveling parallel, along the route towards the target, but is off to one side. As such, the navigator must move sideways in order to get the arrow back to center and then again start moving directly towards the target position.

Remember to calibrate the compass prior to using if for any navigational work.

Exercise – GPS – Find / Go-To
Instructor Notes: Provide opportunity for the student to practice utilizing the Find / Go-To feature of their GPS unit.
Utilizing the unique coordinates entered previously, instruct the student to use the Find / Go-To feature of their GPS unit to discover what is at the designated coordinates.

Field Navigation – Orienteering Course

Exercise – Orienteering Course
Instructor Notes: At the conclusion of instruction, provide opportunity for the student to practice an orienteering course.
Utilizing the 'Course Setup Instructions' provided in the Student Task Book, setup a similar course to allow the students time to practice. The course shall consist of a variety of features.
Exercise: 1. Map & Compass Orienteering 2. Determining distance (pace) between points 3. GPS Navigation – USNG & Latitude / Longitude

Orienteering commonly refers to a system of navigation in which precise point-to-point wayfinding is needed; orienteering requires very close attention to detail and careful execution. In orienteering the navigator is attempting to move directly between points all the while maintaining a specific course bearing. While Orienteering is precise and highly the drawback is that such can be somewhat slow and tedious. This limitation can be mitigated only through practice.

As such, opportunity will now be provided for the student to complete an orienteering course as created by the Instructors. Detailed instructions for an example orienteering course setup are available in the Task Book; but at a minimum should provide opportunity for both map & compass and GPS navigation (utilizing both USNG and Lat / Long coordinate systems).

Shooting a Compass Bearing

This skill allows the navigator to determine the direction of travel from their current position to another location (non-visible) given a specific compass bearing (direction / angle). For example, you know the bearing from your campsite to your vehicle, but you cannot see such. This skill can be accomplished through a few simple steps:

Note: the compass magnetic needle is critical to this task, so any sources of magnetic interference must be avoided.

1. Determine which direction is approximately north and face that direction.
2. Given your intended bearing, visualize such, and rotate your body to face approximately along that bearing direction.
3. Set the prescribed (magnetic) bearing on your compass. Rotate the bezel until the index line is accurately aligned with the appropriate angle. Double-check that the proper bearing was read and set.
4. Properly hold the compass such that you can visualize the compass housing in the mirror.
5. Look at the compass housing reflection and rotate your body until the magnetic needle is aligned parallel inside the orienting arrow.
   Put "Red Fred" (magnetic needle) in the "Shed" (orienting arrow).
6. If this is not the approximate direction you were facing, then there is likely a problem. Rework the exercise.
7. Look / sight over the top of the compass; you are now looking along the prescribed bearing. Pick an object in the distance, the further the better, this is your target.
   Note: many compasses utilize 'gun sight' notches in the mirror case to improve the accuracy of this step.
8. You have now successfully determined the direction (magnetic) of travel from your current location to another location.

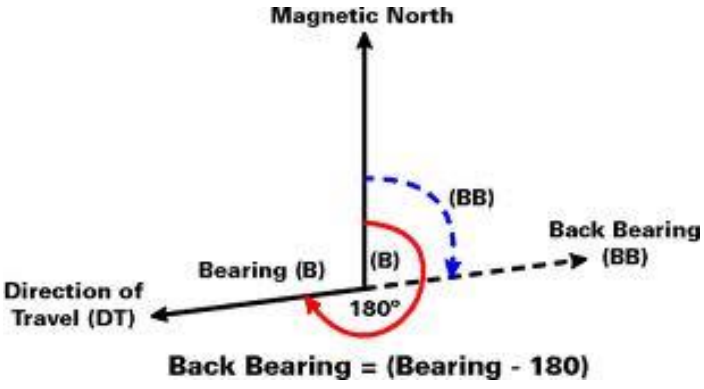
Walking the Compass Bearing

So, once you have accurately shot the desired bearing and selected the target object, it is necessary to begin moving towards said object. At this time, the navigator shall put down there compass and move directly to the target object; do not attempt to watch your compass while walking. Then, upon arrival at the initial target object, the process can be repeated towards the next visible target until the desired destination in reached. As simple as this may sound a few points of warning should be mentioned:

- Select a target point that is readily identifiable and at the furthest possible distance
- Carefully observe the target location – as you move it may begin to look different
- Carefully observe your starting location – this will be discussed more later
- Maintain a pace count while moving towards your target location – this will be discussed more later

Back Bearing

The back bearing is the azimuth (angle) at 180 degrees from the bearing; simply put it is directly behind / opposite the bearing. A back bearing is helpful in maintaining and confirming an orienteering course that is being walked. For instance, once the navigator has reached their next target point, they can then sight back along their back bearing. If their starting location is not aligned



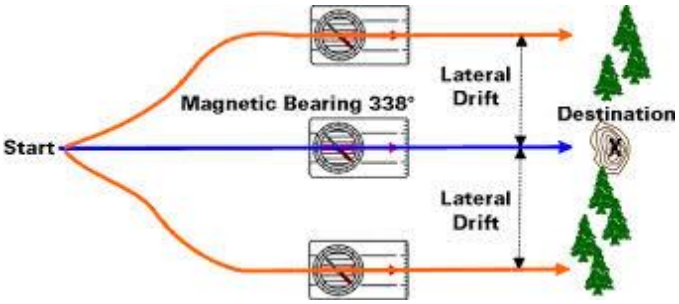
within the compass sight, the navigator has deviated in their travel. If necessary, the navigator can then shift their body to the side until such alignment occurs.

If upon shooting the back bearing, the navigator is aligned with their starting position, they have gained confidence and confirmation of their navigation course. The navigator can continue shooting bearings and moving towards their destination; periodically checking their back bearing.

Note: on most compass, it would not be necessary to adjust the bezel to obtain the back bearing, simply use the opposite end of the magnetic needle as you would in typical navigation.

Lateral Drift

Everyone has some tendency to 'laterally (sideway) drift' when walking. Typically, this is insignificant and unnoticed as we make frequent corrections, for example while walking down the street. But, when navigating, there is not readily obvious way to recognize and therein correct such drift.



Lateral drift may be caused by terrain (tendency to drift downhill, particularly when walking a side slope), vegetation (tendency to avoid thick brush), trails (tendency to travel along and avoid departing from a trail or clearing), or simply 'drifting' while walking. Typically, an individual tends to drift one way or another (right or left); it is only with experience that you will begin to recognize and therein take steps to reduce the effects of such drift.

However, by recognizing our potential for lateral drift, we are able to take caution towards reducing its impact. Primarily, this is done through careful and precisely following navigational targets and frequently checking one's back bearings.

Determining Distance

With navigation it is important to know not only direction of travel, but also distance traveled, in order to determine their new location. One of the most accurate ways to estimate the navigator's travel distance is through the use of pace count.

A pace is simply tow NORMAL steps. For instance; starting with your feet together, take a step with your right foot, and then your left foot and your right again; this is a pace. Each person's pace and therefore their pace count is different, so we must each individually calculate our own. Additionally, our individual pace can vary based on terrain, vegetation, fatigue, etc. so we should be aware of such items. In order to initially determine your pace count, complete the following steps:

1. Establish a 100 meter long course through the terrain and vegetation typical of the area to be navigated.
2. Walk, normally, along this course while counting each pace (every other step).
3. Upon arrival at the end, write down the pace count.

4. Turn and repeat the exercise back to the starting point.
5. Now, average the two pace counts to determine your Pace Count at 100 meters.

Now, as you navigate along a course, constantly keep track of your paces. Then, with a little simple mathematics, your pace count can be converted into metric distance:

- 100 / Pace Count = X (meters per pace)
- X * number of paces = distance traveled (in meters)

Exercise – Pace Count
Instructor Notes: Provide opportunity for the student to both determine and practice utilizing (converting pace to meters) their pace count.
Create a 100m 'Pace Count Course.' Also, create a variety of length courses, in order that the students can practice converting their pace count into metered distances.

Encountering Obstacles

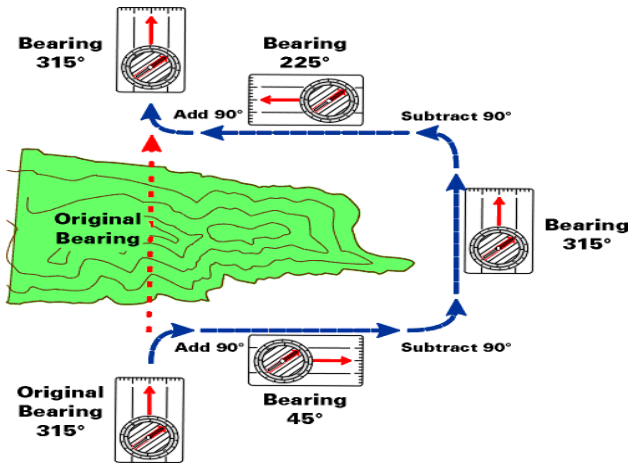
As it is imperative that an accurate bearing and distance is maintained while walking an orienteering course, it is inevitable that some impassable obstacles will be encountered along the course. As such, we must determine a method to navigate around those obstacles.

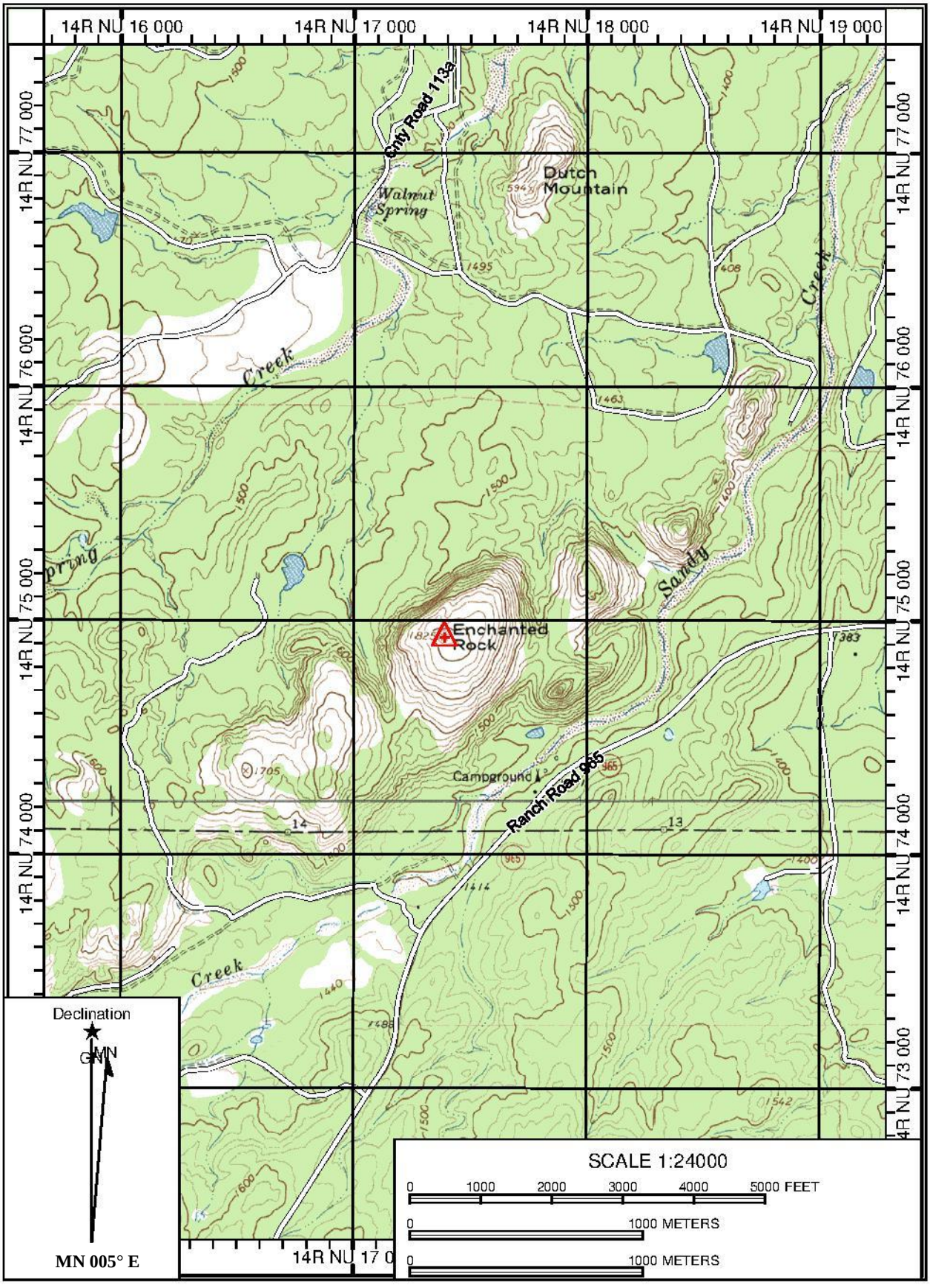
Sighting Past an Obstacle

If you are able to see and select a target point through / past a particular obstacle, it may not be necessary to walk directly through such obstruction. Simply move around the obstacle to the selected target point, making sure to check your back bearing upon arrival. However, caution should be exercised with this method, as distance must be estimated since a straight line pace was not maintained.

