Plotting Points on a Map using UTM

When working with UTM coordinates it is essential to have a UTM grid reader. There are many different types of UTM readers and they all work differently; one example is illustrated in Figure 6-8. A grid reader is usually printed on a transparent plastic sheet. Appendix C has a grid reader that you can photocopy on a transparent plastic sheet. When using a grid reader to plot points on a map, the scale on the grid reader must match the scale of the map.

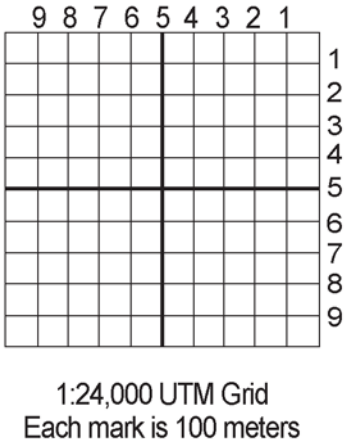
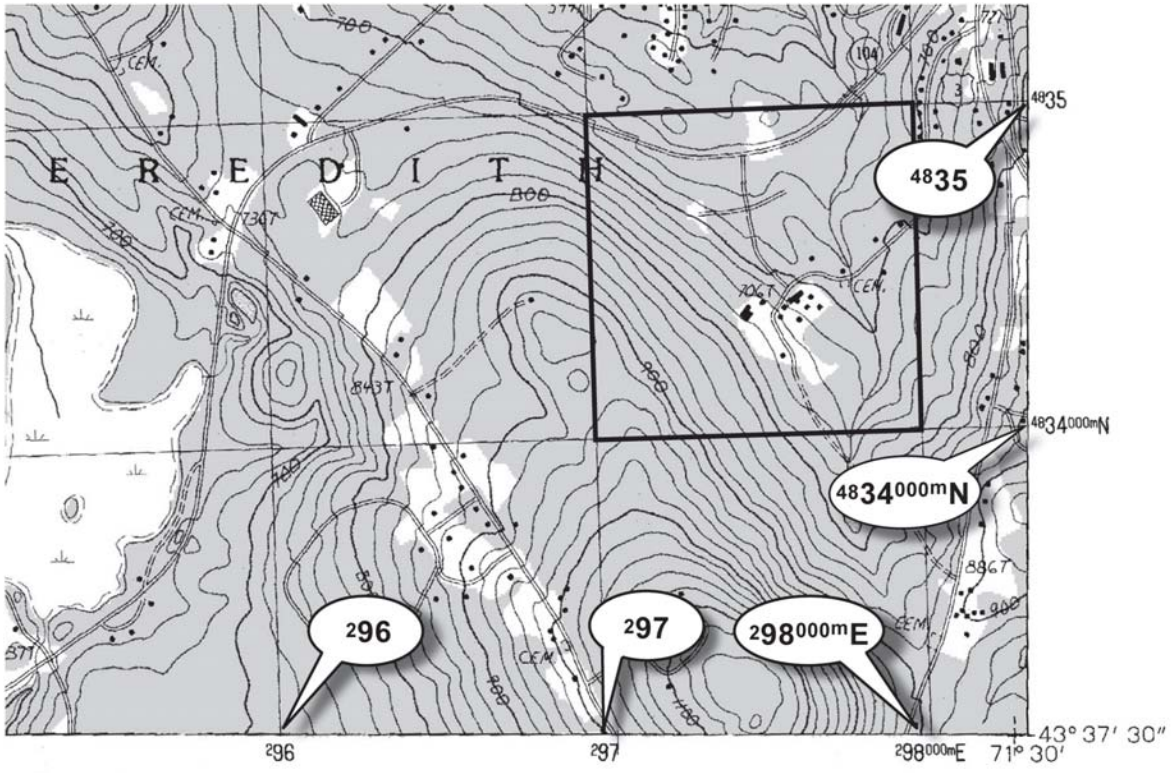


Figure 6-8. This is a UTM grid reader for 1:24,000 map scale (not to scale). The "1" represents 100 meters, "2" represents 200 meters, and so on. The numbers on the right are used to determine the northing coordinate location and the numbers on the top are used to determine the easting coordinate location. The point is plotted in the top right corner.