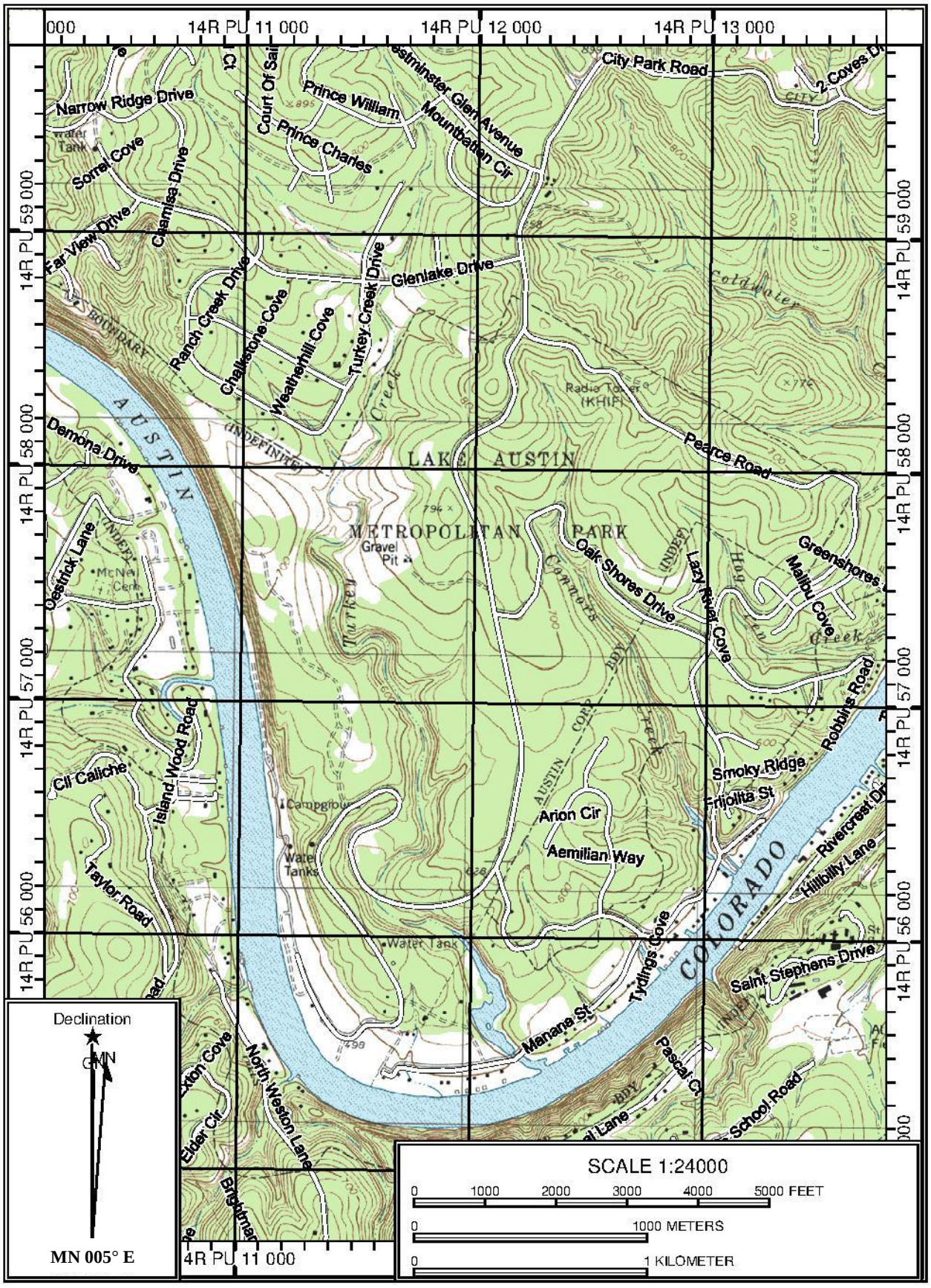
Boxing Around a Small Obstacle (i.e. patch of cactus)
A small obstacle can be avoided simply by taking several large side steps, perpendicular to the direction of travel (do not count these steps with your pace); then once past the edge of the obstacle, the navigator should continue on the original bearing until past the opposite side of the obstacle. Once past the other side; the same number of side steps will place the navigator back on the original course; from which they can continue their original navigation.

Boxing Around a Large Obstacle (i.e. pond)
This is accomplished the same as a small obstacle, but due to the long side-to-side distances, the navigator is unable to simply 'side step' such. Rather, the navigator must use their compass to navigate around the object; setting the compass bearing to 90 degrees from the original bearing and walking sideways to clear the object.





Map: Enchanted Rock



Map: Emma Long Park (west Austin)

Wilderness Search & Rescue – Level I

Class Title:
Incident Management System for Wilderness SAR

NFPA 1006 JPR's: N/A

Time:
15-20 Minutes

Scheduling Suggestions:
Toward the beginning of the class

Materials/Equipment needed: N/A

Instructor requirements:
1:15 Instructor to Student Ratio

Objectives:
At the end of the lesson the trainee shall be able to:

- Identify the Primary Principles of the Incident Management System
- Identify the various standardized IMS terminology used in Wilderness SAR incident
- Identify the three Incident Priorities
- Explain the L-A-S-T acronym
- Identify the three possible Modes of Operation
- Describe and use a C-A-N report when giving a size-up
- Identify Task/Tactical Level Benchmarks
- Identify Command Level Benchmarks

Introduction

The Incident Management System (IMS) should be familiar to most rescuers who take this class. To review its primary principals:

- It is a standardized flexible format that expands and contracts to fit the needs of a given incident.
- Uses common terminology that allows rescuers from multiple organizations to work together.
- Creates a unified command structure that ensures everyone works for one leader and no tasks are duplicated (unless needed).
- Identifies an Incident Action Plan (IAP) for every incident. Sometimes these are formal and written, other times they are predetermined.
- Creates a manageable span of control to ensure no one is overloaded with tasks or personnel. Typically, one person should manage three to seven people or tasks, with five being optimal.
- Creates a comprehensive resource management plan.

As reviewed in General Rescuer, the standardized format for setting up the command structure includes:

- **Command Staff**
  - **Incident commander (IC) or Command-** Is the leader, ultimate authority and responsible party.
  - **Safety Officer-** Is the person designated specifically to oversee the safety aspect of the event. In the technical rescue setting this person should have a background and several years of experience in technical rescue.
  - **Liaison Officer-** Is the person who would interface with other people and organizations who may be involved or have a vested interest in the incident.
  - **Public Information Officer (PIO)-** Is the person who usually should interface with any media or other group whom information about the incident is to be released.
- **General Staff**
  - **Operations Chief-** Oversees the operational aspect of the rescue or recovery.
  - **Plans Chief-** Creates plans for the event including: travel plans, accountability plans, operational period plans, etc. Additionally this chief normally runs meetings and is responsible for the overall documentation of the incident including the IAP.
  - **Logistics Chief-** Takes care of all of the logistical needs of the incident including: food, shelter, equipment, etc.
  - **Finance Chief-** Takes care of the financial aspects, including: tracking equipment cost, personnel cost, fuel cost, etc.

The IC will determine the format that will be used for the incident. Each IC has their own preferences for how to set up the structure and this varies with the needs of different incidents. Under a Section Chief there can be Single Resources, Groups, Divisions, and Branches. Single Resources may be given tactical assignments. Groups are responsible for specific tactical functions and are lead by a Group Supervisor. Divisions are normally associated with a specific

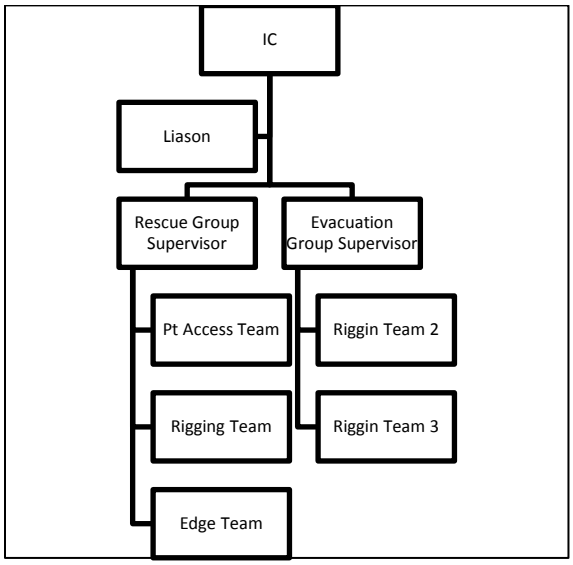
geographical area and are lead by a Division Supervisor. Branches can be created when resources, groups and/or divisions reach a number that the span of control is too large and an additional layer of management needs to the created. Branches are lead by a Branch Director.

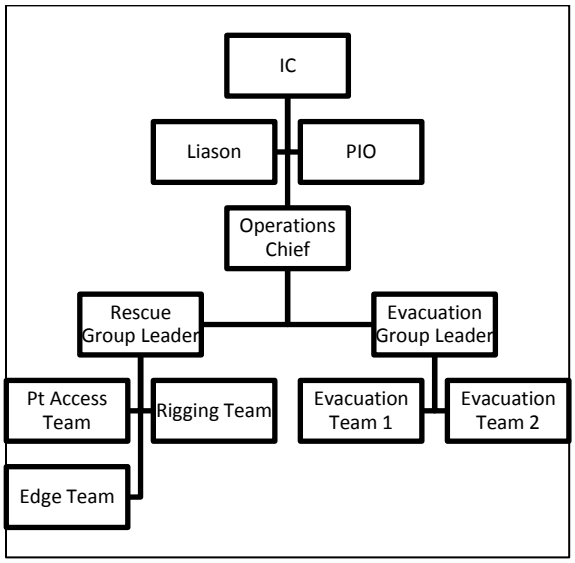
Common Terminology is one of the benefits to the IMS system. Additionally, the RESET curriculum defines terminology used by its students and instructors. The terms used by RESET were chosen in an effort to maintain consistency with other technical rescuers throughout the US. This can be as simple as specifying what to call a specific haul system or device. To better define standardized terms, below are some IMS terminology relevant to Wilderness SAR incidents:

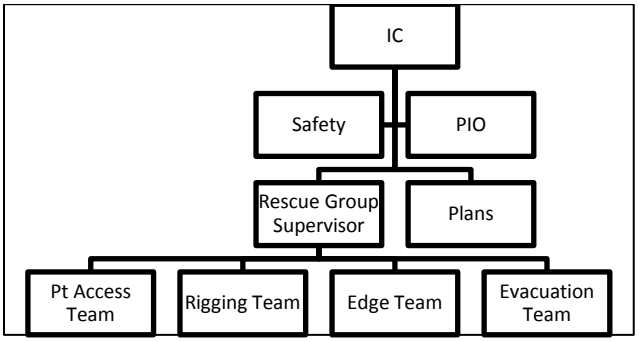
- **Hot Zone-** This is identified as the area in wilderness, away from established trails or roadways.
- **Warm Zone-** This is the areas away from civilization but still on established trails that lead back to a safe area.
- **Cold Zone-** This is outside of the wilderness area. Typically the command post and other support functions can be found here.
- **Rescue Group-** Is the Group that performs the rescue functions associated with a specific task. In complex rescues or rescues that span over a large area, there may be multiple Rescue Groups. These groups are normally created after the Wilderness search aspect is completed and the patient(s) is located.
- **Rescue Group Supervisor-** This is the person designated to lead the Rescue Group. This person normally directs the operations of the rescue and decides how the rescue will be accomplished.
- **Medical Group-** Is the Group that has responsibility to provide care to the patients and rescuers.
- **Medical Group Supervisor-** This is the person designated to lead the Medical Group.
- **Evacuation Group-** Is the group charged with transporting the patient(s) from the rescue area to the ambulance or other transportation to the hospital. In complex rescues or rescues that span over a large area, there may be multiple Evacuation Groups. Sometimes the Rescue Group carries out this function.
- **Evacuation Group Supervisor-** This is the person designated to lead the Evacuation Group. This person normally directs the operations of the evacuation and decides how the evacuation will be accomplished.
- **Search Team-** Is a team of rescuers who are responsible for searching an area and is lead by a Search Team Leader. This includes Rapid (Hasty), Primary (Loose Grid), Secondary (Tight Grid), and Evidence searches.
- **Segment-** Is a small geographical area within the search area. Once the size of the search area is established, the area is typically "segmented" into smaller sections. Segments allow the incident management team to more efficiently coordinate search efforts. A search area that is very large with many segments can be divided into Divisions with multiple segments with in each Division.

As the incident progresses, team or group designations may change to fit the needs of the operation. *(Ex. A Search Team that finds the Pt may turn into the Pt Access Team)*

There are many ways to set up an ICS system. Here are a couple of examples of how they may be set up:







Incident Priorities

The Incident Priorities for a technical rescue are no different that any other incident:

1. Life Safety
2. Incident Stabilization
3. Property Conservation

Strategy and Tactics

All strategy and tactics should be designed with the incident priorities as the overall focus. The strategy used for technical rescue incidents should generally be categorized as one of the following: **Search**, **Rescue**, or **Recovery**.

A strategy should be developed and shall center on satisfying the following objectives. They are referred to as the L-A-S-T acronym.

- **Locate-** the person(s) needing assistance. This may be simple or may be a complex search. **This is what this class is all about!!!**

- **Access-** the person(s) needing assistance. Walking, swimming, rappelling, being lowered, or other means may accomplish this task.
- **Stabilize-** The person(s) needing assistance. Provide medical care and package the Pt in a device that will provide the best means of extrication.
- **Transport-** the person(s) to an ambulance, designated area or other safe area.

Modes of Operation

One of the first decisions made by the first rescuers is the mode of operation. Much like fire scenes the mode of operation will be used to assign the appropriate tactics and establish a command structure. The IC should announce the mode of operation over the radio and/or ensure all personnel operating on the scene are informed. These Modes of Operation are: **Search, Rescue, or Recovery**

Search

The location of the person(s) needing help will not always be known. Locating the person(s) will be the first objective. Information gathering will assist with determining where to search. Information gathered from the 911 call taker, interviewing people on scene, talking to witnesses, use of a Lost Person Questionnaire, familiarity with the area, etc will help with gathering information. Law Enforcement is exceptionally good at gathering information and investigating the unknown. Using them in this process is usually very helpful.

One of the primary focuses should be on determining the Point Last Seen (PLS). As information gathered allows you to make decisions, deploy Hasty Teams to areas where the Pt is likely to be found or other areas of interest and Search Teams to more thoroughly search areas. Search theory and tactics are outside the scope of this lesson. Please refer to lost person search tactics for more information.

Once the person(s) needing help is located it must be determined if this is a Rescue or a Recovery. This decision will affect the pace of the operation and may affect the techniques used. The axiom risk a little to save a little, risk a lot to save a lot, applies. Be sure the IAP is appropriate for the mode of operation.

Rescue

This strategy should center on the safe and speedy removal of the person(s) from the hazardous environment. Once Pt contact is made a medical classification of the Pt should be determined and relayed to the IC/command. Next, medical care and packaging the Pt for extrication/evacuation, if needed, should be the focus.

As resources arrive Group Supervisors should be established to accomplish any rescue or evacuation required. Depending on the size and scope of the incident multiple Groups may be needed, including: Evacuation Groups, Medical Groups, Rigging Groups, or other types of groups may be created to accomplish the rescue.

Recovery

If it is determined the person(s) we are there to help is deceased, the IAP should undergo a review. There may be a need to delay extrication until Law Enforcement can conduct an investigation. The format and functions for conducting a recovery are the same as the rescue mode with the exception of ensuring the techniques are chosen with a more methodical approach. More time should be expended building systems in such a way that the most efficient method is selected. Often times the most efficient method takes more time, and therefore is not what is chosen for rescue.

Size-Up

Size-up is a rapid mental evaluation of the factors involved in the incident. This is a continual process and should be continuously evaluated. First arriving rescuers should provide size-ups to incoming rescuers so they can better prepare. Size up reports should provide a picture of what is happening, what you are doing to make it better and what incoming rescuers need to do. An acronym used to ensure these elements are incorporated is C-A-N, often referred to as a **CAN Report**.

Conditions- State the current conditions. *Ex. "We have made contact with the reporting party and have identified the Point Last Seen."*
Actions- This describes the actions you or your crew is taking to make the situation better. *Ex. "We are looking for clues around the Point Last Seen and are sending a Hasty Team to Twin Falls."*
Needs- Tell the incoming rescuers what you need from them to support the search/rescue. *Ex. "We need the next arriving team to perform a hasty search of Sculpture Falls."*

Size-ups or CAN reports should be given when arriving, and when significant benchmarks are met (Ex. making Pt contact, assigning or assumption of a rigging leader, determining the rigging techniques, evacuating the Pt, etc).

Reaction Time

Searching for lost persons can be a very long process. Once assignments are made it can be hours before the assignment is completed. Additionally, depending on where the assignment is located, it may take significant time to reach the assigned area to begin an assignment. The time between when an assignment is given and when the assignment begins or is completed is called reaction time. Command and Tactical level leaders need to factor in reaction time when they are planning searches.

Operational Period

Searches often become complex operations spanning multiple days. As it becomes apparent that the operation is going to be protracted the Incident Commander should establish Operational Periods. An Operational Period is:

> "T*he time scheduled for executing a given set of operation actions, as specified in the Incident Action Plan. Operational Periods can be of various lengths, although usually they last 12 to 24 hours."*
> *NIMS December 2008*

Search operations typically operate on 12 hour Operational Periods. When an incident extends beyond one Operational Period a formal written Incident Action Plan should be created. A new Incident Action Plan should be generated for each Operational Period.

Benchmarks

Benchmarks are points of reference that help measure the progress toward the achievement of the incident priorities. When assuming or being assigned a tactical assignment or function, the rescuer should announce this on the radio or ensure the ICS structure is aware of this assignment. Benchmarks can generally be grouped into two categories: Task/Tactical Benchmarks and Command Benchmarks.

Here are some examples of Task/Tactical Level Benchmarks:

- **Assumption or acknowledgement of an assignment** (Ex. E-1 is Hasty Team 1 and going to search Sculpture Falls)
- **Completion of Assignment** (Ex. Hasty Team 1 Has Searched Sculpture Falls with nothing found)
- **Inability to complete assignment** (Ex. Hasty Team 1 cannot search the "river right" side of Sculpture Falls because of high water)
- **Any significant delay in completing assignment** (Ex. Hasty Team 1 will be delayed in our assignment, we took a wrong trail)
- **The need for additional resources to complete task** (Ex. Need an additional Hasty Team to search the "river right" side of Sculpture Falls)

Command/IC should report Command Level Benchmarks for the incident record. Often these benchmarks are a part of a written IAP on a separate "worksheet". This worksheet details the specific functions and benchmarks identified for a specific event. The following are examples of Command Level Benchmarks specific to Technical Rescue and would likely be found on a "Technical Rescue IAP Worksheet".

- **Search has been initiated to locate the person(s)-** When the search has begun to locate the person(s) requesting assistance.
- **Pt(s) have been located-** When the location of the Pt(s) has been identified.
- **Pt Contact has been made-** When verbal and physical contact is made.
- **Medical Classification of the Pt(s)-** When the Medical Classification(s) of the Pt(s) has been identified. This helps drive the pace of the operation, the need for additional resource types *(Ex. STAR Flight),* and gives advance notice to the receiving medical facility.
- **Pt is removed from the hazard-** When the Pt has been removed from the area he/she needed rescue from. *(Ex. at the top of a hauling evolution, the bottom of a lowering evolution, out of a confined space, Pt has been hoisted by STAR Flight).*
- **Pt is being evacuated-** When the Pt is away from the hazard and being moved to the vehicle providing transport to the hospital.
- **Pt is being transported to the hospital-** When the Pt is in the ambulance, medical helicopter, or other means of transport to the hospital.
- **All Rescuers are accounted for-** When all rescuers have exited the hazard area and are preparing to demobilize.

Summary

All rescues have different aspects. Rescuers should remain fluid and flexible. Plans change as new information is assessed. Managing rescues using the IMS system ensures that everyone is on the same page. Each rescuer is responsible for ensuring they stay on task and perform their function to the best of their ability.

Wilderness Search & Rescue – Level I

Class Title:
Search Theory, Strategy & Tactics

NFPA 1006 JPR's:
16.1.1 & 16.2

Time:
3 ½ hours

Scheduling Suggestions:
Early Session

Materials / Equipment Needed: N/A

Instructor requirements:
1:15 Instructor to Student Ratio

Objectives:
After this lesson the searcher should be able to demonstrate the ability to:

- Interview a witness so that available information can be determined;
- Use the available information to establish a subject profile;
- Use the available information to identify a subject's last known location;
- Use the available information to determine search urgency and prioritize search areas;
- Collect, interpret, and document evidence to determine a victim's potential location;
- Recognize the limits of conventional emergency response skills/equipment in wilderness environments;
- Initiate the collection and recording of information necessary to assist operational personnel in a Wilderness Search and Rescue;
- Identify and isolate any reporting parties and witnesses;
- Travel through various wilderness environments while minimizing threats to safety;
- Modify actions and urgency as applicable to a rescue versus recovery;
- Acquire information on current and forecast weather, including temperature, precipitation, and winds;
- Participate in search ops intended to locate victims whose location is unknown;
- Recognizing team's limitations regarding accessing and/or evacuating a victim.

Course Overview

Just as we depend on theory driven tactics in our everyday work environments, we depend on theory driven search tactics to conduct formal wilderness searches as efficiently and safely as possible. We will be discussing some of this theory and how it drives the tactics used in the wilderness search discipline. The intent for this lesson is to provide an awareness level of knowledge in wilderness search theory and tactics. We will discuss how our Urban/Wilderness environment affects the application of these tactics. Proficiency in the skills required to carry out these tactics can and should be gained with practical exercise. Such exercise will also allow determination of what theories apply to and what tactics work best for your local environment.

Overview of Search Theory

Operations Research, a professional scientific discipline, provides for a systematic approach to informed decision-making, especially in uncertain situations. Search Theory, an applied mathematical sub discipline of Operations Research, uses Operations Research principles and methods to help resolve search problems.

Translation: (There are people that nerd out on this stuff!) In all seriousness, what you need to walk away with is this: Search Theory is the subject of where to search and how to search. We are not going to get deep into the history of Search Theory; however, some history of its development is important to understanding why things are done the way they are today.