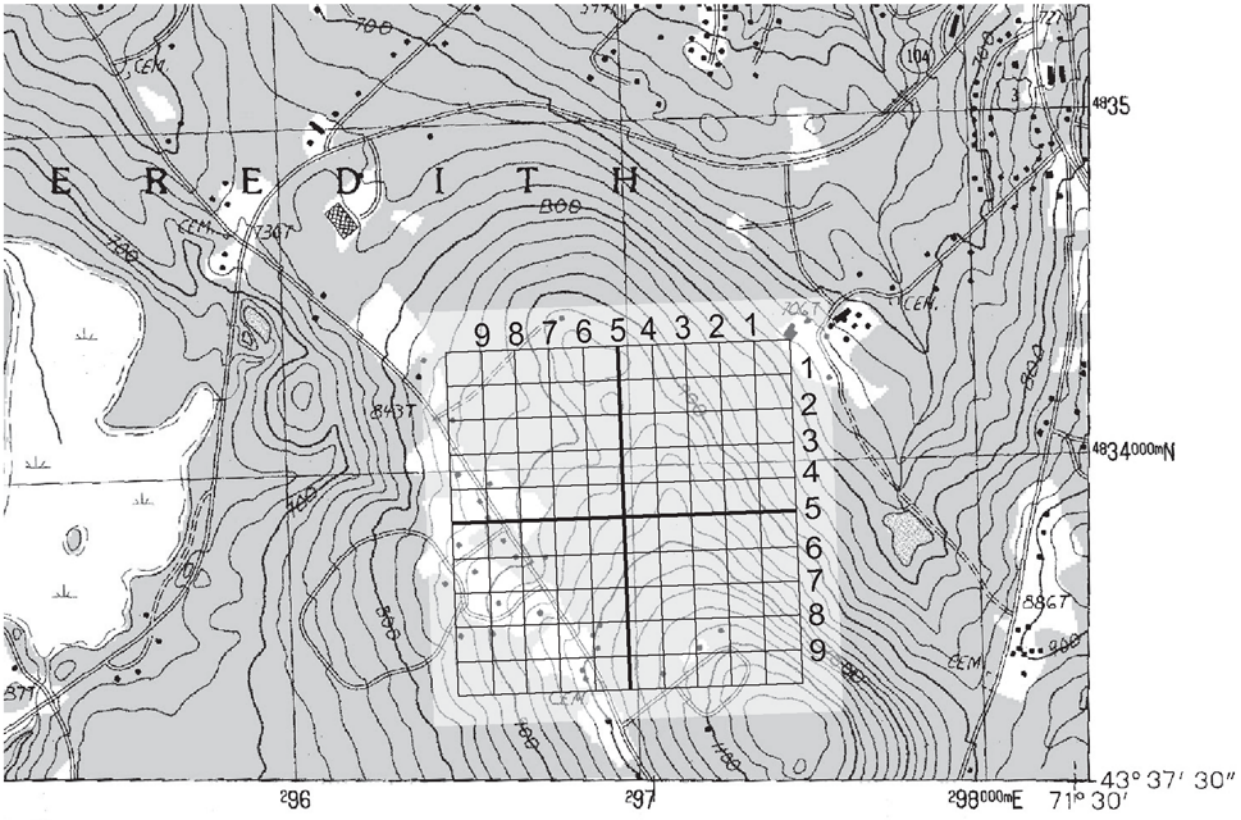
Table 6-8 illustrates the steps for plotting the UTM coordinates 02**97**480E and 48**34**360N.

Table 6-8. Steps for plotting UTM coordinates.

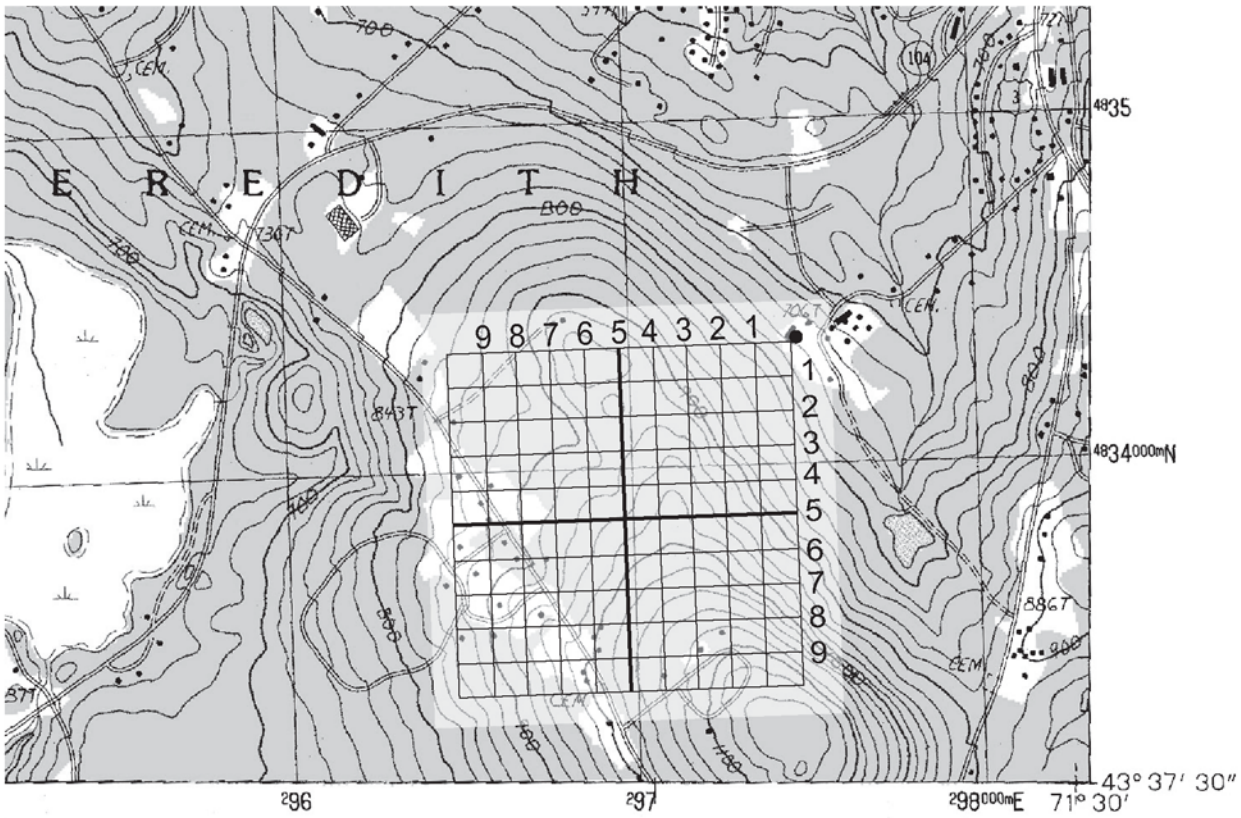
Steps	Directions
1	Find the northing and easting tick marks on the map. Identify the UTM grid square in which the given coordinate is located.



Steps	Directions
2	Place the right corner of the grid reader in this grid square, and ▪ Slide the grid reader so that the last three numbers of the easting coordinate (480) align on the north-south UTM coordinate (0297), then ▪ Slide the grid reader so that the last three numbers of the northing coordinate (360) align on the east-west UTM coordinate (4834).



Steps	Directions
3	Plot point of UTM coordinate in upper right corner of grid reader.