Timeline of Search Theory development

- Pioneering work during and after WWII for locating downed aircraft and lost soldiers.
- U.S. Coast Guard provided first comprehensive applications to inland SAR in the 1950s.
- Incorporated into 1st edition of *U.S. National Search and Rescue Manual* in 1959
- 2011, Land Search and Rescue Addendum to the National Search and Rescue Supplement to the International Aeronautical and Maritime Search and Rescue Manual…in simpler terms: the primary "federal standard" to which this lesson's information, terms and tactics are tied.

Minimum requirements for effective "lost person" searching

There are seven "crucial" statements that summarize the minimum requirements for effective "lost person" searching:

- Search is an Emergency
- Maximize the Probability of Success in the Minimum Time with the Available Resources
- Search is a Classic Mystery – remember the game of Clue
- Search for Clues and the Subject – over 3000 steps/mile
- Focus on Aspects Important to success – positive mental attitude
- Know if the Subject Leaves the Search Area
- Tight Grid Search as a Last Resort

POC x POD=POS (Awareness Level)

POC or Probability of Containment

A term used for any portion of the search area. Defined as the probability of the search object being in that portion of the search area. POC is only one of the factors to consider when deciding where resources should be deployed.

Note: You may, and most likely will, hear the term POA, meaning Probability of Area, this term is synonymous with POC the "preferred term with international recognition."

POD - Probability of Detection

The probability of finding the search object, assuming it is in the segment being searched. POD is determined at the segment level and depends on two factors:

1. How easy or difficult it will be for the object to be detected by searchers in the segment;
2. How much search effort is expended in relation to the segment's size.

POS - Probability of Success

The probability of finding the search object with a particular search. This is the measurement of search effectiveness.

Given these definitions, we can begin to understand that a successful search is based on searching in the right location and then detecting the search object. We can express the relationships between these factors in the form of the equation: POC x POD=POS

These calculations may seem to have little value to you, the field searcher; however, they yield information that can be used by search planners to numerically represent intangible possibilities that can be very useful for planning purposes.

A few search planning terms…

Point Last Seen (PLS)

- This is the point on the map where a witness with positive identification (someone that knows the subject) last spotted the person. If you know for certain the person was seen standing by their car in the parking lot just two hours ago, then you have a place to begin your search. You also know about how far the person might be able to travel in two hours, which helps limit your search area. [It is useless when the PLS is the subjects home as they were leaving on the trip.]
- Point last seen can indicate a handful of things:
    - What was the subject supposed to be doing when the loss occurred?
    - Was the subject en route somewhere? To where? By what route?
    - Was the subject expected somewhere? Where? When?
    - How was the subject prepared for the trip?
    - What was the attitude and personality of the subject(s) (aggressive, anxious, etc.)?

Last Known Point (LKP)

- This may be more useful than a PLS. It can be the subject's car parked at the trailhead, their abandoned campsite, a verified piece of equipment found abandoned in the woods. No one actually saw the subject there but evidence and clues are just as good to place the subject at that location at some point after they left on the trip.
- LKPs help narrow and refocus the search area.
- There may be only one PLS but there may be several LKPs discovered as clues are found and verified.

Search Area

- Area determined by the search planner where SAR personnel will look for a search object.
- The search area includes the smallest area, consistent with all available information, which contains all of the possible search object locations, and therefore includes all segments.
- The search area may be divided into segments based on the probable scenarios and for the purpose of assigning specific tasks to the available search resources.

Search Area Segmentation

- Designated subarea (subset of the search area) to be searched by one or more specifically assigned search resources.
- The search planner determines the size of a segment.
- The boundaries are identifiable both in the field and on a map; are based on suitability for assigning search resources, not probability of the search object's location.

Search Data

- The 5 pieces of information that each searcher needs to know.
  - Name to call
  - Clue information, (Clothing, equipment etc.)
  - PLS or LKP
  - Search area assignment
  - Command structure
- Without this information, it is senseless to commit teams to the field.

Likely Spots

- Any place that may attract a lost person, such as water, caves, shelters, and viewpoints.
- Also geographic features that could be the cause of the subject being overdue, such as steep terrain, fast rivers, switchbacks, cliffs, drainage's and terrain that tend to direct a person's direction of travel.
- These are places to search first with hasty teams and things and to be alert for while they search.

Search Approaches, Strategies and Tactics

There are two overarching search strategies, Passive (Indirect) and Active (Direct). The strategy to use is determined by the incident objectives. There are a couple generalities to know about the differences between the two, Passive (Indirect) search will typically have a greater resource requirement but lesser technical skill requirement. Active (Direct) search will be the brush busting, labor and energy expending form of search that will require fewer resources but greater technical skill. For both types it is often desirable to start in "likely spots." Trying to determine what happened to the missing subject is a significant part of any successful search.

Passive (Indirect) Search Types

- *Investigation*

This is a strategy that is usually used in the early stages while collecting information with which to make search plan decisions with. Confinement is a strategy used to limit the area of the search by the tactical use of roadblocks, trail blocks and placement of boundaries that the subject should not cross. This strategy must be undertaken early and at a distance far enough from the PLS (Point Last Seen) or the LKP (Last Known Point) that the subject will not have already passed that location. This is of limited use and is not often utilized.

- *Attraction*

This is a strategy that attempts to alert the missing subject to the direction they need to travel to find help. This is tactically accomplished by the use of lights, sirens, horns, voice checks, whistles, smoke or any other device for visual or audible signaling. As an example, most subjects found by hasty teams are found with voice checks long before there is a visual sighting. Be aware, the use of attraction can carry the potential for drawing the subject into a hazard if they try to travel to the signal at night when visibility is poor.

Active (Direct) Search Types

There are a couple of search strategies that include the five search tactics that are most commonly used to conduct active searches. There are currently a handful of different terms in use across various sources of education. The RESET committee has decided, for this class, that we will use those terms presented in the NSARC addendum.

- *Rapid (Hasty)*

This is a quick and efficient search strategy conducted by small teams that travel quickly and by the route of least resistance to the spots most likely to produce clues or the subject quickly. Depending on your team type this may be accomplished on foot, with the use of ATVs, bicycles or other terrain appropriate vehicles. Depending on the environment, such as cave and water, specialized technical skills may be required from responders. The hasty search is generally the first tactic used in the early hours and days of a search with the hope that the subject is still alive and responsive.

- *Segment Searches*
  - *Primary (Loose Grid)*

    This is a more organized, yet rapid, search of a large geographic area using fewer resources. Small teams of only three to seven persons are assigned. One team member guides on a compass bearing or physical feature such as a trail, creek, road or ridge top while the remaining team members guide off that person. This does not require all to remain in-line with each other but to "purposefully wander" through the brush, following the path of least resistance and checking likely spots. It is best if searchers can maintain visual and voice contact with one another, but not mandatory. Vegetation density dictates how far apart searchers may be and the distance will fluctuate depending on the visibility. This is a very efficient search tactic, used while the subject is still believed to be responsive and will answer to voice checks. Further benefits consist of less environmental damage with quickly increasing overall POS. Conversely, the trade-off is lower over-all coverage, as thoroughness is not a characteristic of primary searches, about a 50% probability of detection can be expected. The most effective resources will be trained grid search teams, dogs, sign cutters, aircraft and clue conscious teams.

  - *Secondary (Tight Grid)*

    This is a thorough, slow, and highly systematic, but very inefficient search method. Usually reserved as a last resort after other search tactics have failed to provide a desired POD. It requires a great deal of effort to maintain coordination of a large number of people to cover a relatively small area with a high probability of detection, typically 63 to 86%. Searchers line up on a base line at relatively close spacing and proceed in straight, parallel, equally spaced tracks, to the extent terrain and vegetation will allow. It is used in the later stages of a search when the chance the subject is down and not responsive has increased. The trade offs for this search type is that it is highly destructive to the environment and undetected clues and if used early in an incident it will result in a very slow POS growth rate.

    Both Primary and Secondary Segment searches can be accomplished using one of two modes of operation, Route Search and Area Search. Both of these will be discussed and clarified later in the lesson and during the hands on portions of class.

  - *Evidence*

    A more thorough version of a secondary search. There is often no second chance at an evidence search; therefore, it is not uncommon to be performing parallel sweeps, spaced shoulder-to-shoulder, proceeding forward on your hands and knees with team members clearing brush down to bare earth and looking for small evidence items such as weapons, bullet casings, bone fragments, etc. There are three significant differences between an evidence search and a secondary tight grid segment search:

    1. Time and urgency are decreased; "Often requires twice the time at half the speed"
    2. We are searching for small objects in limited areas
    3. The rules of evidence will be strictly enforced

- *Urban*
  This consists of a Primary or Secondary search in an urban setting rather than a wilderness setting. Searchers are asked to look for hiding spots and be more alert to the possibility of criminal acts associated with the missing person. They must also be more aware of hazards associated with urban settings to include traffic, animals, private property, industrial sites, chemicals and confined spaces.

Clue Awareness

There are many types of clues encountered during a search. The ultimate clue is the subject; however, anything that the subject leaves behind in passing through an area is also a clue. The absence of clues in a given area is also informative in that it suggests, in the form of a probability, that the subject did not pass through the area.

State-of-the-art search techniques are "clue oriented." That is, today's approach to search is dependent on the detection of clues. Any measure of clue detection is based on the unique combination of the characteristics of three things:

1. Sensor (people, electronics, etc)
   a. Level of training
   b. Motivation for searching
   c. Terrain complexity
   d. Searcher boredom
   e. Limitations
2. Search object (what you are trying to find)
   a. Size
   b. Color
   c. Contrast with background
   d. Degree of movement
   e. Ability to make noise
3. Environment (where and what conditions exist; size of search area)
   a. Factors affecting lighting and visual clues
   b. Factors that affect movement, footing and safety of the searcher

Five categories of search clues include:

1. Physical – (footprints, discarded material, etc.)
2. Documentary – (trail register, park receipt)
3. Testimonial – (witnesses, family, friends, people in search area, etc.)
4. Events – (flashing lights, whistle, yell, etc.)
5. Analytical – (the results of reasoning; e.g., if the subject is going from A to B, he would have to go through C.)

Searchers must be made clue aware so the potential clue left by a subject is not overlooked. There are far more clues in a search area than there are subjects. Good clue seeking is a learned art that must be practiced frequently to develop and maintain a high level of skill, gain the experience necessary to develop a sense of what information is important to the search (clues) or not (rubbish) and gain the experience that makes it easier to recognize or discover clues.

Major components of clue awareness is the realization that we are all track erasers and have the potential to both add to the confusing clutter of non-relevant clues and to destroy clues that we may miss but another searcher coming through the area later would have been able to detect. For this reason, it is very important that field team members have minimum impact on the environment that they move through. As much as possible, stay off obvious tracks and other clues, off the soft dirt parts of trails where tracks can easily be picked up, and walk in the lead member's footprints to both reduce the chance of inadvertently destroying a clue and, also, to limit the number of non-relevant clues that the field team leaves behind.

There are at least four pieces of information that human subjects may convey through the clues they leave:

1. Present location of subject: a yell, a whistle, a flash of light
2. Previous location of subject, evidence of where the subject was
3. Destination of subject, evidence of where the subject is going
4. The subject was not here, i.e. lack of clues

Regarding the interpretation of a clue, an opinion should be formed based solely on the information available. Forming an opinion and then gathering information to support that opinion should be avoided. Gather all information possible and assemble a complete subject profile on which to base further clue collection. Let the profile offer direction.

There are several pieces of information that can help the searcher by providing hidden clues, and almost all of these can be supplied through the completion of a Missing Person Questionnaire. When the information provided is used as a basis for ongoing clue detection, a sound foundation for discovery is laid.