Estimating Your Own Position Location

There may be times in the field when you do not know where you are on the map or you may need to communicate your position location to the Operations Section or Situation Unit. One method to estimate your own position is called triangulation. It involves sighting on two **known** landmarks (you know where they are on the map) and where those lines of position intersect is where your position is located. Table 6-9 outlines one method to determine your own position using triangulation and is illustrated in Figure 6-9.

Table 6-9. Steps to determine your own position using triangulation.

Steps	Directions
1	Adjust compass for declination.
2	Locate two or more objects (e.g., topographic features, structures), that can be identified on the map. It is best if the objects are approximately 90° apart to reduce potential errors.
3	Take a bearing to each of the objects.
4	Convert to back bearings.
5	On the map, draw the lines of the back bearing from the objects – these are called lines of position. The point where these lines intersect is your position.

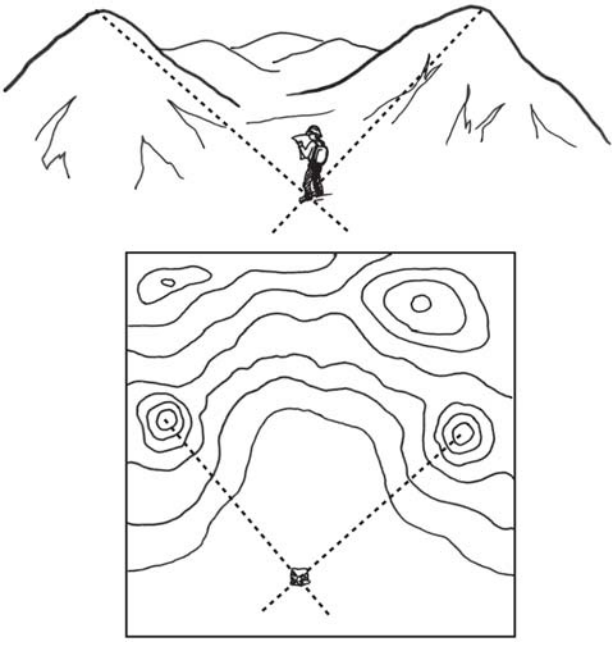


Figure 6-9. Estimate your own position by taking bearings and drawing lines of position on a map; where they intersect is your position location.

Estimating Unknown Position Locations

Triangulation is also used to estimate the location of an unknown position. For example, two field observers spot smoke. The field observers know their own position locations but they don't know the position of the smoke. They can determine the location of the smoke by taking a bearing and plotting it on the map. The intersection of the two lines is the location of the smoke. Table 6-10 outlines one method for estimating unknown positions and is illustrated in Figure 6-10.

Table 6-10. Steps to estimate an unknown position.

Steps	Directions
1	Adjust compass for declination.
2	Take a bearing from two or more **known** locations to the **unknown** position.
3	Plot bearings on the map and draw connecting lines. The point where the lines insect is the approximate location of the previously unknown position.

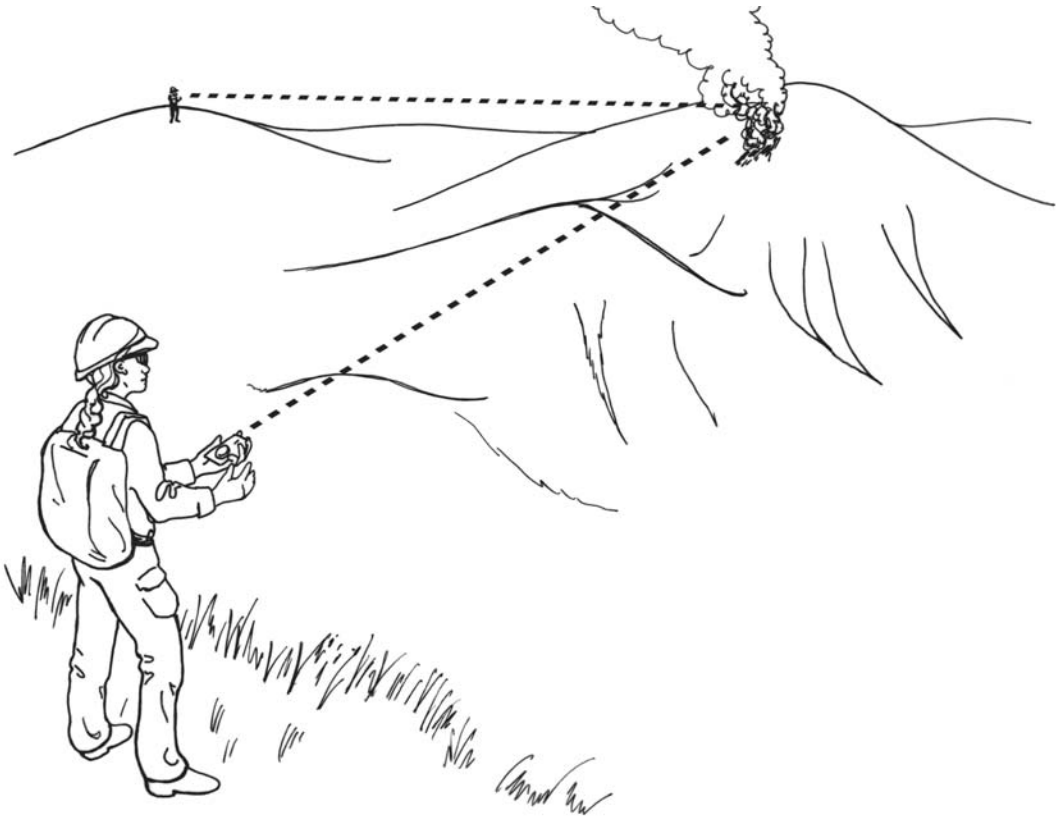


Figure 6-10. Estimating an unknown position.

Estimating Distance on the Ground

Being able to estimate distance on the ground is important for both navigation and field mapping. Maps measure the distance between two points "as the crow flies." This means they measure horizontal distances, not slope distances (Figure 6-11). When navigating, if the land is flat this causes no problems, but when there are hills and mountains, distances measured on maps are going to be way off.

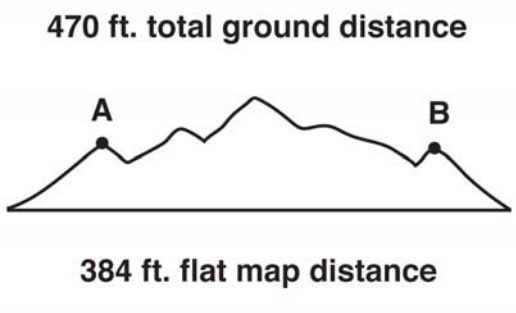


Figure 6-11. Map distances can under-estimate the actual ground distance.

There are various methods of determining distance along the ground. Since it is not usually practical to measure long distances on uneven terrain with a measuring tape, other methods such as pacing must be used. This section focuses on estimating distance using pacing and briefly mentions other methods for estimating distance on the ground.

Pacing

Pacing is one way to keep track of your distance when in the field. A pace is defined as the average length of two natural steps (a count is made each time the same foot touches the ground). Everyone has a different pace. Estimate your own average length of a pace by following the steps in Table 6-11.

Table 6-11. Steps to determine your own pace.

Steps	Directions
1	Set up three pacing courses to ensure an accurate determination of pace length. Each course needs to be 100' or 66' (one chain). One course needs to be on level ground and the other two need to be on a moderate slope and steep slope.
2	Walk each course and count the number of paces (each double-step).
3	Calculate your pace by dividing the distance measured (100' or 66') by average number of paces.
4	Repeat this process a number of times to get your average pace.

To estimate the distance between two points on the ground, count the number of paces as you walk between the two points. Then multiply the number of paces by the length of your average pace. It is a good idea to have a system to record your pace count, especially over long distances.