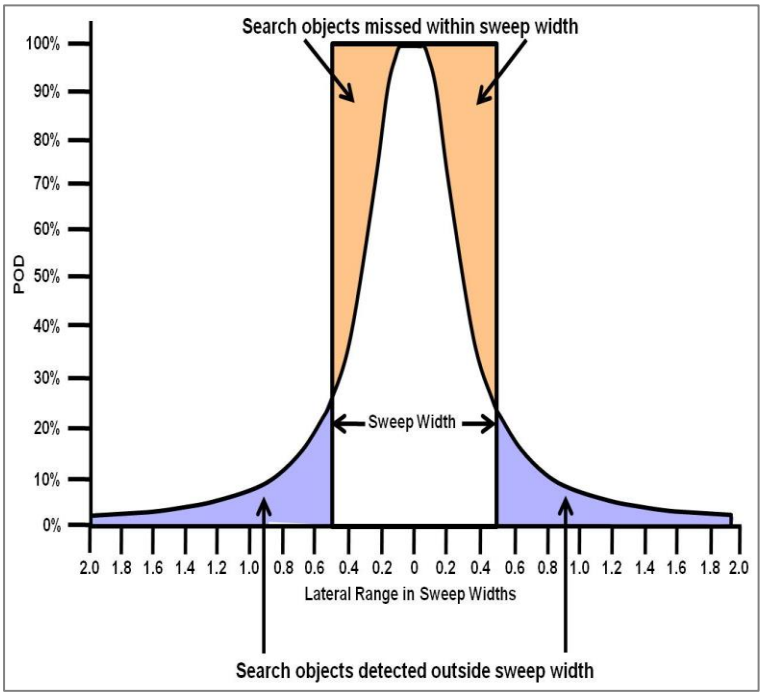
Crime Scene
Every search response scene is a potential crime scene and must be treated as such, until determined otherwise. As a result, all responders should be familiar with common crime scene response and evidence preservation. This includes common emergency response protocols such as ensuring accountability and documentation.

Evidence
Since the search area is a crime scene, any clues would be considered evidence. As such, it is vital that such clues are observed and treated accordingly. Thorough and precise documentation of all clues is important; additionally disturbance and contact with clues should be limited. Specifics for evidence (clue) handling and documentation may vary on each search scene; therefore, should be addressed by Search Management in general briefings.

Effective Sweep Width (ESW)

A quantity of measurement, indicating the ease or difficulty of detecting the search object.

This quantity is most easily understood by considering ESW as an "index of detectability." A measurement of how easy or hard it will be to detect a given search object in a specific environment with a particular sensor. Sweep width is affected by many of the same factors that affect clue awareness abilities. Conceptually, sweep width is the distance (equally distributed to the left and right of the sensor) at which the likelihood the sensor will detect an object beyond that distance is equal to the likelihood the sensor will fail to detect an object within that distance. It recognizes the likelihood of not detecting objects near the observer, along with the likelihood of detecting objects at a longer range from the observer. It, however, DOES NOT indicate the maximum distance at which an object might be sighted, nor that an object would be sighted within a specific range.



Sweep Width can only be determined through…scientific methods…the result of which is the generation of a lateral range curve that is used to find the sweep width for the tested sensors as used under the conditions in the experiment. This curve graphs the probability of detecting an object against the distance from the searcher to the object at the closest point of approach.

Sweep width is very specific and dependent upon the experienced conditions during the search. For instance, visibility, type of object, vegetation, and terrain may inhibit detecting the object.

Critical Separation

During the latter part of the 198Os a Dave Perkins and Pete Roberts, from the United Kingdom, developed a fundamental concept called Critical Separation. This field tactic places searchers at Critical Separation when the visual horizon for each searcher falls at roughly the middle of the measured distance between any two searchers. In other words, an individual searcher's visual horizon neither overlaps nor falls short of the visual horizon of the team member on the left or right of any individual. (While Critical Separation defines this ideal distance, searchers find it difficult if not impossible to maintain in many environments and only well trained searchers attain it consistently) The aim of critical separation is to provide maximum efficiency and it can provide some field expedient information to rescuers and management:

- Gives experience of seeing how an object similar to the search object appears in the environment, though it is important to avoid fixation that can result in overlooking other clues
- Though not a measure of detectability it does provide a quantitative measure, to search managers, of search conditions
- Experience with Critical Separation and AMDR places searchers in better position to make other observations about their search environment.

Critical Separation distance maintained between SAR team members as they make their way through a search area—allows the incident commander to balance the need for covering an area quickly with the importance of being thorough. The technique takes into account local terrain, foliage, and weather.

To determine the distance of critical separation for a particular search, SAR team leaders select a location that is typical of the area their team has been assigned to search and perform the following steps:

- Lay a backpack (or something of equal size) on the ground and, if available, cover the pack with clothing similar to that last seen on the missing person.
- Three team members walk away in different directions until each loses sight of the object.
- They walk directly back to the object, counting their steps as they return.
- Average those step counts and double the result to come up with the distance of critical separation—(That is, the number of steps from one another that should be maintain as searchers sweep through an area, knowing as you go that you will have a high probability of seeing the subject of their search.)

Lost Person Behavior

Lost person behavior is an additional field of research that is rather extensive. Studies on how missing persons act and where they are located can be useful. The likely behavior of the missing person is an important consideration in establishing search efforts. The data may greatly contribute to determination, and possibly reduction, of search segment size and structure. Additionally, it can assist in determining likely routes of travel and likely locations to search early and quickly. The advantages of applying lost person behavior in the field are rooted in three concepts:

1. An understanding of the behavior of past-lost subjects can be applied in present situations to help predict actions.
2. An understanding of how the present lost subject has acted in the past might help predict future actions.
3. A thorough knowledge of the present subject(s) can offer guidance to the searcher and might suggest trends or propensities.

While these lost person behavior studies provide numbers and percentages, their key use is in the information they provide about the varieties, similarities, differences, possibilities, and impact of how different people behave when lost. Some of this information may also help determine what types of resources and tactics to use.

Following are some of the most common characteristics of various lost person groups:

Children (ages 1-3)	
➢ Unaware of being lost	➢ Tend to wander aimlessly
➢ No sense of direction	➢ Will lie down and go to sleep

Children (ages 3-6)	
• More mobile than 1 – 3 year olds	• Will lie down and go to sleep
• Will return to somewhere familiar	• Might not answer to "strangers"
• Will follow personal interests	

Children (ages 6-12)	
• Much better sense of direction	• Might not answer when called
• Confused in a strange environment	• More willing to be found after dark
• Might run away to gain attention, avoid punishment, etc.	• Same fears and problems as adults

Elderly above age 65	
• Consider senility	• Likely to overextend themselves
• Distractible	• Sometimes have problem hearing
• Past-oriented	

Developmentally Disabled	
• Act and react same as Children 6 – 12	• Might not move for days
• Won't respond to their name	• No physical impairments
• Often hide from view	

Despondent	
• Seek solitude	• Within sight/sound of civilization
• Don't respond to searchers	• Found near prominent locations

Hikers	
• Rely on trails, with set destination	• Cutting switchbacks can loose trail
• Can't navigate off-trail	• Hiking buddies often mismatched

Tracking

All search teams should have some tracking training. Finding tracks or other signs of a subject passing are excellent tools in reducing the size of a search area. The most significant problem with tracking is making sure the sign or track is in fact made by the subject who is missing and not by some other person or searcher. The added difficulty in most of our urban wilderness environments is the fact that there are commonly large amounts of traffic that can disrupt or destroy these tracks despite the volume of tracks the average person leaves behind.

Travel in the Wilderness Environment

There are various methods and tips for traveling in the wilderness environment, we will not attempt to address each of these, but will provide some tips that may assist the navigator in moving through such terrain. We must remember, we are here and traveling through this environment in search of a missing person. So, if we are so uncomfortable and focusing simply upon moving, then we have lost all search effectiveness.

There are two classifications of travel in the Wilderness SAR environment:

- Non-technical - walking, the predominant form of non-technical travel is the most often required travel for getting to a search area and searching. NASAR discusses walking techniques for the wilderness environments in which they break it down to two factors for consideration.

    - Travel Type
        - Route travel - This is the easiest and simplest involving following trails or roads that may require greater distance but less effort.
        - Straight line travel - This is the more difficult, which can involve vegetation challenges and requires greater navigational skills but is usually the least distance.

    - Pace
        - The greatest issue with pace and the failure to maintain a proper pace is the element of fatigue. Fatigue in the SAR environment often proves to be a dangerous element.
        - The considerable Texas related element is temperature maintenance. A consistent, realistic pace saves energy and keeps the body temperature stable. The recommendation for rest periods is ten minutes of rest per hour of easy terrain travel.
        - Factors dictating proper pace are the area to be covered and the time available not the urgency of the situation or perceived shame of traveling slower than others.
        - Traveling too fast decreases the possibility of detection.

- Technical.
  - This is one area in which the skill of topographic map reading can prove to be very beneficial during travel planning and execution.
  - Technical travel may be required to access a patient and/or to remove a patient to a stable transport environment.
  - The risk evaluation processes required for determining risk levels for various technical modes of travel are covered in the classes addressing those disciplines i.e. technical rope, cave and water.

Ground SAR Team
Overview of
Strategies, Tactics, and Modes of Operation

Active (Direct) Approach

Strategy	Tactics	Type
Rapid Search (Hasty)	Linear Features Search	
	Points of Interest	
Segment Search	Route	Primary (Loose Grid)
		Secondary (Tight Grid)
	Area	Primary (Loose Grid)
		Secondary (Tight Grid)

Passive (Indirect) Approach

Investigation	Missing Person Questionnaire	
	Lead Follow-up	
	Interviews	
Confinement	Road/trail blocks	
	String lines/signs	
	Track traps	
	Perimeter Search	
Attraction	Lookouts	
	Helicopter/Airplane Flyovers	
	Public Address Sound Devices (Sirens)	