Pacing is not exact and one has to compensate for the following:

- Pace can change based on steepness of slope; typically, pace lengthens down slope and shortens upslope.
- Walking into strong winds causes the pace to shorten; walking with a tail wind causes it to lengthen.
- Soft surfaces such as sand and gravel tend to shorten the pace.
- In wet, rainy, or icy conditions, the pace tends to shorten.
- A paced distance may vary from a map distance because land surveys are based on horizontal distances, not slope distances, especially in uneven or rough topography.

Other Methods to Estimate Distance

There are other methods to estimate distance such as using your vehicle odometer and visual comparison. The odometer works great if you need to measure distances where roads are located. Occasionally you will encounter a stream too deep to wade or a slope too steep to cross, and the distance must be estimated. One way to do this is visually compare it to a known distance, such as the length of a football field.

Field Mapping

Field maps are usually drawn on topographic maps but they can also be drawn on other types of maps or on plain paper. Ideally, you will have a standard USGS topographic map with the margins and scales; however, there will be times when you have just a portion of a map without the margins or scale. Field maps are also produced with the information collected in a GPS receiver. The GPS data is downloaded into Geographic Information System program for producing digitized maps.

Field maps are used to prepare the Situation Unit map, Incident Action map, and other incident maps. It is extremely important that the information on field maps is as accurate as possible because life and death decisions are made based on this information. This section discusses how to draw a field map and use a GPS receiver for mapping.

When drawing field maps it is important to follow standards, locate your start point, and draw features and plot points following recommended procedures.

Follow Standards

Standards help ensure that maps are of consistent quality and meet the needs of those who use them.

- S.T.A.N.D.D.

  This standard helps ensure that all maps have scale, title, author, north arrow, date and time, and datum recorded either in the map legend or somewhere else on the map.

  Scale. Draw the scale at bottom of the map. If map is "not to scale" then write that on map. Map scale may change with the copying process.

  Title. Write the title at top of map. Record incident name and number as appropriate. This includes state, unit identifier, and number (example: ID-BOF-0095).

  Author. Record your name or initials in lower right corner of map.

  North arrow. Draw north arrow.

  Date. Record date and time information gathered.

  Datum. Record datum of the map used.

- Symbology Standard

  This standard helps ensure that maps are consistent and readable. Symbols must be defined in the legend.

  – Use Incident Command System (ICS) symbology, which was discussed in Chapter 1, Overview of Maps. The Fireline Handbook also has a copy of ICS symbology.

  – Additional symbols can be created as needed, but must be defined in the legend.

- Accuracy Standard

  The accuracy standard helps ensure information on the map is accurate.

  – Current and up-to-date information.
  – Features are drawn in the right location and have accurate shape and proportion.

- Utility Standard

  The utility standard helps ensure that the field maps serve the needs of the Situation Unit, Operations, Command and General Staff, and other incident personnel.

  – Complete
  – Readable
  – Submitted on time

Locate Your Start Point

Locate your start point on the map by measuring from a known point that is on the map, measuring between two points or using a GPS receiver.

Draw Features and Plot Points on Map

The features drawn on a field map will vary with each incident; however, common features include:

- Fireline
- Contingency lines
- Division breaks
- Access
- Helispots
- Hazards
- Roads and trails
- Water sources
- Spot fires
- Fuel types
- Escape routes, safety zones
- Natural barriers
- Hotspots
- Facilities/improvements
- Structures
- Potential safety zones/escape routes
- Plot points as appropriate
- Other features

Use ICS symbology to draw these features on the map and check to make sure that scale, title, author, north arrow, date and datum (S.T.A.N.D.D.) are recorded.

Use a Global Positioning System Receiver for Mapping

The data entered into a GPS receiver can be downloaded into Geographic Information System software to produce digitized maps. However, do not rely on the GPS receiver alone – always have a map and compass. Refer to the GPS receiver owner's manual for specific instructions. Some basic tips on using the GPS receiver for mapping include:

- Determine Memory Capacity of GPS Receiver

  Find out what the memory capacity is for your GPS receiver. Also, determine how many track points the GPS receiver is capable of storing. If you run out of memory while you are collecting data it can result in a loss of data, decrease in accuracy of data, and other problems.