Ground SAR Team Strategies, Tactics, and Considerations
Active (Direct) Approach

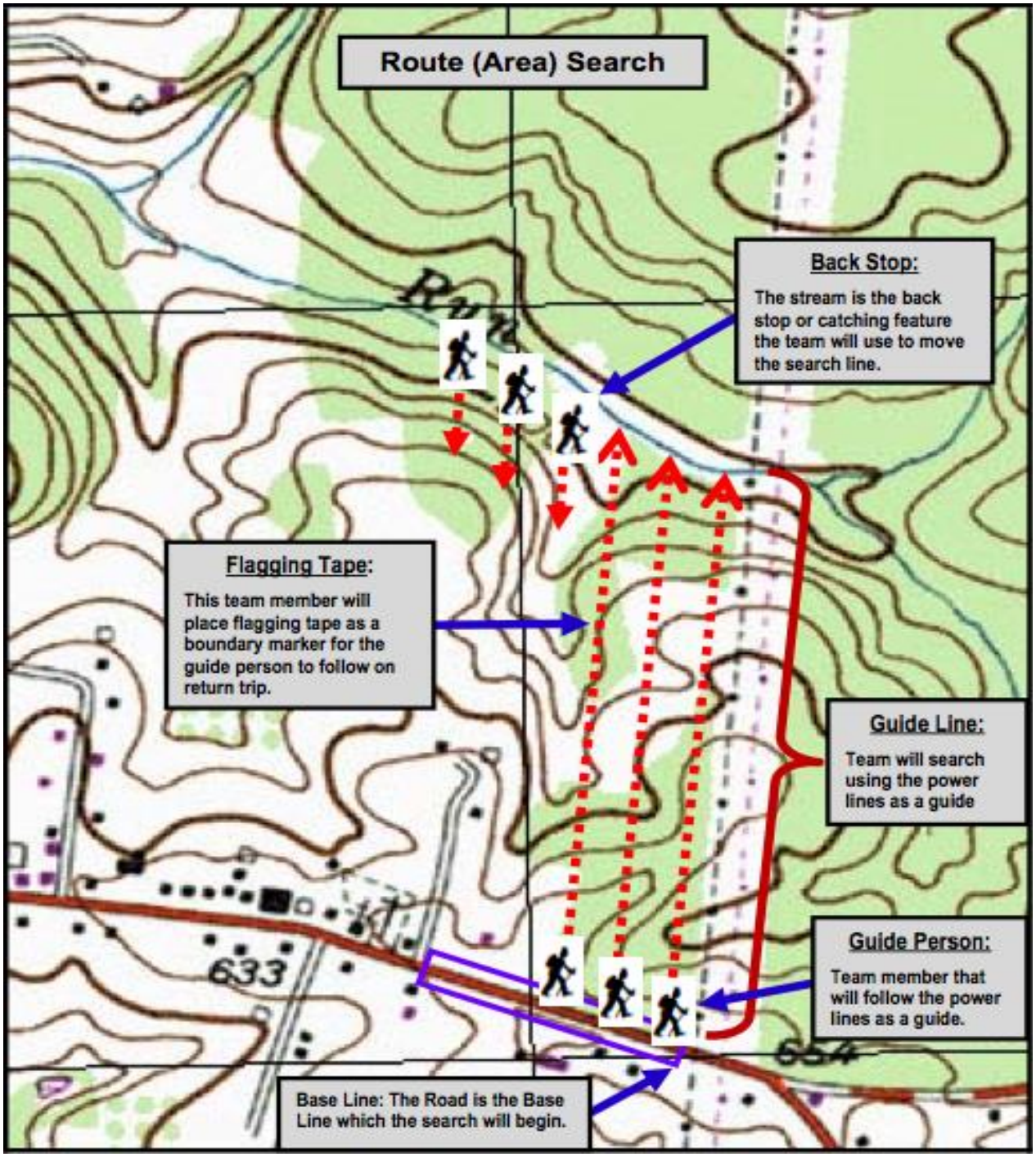
Strategy	Tactics	Considerations
Rapid (Hasty) Search	**Checking the immediate area, trails, roads, buildings, campsites, and specific areas of high probability.** Rapid	
	Linear Features Search	**Determine most likely route subject would have gone and quickly cover this route.** • Often used for lost hikers; walkers; • Conducted by initial responders; • Need to specify distance from feature for desired coverage; • Follows travel aids (trails, drainages, etc); • Navigation is the greatest challenge, start task at clear point; • Downhill preferable; • Clue awareness, especially at decision points, is critical; and • Easily combined with sound and tracking techniques.
	Points of Interest (Spot)	**Thoroughly cover a specific area in which the subject may be located.** • Check scenic overlooks, bathrooms, playgrounds, swim pools, bodies of water; and • Check residence, out buildings, and possible locations the missing subject may have visited
Segment Search	**Requires Easily identifiable boundaries for search teams. Often, these, boundaries are also likely routes the missing subject may have traveled. Topographical features (natural (ridges, streams, drainages, field edges) or man-made (roads, trails, fences, power or utility transmission line clearings).** • Tactics depend on type of resources available and terrain.	
	Route Search	**Systematic search in which team members follow tracks parallel to a side boundary & maintain a predetermined separation.** • Search area may be covered in one or more passes; • All searchers should attempt to walk in nearly straight lines parallel to the edge of the area, providing uniform, predictable coverage of the entire area; • The baseline is usually formed along a search area boundary with searchers properly spaced apart; o Spacing will determine if the tactic is less thorough or thorough o Spacing will be determined by the density of vegetation in the area • Purposeful wandering may be employed; • Search leaders should select area boundaries that are easy for the search teams to recognize and follow; may be natural or man-made, pre-existing or set up by the search teams; and • Team Leader keeps the team moving in the right direction, at a reasonable pace, and maintaining proper searcher separation.
	Area Search	Thorough tactic to raise POD and look for unresponsive subjects. • Competent flankers required, if using emergent volunteers more experienced crew leaders required; • Direction of the search follows a specific compass bearing; • Purposeful wandering may be employed; • The baseline is usually formed along a search area boundary with searchers properly spaced apart; o Spacing tight to ensure thorough tactical search. Spacing will be determined by the density of vegetation in the area o Evidence type search may be shoulder to shoulder and conducted on hands and knees; • Tight Grid Searching (thorough) is manpower intensive and should be considered as a last resort after other search tactics have been used and narrowed the search area down.

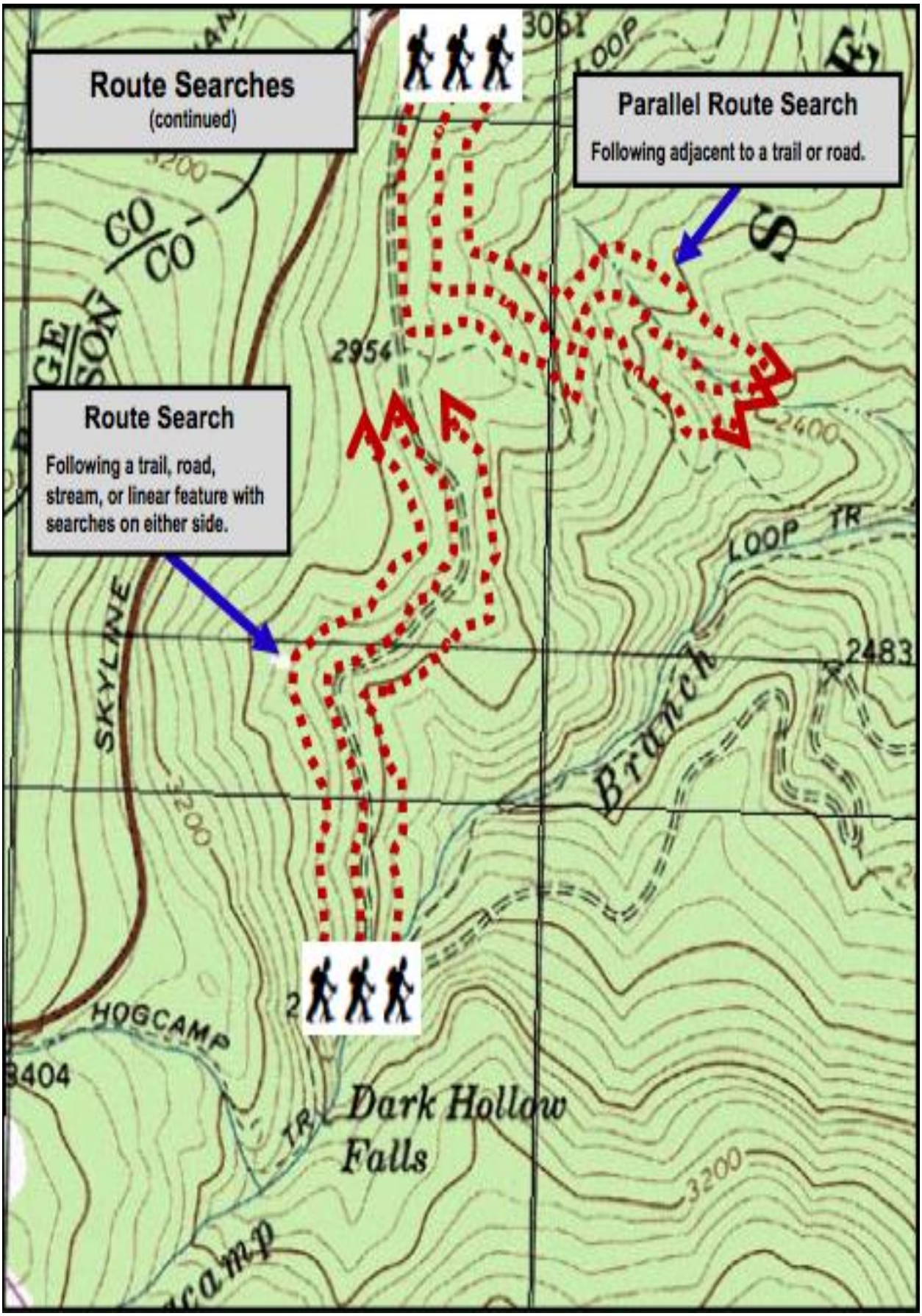
Ground SAR Team Strategies, Tactics, and Considerations
Passive (Indirect) Approach

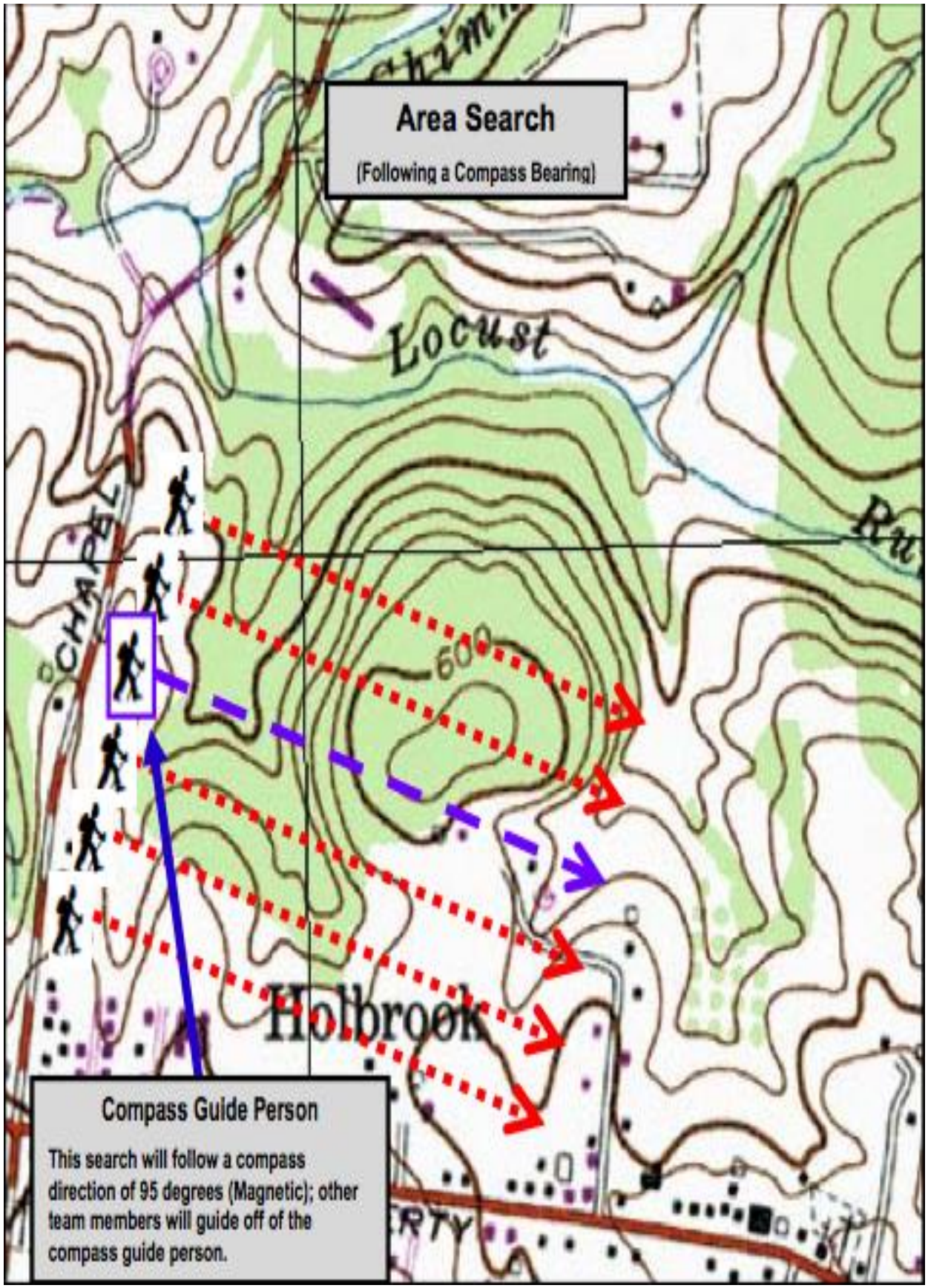
Strategy	Tactics	Considerations
Investigation	**Obtain missing person information and determining why the missing subject went missing.**	
	Missing Person Questionnaire	• Complete missing person questionanaire
	Lead Follow-up	• Follow-up on leads/clues to determine relevance to the missing person.
	Interviews	• Interview family, friends, neighbors, doctors, co-workers, etc.
Confinement	**Keep subject within area, detect if subject has left search area; locate subject on roads or trails.**	
	Road/trail blocks	• Established on all roads/trails leading into and out of area; and • May be used in conjunction with string lines and signs.
	String lines/signs	• If possible, combine with attraction; • Placed waist high with paper arrows pointing toward camp or road; and • Ensure in the language of missing subject, age appropriate.
	Track traps	• Used to detect if subject has traveled through the area; • Brush off bare areas to detect footprints; and • Stream/shore banks and areas of loose dirt provide natural track traps.
	Perimeter Search	**Trackers can sign cut boundaries that tend to collect signs (fence lines, road edges, trail, stream beds, etc.)** • Secure the confinement perimeter. • Limit priority segments from the search area (if the missing subject did not cross some boundary, little need to search there.) • Establish a new LKP and a direction of travel.
Attraction	**Encourage the missing person to find the searchers** (assume the missing subject is mobile and able to follow the signals to a place of safety).	
	Lookouts	• Using Lookout or Observation Towers (Fire Towers) to look for subject; • May use handheld thermal imagers or binoculars; • A ladder, aerial, or tower truck may be used as a portable lookout; • Also due to the lookouts height it would attract the subject; and • Look-over's, scenic views, bridges, are forms of lookouts.
	Helicopter/Airplane Flyovers	• Aircraft flyovers may attract the missing subject to come out to a clearing or open area and be seen; and • Use of public address systems mounted subject can go toward the sound.
	Public Address Sound Devices (Sirens)	• Use of public address systems to call for the subject; and • Must be stationary so the mobile subject can go toward the sound.

Tactical Search Terms…

- *Base Line* – a line perpendicular to direction of travel on which the searchers line up.
- *Guide Line* – Direction in which a searcher looks for guidance as to the status of the search line.
- *Guide Person* – person that monitors guide line and searchers
- *Search Lane* – Area an individual searcher is assigned to scan.
- *Trail Line* – Material that can be used to indicate a line where no natural line exists




Route Searches
(continued)
Parallel Route Search
Following adjacent to a trail or road.
Route Search
Following a trail, road, stream, or linear feature with searches on either side.
LOOP TR
SKYLINE
Branch
HOGCAMP
Dark Hollow Falls
2954
2483
3404
3200
2400


Area Search
(Following a Compass Bearing)
Locust
CHAPEL
600
Holbrook
Compass Guide Person
This search will follow a compass direction of 95 degrees (Magnetic); other team members will guide off of the compass guide person.

Wilderness Search & Rescue – Level I

Class Title:
Search Theory, Strategy & Tactics – Field Course

NFPA 1006 JPR's:
16.1.1 & 16.2

Time:
3 ½ Hours

Scheduling Suggestions:
Following Search Theory, Strategy & Tactics Classroom Instruction

Materials / Equipment Needed:
- Active, Primary, Segment, Route Search
  - Items to be searched for
  - Flagging Tape
  - Survey flags
- Active, Primary, Segment, Area Search
  - Items to be searched for
  - Flagging tape
  - Survey flags
- Compasses for student use
- GPS for course layouts
- Measuring device for course layouts
- Pace count area

Instructor Requirements:
1:5 Instructor to Student Ratio

Objectives:
At the end of this lesson the rescuer should be able to:
- Demonstrate an Active, Primary, Route Search
- Demonstrate an Active, Primary, Area Search
- Express the fundamental differences between Passive/Active, Primary/Secondary and Area/Route/Evidence Searches

Course Overview

Earlier we discussed the concepts of Primary and Secondary Active segment searches. The focus for this fieldwork will be to demonstrate and then apply these tactics, as they are the most likely forms of technical search we may undertake.

Note: the student is encouraged to reference back to the "Search Theory, Strategy & Tactics" curriculum for additional detailed instructions.

Passive vs. Active Search

Discuss the differences between and strengths or weaknesses of our given agencies in providing these forms of search.

Primary vs. Secondary Search

Both being forms of Active Search it is important to understand the fundamental differences between Primary and Secondary search. Primary search is meant to be the most efficient form of search we can undertake, whereas Secondary is meant to provide us with the greatest POS. The differing factor is that of time, a Primary balances time with area of coverage, whereas a Secondary search emphasizes coverage regardless of time involved. Highlight the concepts that differentiate these from each other i.e. Effective Sweep Width and Critical Separation.

Area Search vs. Route Search

It is important to understand the foundational difference between area and route search is their reference point, Area uses a navigational reference, usually in the form of a bearing, usually allowing greater independence between the searchers; whereas, a route search will use a physical feature as its reference point, usually resulting in a route search being more team based and requiring a higher degree of communication between the searchers. Both require an understanding and comfort with the use of pace counting to determine distances.

Evidence Search

Important to discuss that though Evidence search seems to be a form of Secondary search it usually has the added component the tightest spacing possible up to and including hands and knees search. Most importantly realizing that this is a form of search that aims for 100% POS otherwise evidence may become damaged and therefore not discovered. *"Twice the time at half the speed"*

Search Data

Before any of these searches are undertaken it is critical that the 5 pieces of information that each searcher needs to know be obtained:

- Name to call
- Clue information, (Clothing, equipment etc.)
- PLS or LKP
- Search area assignment
- Command structure

Wilderness Search & Rescue – Level I

Class Title:
Shelter & Survival

NFPA JPR's:
16.1.3, 16.1.5, 16.1.6 & 16.1.7

Time:
1 Hour

Scheduling Suggestions:
Prior to scenario

Materials / Equipment Suggestion:
- Personal First Aid Kit
- 24 Hour Pack
- Water Purification/Filtration equipment

Instructor requirements:
1:15 Instructor to Student Ratio

Objectives:
At the end of this lesson the rescuer should be able to:
- Identify equipment to be used for survival in the wilderness setting
- Identify components of a basic first aid kit and uses of those components
- Describe how to make a shelter to protect oneself from the weather
- Describe how to collect and purify water to make potable water for consumption
- Describe how to identify food sources, collection and ways to prepare them for consumption

Course Overview

Survival in the wilderness is a wide array of topics that are impossible to cover completely in the time frame we have for this course, therefore, the scope of this section is to cover needed information for the first 24 to 48 hours in the field. The need of minimum skills is the only expectation of a rescuer in the central Texas region.

Top 4 Survival Priorities

1. Shelter
2. Water
3. Fire
4. Food

Typically, your survival priorities will be in this order: Shelter, Water, Fire, and Food.
However, the details of a scenario ultimately dictate the final order.

A few things to remember about survival priorities in extreme conditions:

- You can live 3 minutes without a positive mental attitude.
- You can live 3 hours without shelter.
- You can live 3 days without water.
- You can live 3 weeks without food.

Environmental Hazards

Weather

Before going into the field, prepare for any weather you may face, cold, hot, wet, dry

Plants

Know what poisonous plants look like such as ivy, oak, and sumac.

Insects

Be cautious around areas that may provide shelter for poisonous insects.

Animals

Watch out for animals that may attack to protect themselves and understand most animals in the central Texas region will likely avoid humans.

Terrain

Wear appropriate PPE for the terrain. General PPE considerations could be:

- Lightweight helmet
- Gloves
- Safety glasses

Equipment for Survival

The following are examples of items to carry in a 24-hour SAR pack that will allow a responder to be prepared for working in a wilderness setting.

Shelter and warmth

Varieties of materials are recommended for emergency shelter, and vary between geographic regions. Options often included in survival kits may consist of:

- Reflective "aluminized" (Mylar coated) space blanket or survival blanket to retain body heat
- Fire starting tinder – cotton balls coated in Vaseline, twine coated in paraffin wax
- Lightweight poncho for protection against wind and rain
- Magnesium fire starter and fire striker
- Catalytic heater and bottled gas fuel
- Waterproof matches or lighter
- "Tube tent" or bivvy bag

Food and water

This involves sustenance for short time periods, to be used and replenished before contents spoil.

- Ready-to-eat meals (MRE), or high-energy foods such as chocolate or emergency food bars.
- Water storage container- Bottles, Bladders
- Water purification and filtration tools

Signaling, navigation and reference

Since the primary goal of a survival kit for lost or injured persons is rescue, this part of the kit may be considered the most essential. Key elements for rescue include:

- High power LED light (able to have batteries replaced, and carry an extra battery)
- Laser pointer with lithium batteries, for superior signaling range
- Trail maps/charts (if location is known in advance)
- Whistle
- Signal mirror
- Surveyor's tape
- Pen/pencil and paper
- Survival manual
- Compass

Multipurpose tools or materials

Survival kit tools emphasize portability and versatility. Tools recommended for many types of survival kit include:

- A compact saw such as Japanese style backsaw or bow saws can quickly cut larger diameter limbs and small to medium thick trees. A folding saw can be small enough to fit into a kit, but big enough to cut small to medium diameter limbs, and possibly smaller trees.
- Some type of gas burner and fuel such as bottled propane or Liquefied petroleum gas (LPG)
- Sturdy cord or "550" parachute cord for setting up a tarpaulin and snaring small animals
- Hatchet with sheath for cold conditions, or machete for tall grass conditions (shelter and fire)
- Heavy-duty needle and thread for repairing clothing and equipment
- Fixed-blade knife, or multi-tool
- Red or orange plastic bags or trash bags
- Candles for light, signaling, fire-starting
- Water bottle
- Can opener
- Solar charger

First Aid Kits

The purpose of a first aid kit is for self-aid and often includes a combination of the following:

- Epinephrine and antihistamines for allergic reactions, primarily to insect stings
- 30-day supply of personal prescription medication
- Oxytetracycline tablets (for diarrhea or infection)
- Sterile combine dressing, and gauze pads
- Multivitamin and mineral supplements
- Extra pair of prescription eyewear
- Other personal items as necessary
- Aspirin
- Medical tweezers
- Disinfectant pads/rubbing alcohol
- Adhesive and gauze tape
- Adhesive bandage
- Nitrile gloves
- Bandages
- Butterfly closures
- Antibiotic cream
- Surgical razor or scalpel
- Sunscreen (above 30 SPF)
- UV protective sunglasses

Shelter Types and Construction

A shelter can protect you from the sun, insects, wind, rain, snow, and hot or cold temperatures. It can give you a feeling of well-being. It can help you maintain your will to survive.

In some areas, your need for shelter may take precedence over your need for food and even your need for water. For example, prolonged cold exposure can cause excessive fatigue and weakness. A fatigued/weakened person may develop a "passive" outlook, thereby losing the will to survive.

The most common error in making a shelter is making it too large. A shelter must be large enough to protect you but also small enough to contain your body heat.

Shelter Site Selection

When you are in a survival situation and realize that shelter is a high priority, start looking for shelter as soon as possible. As you do so, remember what you will need at the site. Two requisites are--

- It must contain material to make the type of shelter you need.
- It must be large and level enough for you to lie down comfortably but keep body heat in.

When you consider these requisites, however, you cannot ignore your safety. You must also consider whether the site--

- Is suitable for signaling, if necessary.
- Provides protection against wild animals and rocks and dead trees that might fall.
- Is free from insects, reptiles, and poisonous plants.

You must also remember the problems that could arise in your environment. For instance--

- Avoid flash flood areas in foothills.
- Avoid avalanche or rockslide areas in mountainous terrain.
- Avoid sites near bodies of water that are below the high water mark.

In some areas, the season of the year has a strong bearing on the site you select. During cold winter months you will want a site that will protect you from the cold and wind, but will have a source of fuel and water. During summer months in the same area you will want a source of water, but you will want the site to be insect free.