- Clear Track Log

  Clear the track log before you start recording data so old data does not get mixed up with new data.

- Set the Record Mode

  – Set interval to "distance" or "time."

    The Record Mode needs to be set to a specific "distance" or "time" interval – this tells the GPS how often it should record. For example, if the record mode is set to record by distance, every 0.01 miles, the GPS will record a track point every 53 feet. Be careful about the interval you set up because you can quickly run out of memory, for example, if the distance interval is 0.01 mile and there is 3 miles of line to track the GPS may run out of memory.

    Distance is the recommended setting. If you set it to record distance at too high of an interval, such as 0.25 miles, you may miss bends or other important features. The GPS can also be set to record at time intervals, for example every 20 seconds. However, whenever you stop, the GPS will continue to record and the points will pile up on each other.

  – Do not set the Record Mode to wrap.

    If the Record Mode is set to wrap and the GPS memory is at 100% it will start to overwrite points that were recorded at the beginning of the track. When you are ready to record and at your starting point, set the Record Mode to "Fill." If you need to back track, veer off course, take a break, etc., turn Record Mode to off. Do not turn GPS receiver unit off.

    Start a new track log for different areas, as appropriate. Setting the record mode to "Fill" tells the receiver to use the last bit of memory and then stop recording. Newer GPS receivers have the ability to convert track logs to a route. A route is permanent and will not be overwritten.

- Name and Save Track Log

  Name and save track log after recording. Keep the name short and write down the name with a description of what it is in your notes. Refer to Chapter 5, Global Positioning System, for information on how to name tracks.

- Name and Save Waypoints

  Keep notes on names and descriptions of waypoints. Refer to Chapter 5, Global Positioning System, for information on how to name waypoints.

- Check Datum

  Make sure the datum set in the GPS unit matches the datum of the map you are using.

Taking Notes

It is extremely important to take good notes when recording observations, drawing a field map, or using the GPS receiver. The notes provide further clarification of what is on the maps and other observations. Don't wait until the end of the day to write your notes because it is too hard to remember what you did. The notes should include:

- Designations/names used on the map and in the GPS receiver (examples: Access #1, A1, DP#1, DP1).

- Description of items mapped, such as capabilities and limitations of water sources.

- General observations

  - Fuel types
  - Spread rates
  - Safety/hazards
  - Fire weather
  - Distances
  - Other information, as appropriate

- Name of person who collected data and when it was collected (date and hours). Writing down the start and stop time when recording track data can help GIS personnel identify track data once it is downloaded.

- Digital photos can also accompany notes.

When writing notes, try to keep them organized and legible, not only so you can read them but others as well. There is no specific format for writing notes; however, Appendix C has a copy of a form that you can use or you can develop your own form.

Checking Your Understanding

Answers to "Checking Your Understanding" can be found in Appendix B.

1. Practice orienting a map with topographic features and with a compass.

Refer to the map on page 6.31 to answer questions 2 – 6.