Types of Shelters

When looking for a shelter site, keep in mind the type of shelter you need and consider--

- How much time and effort you need to build the shelter.
- If the shelter will adequately protect you from the elements (sun, wind, rain, and snow).
- If you have the tools to build it. If not, can you make improvised tools?
- If you have the type and amount of materials needed to build it.

Knowledge of various types of shelters helps answer these questions.

Poncho Lean-To

It takes only a short time and minimal equipment to build this lean-to (Figure 5-1). You need a poncho, 6 to 9 feet of cordage; three stakes about 12 inches long, and two vertical supports 6 to 9 feet apart. Before selecting your vertical supports, check the wind direction and ensure that the back of your lean-to will be into the wind.

To make the lean-to--

- Tie off the hood of the poncho. Pull drawstring tight, roll hood long ways, fold into thirds; and tie it off with the drawstring.
- Cut rope long enough to reach from each corner of long side of poncho to trees on each side. Tie rope to corners by either a grommet or a rock inside material.
- Attach a drip stick (about 4") to each rope, 1" from the poncho. These will keep rainwater from running down the ropes into the lean-to. Tying 4" strings to each corner along the top edge will allow the water to run to and down the line without dripping into the shelter.
- Tie the ropes about waist high on your uprights using a clove hitch or other suitable knot.
- Spread the poncho; anchor it to the ground using the stakes.

If you plan to use the lean-to for more than one night, or expect rain, make a center support with a line. Attach one end, of the line, to the poncho hood; the other to an overhanging branch. Make sure there is no slack in the line.

Another method is to place a stick upright under the center of the lean-to. This, however, will restrict space and movements in the shelter.

For additional protection from wind and rain, place some brush, your rucksack, or other equipment at the sides of the lean-to and to reduce heat loss, place some type of insulating material, such as leaves or pine needles, inside your lean-to.

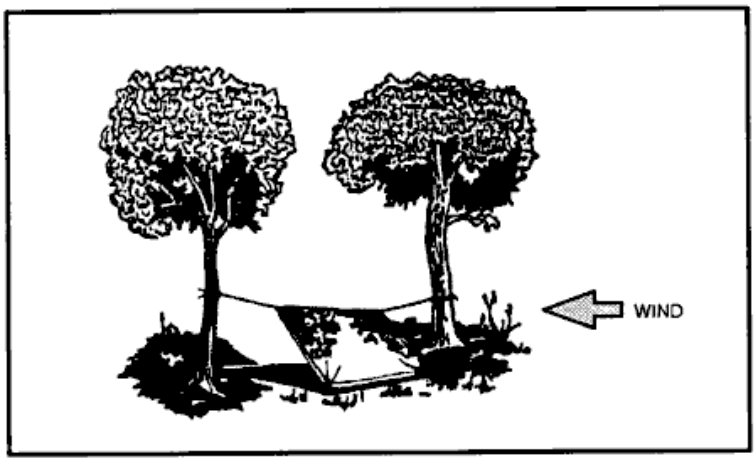


Figure 5-1. Poncho lean-to.

Poncho Tent

This tent (Figure 5-2) provides a low silhouette, however, less usable space than a lean-to. It requires one poncho, 5 to 8 feet of cordage, six stakes about 12 inches long, and two vertical supports, 6 to 9 feet apart.

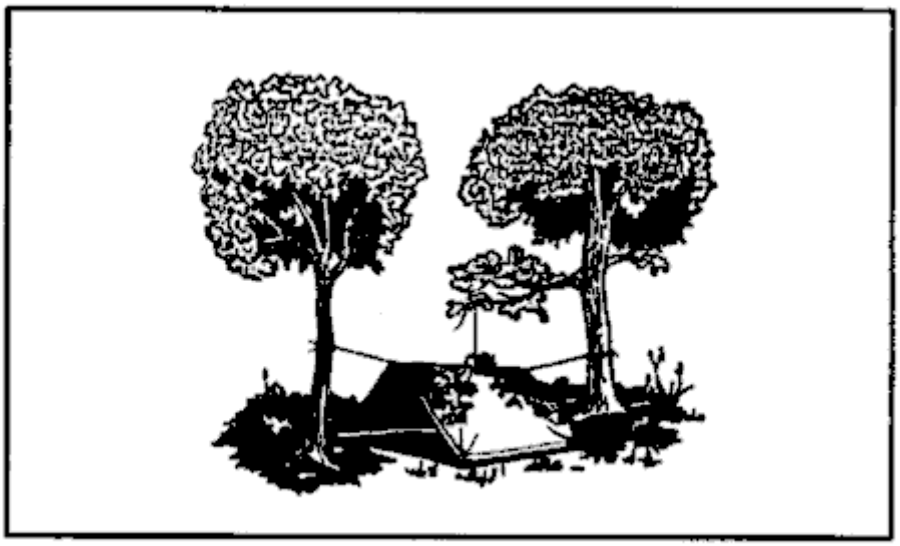


Figure 5-2. Poncho tent using overhanging branch.

To make the tent--

- Tie off the poncho hood in the same way as the poncho lean-to.
- Tie a 5 to 8 foot rope to the center on each side of the poncho.
- Tie the other ends of these ropes at about knee height to two vertical supports 6 to 9 feet apart and stretch the poncho tight.
- Draw one side of the poncho tight and secure it to the ground pushing sharpened sticks through the grommets or attaching to the sticks with short pieces of rope.
- Follow the same procedure on the other side.

If you need a center support, use the same methods as for the poncho lean-to. Another center support is an A-frame set outside but over the center of the tent (Figure 5-3). Use two 3 to 4 feet long sticks, one with a forked end, to form the A-frame. Tie the hood's drawstring to the A-frame to support the center of the tent.

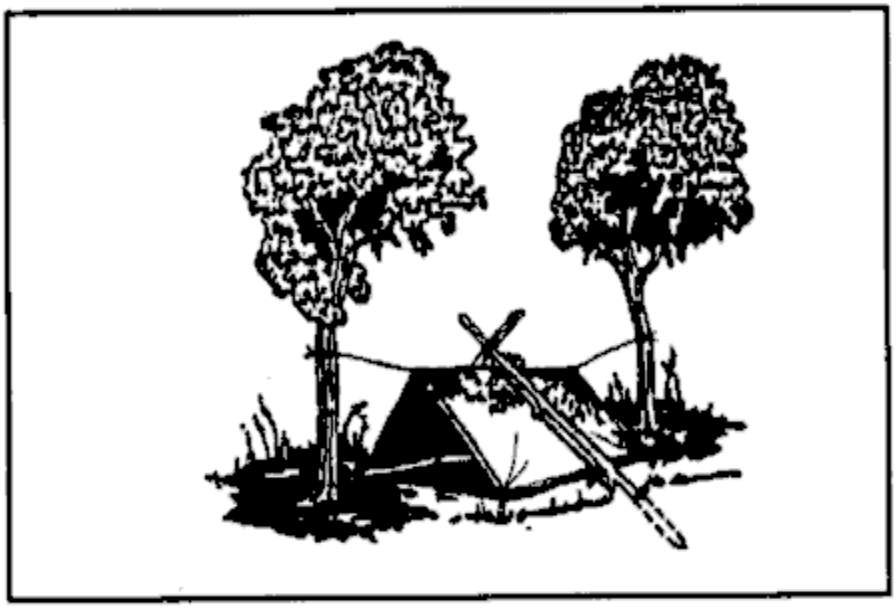


Figure 5-3. Poncho tent with A-frame.

Water Collection and Purification Methods

While the need to purify or filter water in the field will be remote if crews are carrying appropriate amounts of water for their mission it is important to understand the methods involved in securing a water source. When unable to filter or purify water in central Texas it is better to drink available water over no water at all. Dehydration can kill you while the discomfort of being sick after a call will pass with time and proper medical care.

Water Purification

Rainwater collected in clean containers or in plants is usually safe for drinking. However, purification of water from lakes, ponds, swamps, springs, or streams, especially the water near human settlements or in the tropics is strongly suggested if not required.

When possible, purify all water from vegetation or ground by using iodine, chlorine, or boiling.

Purify water by--

- Using water purification tablets. (Follow the directions provided.)
- Placing 5 drops of 2% tincture of iodine in a vessel full of clear water. If the vessel is full of cloudy or cold water, use 10 drops. (Let the water stand for 30 minutes before drinking.)
- Boiling water for 1 minute at sea level, adding 1 minute for every 300 meters above sea level, or boil for 10 minutes no matter where you are.

By drinking non-potable water you may contract diseases or swallow harmful organisms. Examples of such diseases or organisms are--

- *Dysentery.* Severe, prolonged diarrhea with bloody stools, fever, and weakness.
- *Cholera and typhoid.* You may be susceptible to these diseases regardless of inoculations.
- *Flukes.* Stagnant, polluted water--especially in tropical areas--often contain blood flukes. If you swallow flukes, they will bore into the bloodstream, live as parasites, and cause disease.
- *Leeches.* A swallowed leech can hook onto the throat passage or inside the nose. It will suck blood, create a wound, and move to another area, leaving the wounds to become infected.

Water Filtration

If the water you find is also muddy, stagnant, and foul smelling, you can clear the water--

- By placing it in a container and letting it stand for 12 hours.
- Filter water using a bandana or similar cloth to remove gross contamination.
- Using a filtering system.
  - Gravity or squeeze systems
  - Pump systems

Note: These procedures only clear water to make it more palatable. You will have to purify it.

Identify Food Sources, Collection, and Preparation

- The scope of this course does not anticipate the need for finding and using food in the field. It is expected that enough will be carried to meet the mission requirements. The need for identifying food would only be used in worst case scenarios of not being able to evacuate from the wilderness area.
- Reminder: you can survive for 3 days without food therefore, food carried in to the field is normally aimed at energy requirements and not true survival needs.

Closing

Survival skills and preparation are important to the Wilderness Rescuer that will be more important when working in regions with more remote back country. Anytime a rescuer is working in a region outside of the central Texas area some consideration should be given to if the team is prepared for the environment they are about to face especially if something happens to where they must stay in the field.

Wilderness Search & Rescue – Level I

Class Title:
Scenario

NFPA 1006 JPR's:
16.1.9, 16.1.10 & 16.1.11

Time:
3 ½ Hours

Scheduling Suggestions:
Final Session

Materials / Equipment needed:
- Adequate site that requires a search team to use navigation and search skills to locate a victim
- Victim with simulated injuries requiring care and transport
- Basic life support kit
- Wilderness tool kit

Instructor requirements:
1:5 Instructor to Student Ratio

Objectives:
At the end of this lesson the rescuer should be able to:
- Operate as a team using skills learned in this course to find a missing person in a wilderness setting.
- Demonstrate how to manage a victim in a wilderness environment.
- Demonstrate how to move a victim in a wilderness environment at least 0.4 km.

Scenario Goals:

The focus of this scenario is to give the students an opportunity for hands on the skills they learned. The scenario should be setup to allow the students to conduct a search as teams. Once found the patient will be packaged and transported approximately 0.4km to a designated area. If possible a patient for every team is preferred. The lead instructor will have to determine the feasibility of this based on victims and equipment available. If it's only possible to have one victim then opportunities for all members of the class to participate with each element of the hands on should be made if possible.

The following JPR's are the goal to achieve in the scenario.

16.1.9 Locate a victim in a wilderness environment, given a lost person profile, established search area, navigation equipment, topographical maps, and communication equipment, so that the victim's location can be determined.

16.1.10 Manage a victim in a wilderness environment, given a victim, basic life support kit, and wilderness tool kit, so that the basic medical care of the victim is managed during transport, and the potential for further injury is minimized.

16.1.11 Move a victim in a wilderness environment a minimum of 0.4km, given victim transport equipment, litters, other specialized equipment, and victim removal systems specific to the rescue environment, so that the victim is moved without undue further injuries, risks to rescuers are minimized, the integrity of the victim's packaging within the transfer device is established and maintained, and the victim is removed from the hazard.