2. Using a protractor or compass, what is the bearing between point A and B?

3. What is the latitude/longitude coordinate of point C?

   Latitude _____ Longitude _____

4. What is the UTM coordinate of point C? The UTM zone is 11.

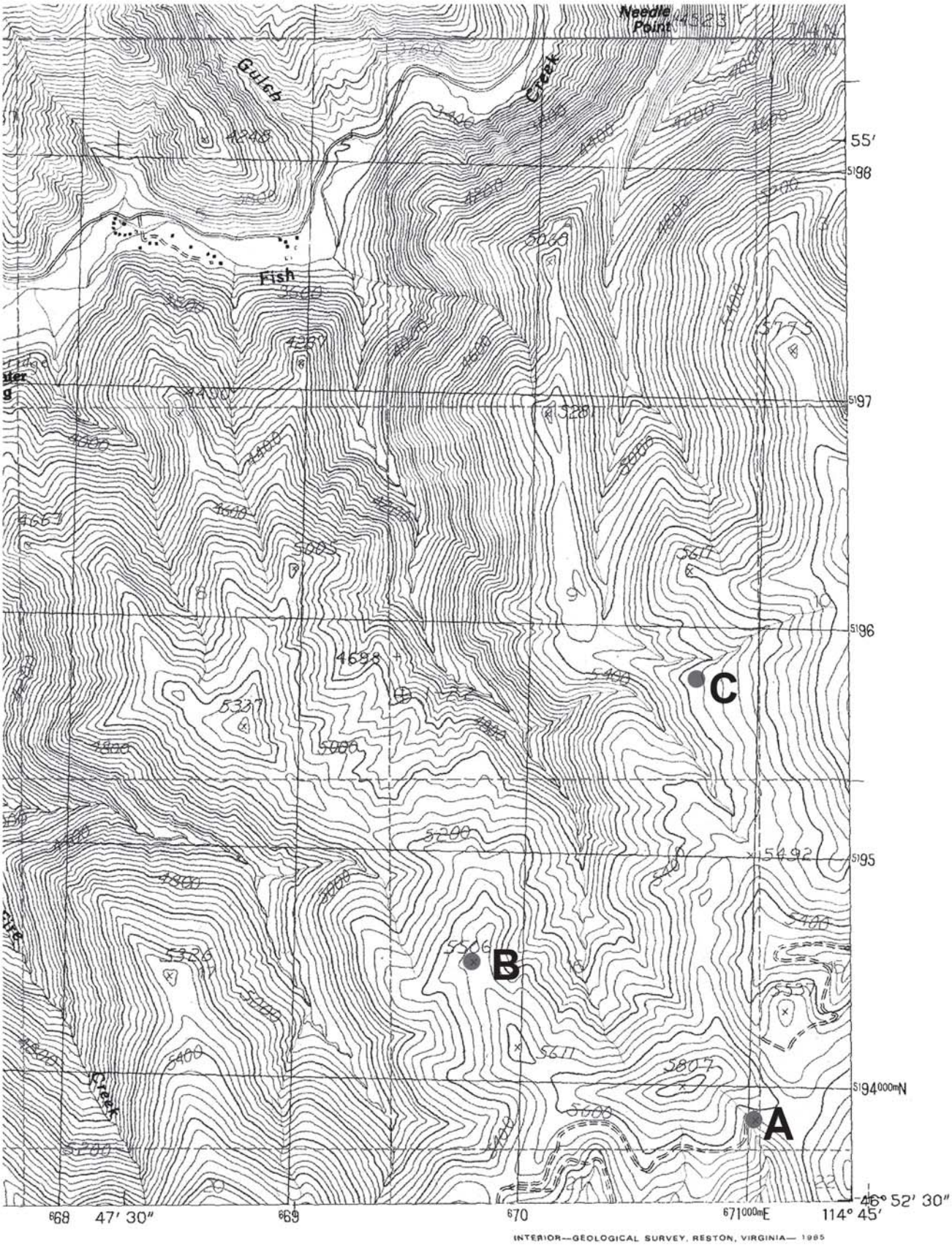
   Easting _____ Northing _____

5. Plot the following latitude/longitude coordinate on the map:

   Latitude 46° 53' 47" Longitude 114° 46' 33"

6. Plot the following UTM coordinate on the map:

   Zone 11 Easting 668760 Northing 5195520


Needle Point
Gulch
Creek
Fish
A
B
C
55′
5198
5197
5196
5195
5194000mN
46° 52′ 30″
114° 45′
668
47′ 30″
669
670
671000mE
INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA— 1985

7. When estimating your own position using triangulation, can you take bearings of a tree and large rock for drawing lines of position?

8. You are a field observer on an incident. You see a potential hot spot several miles away and you need to radio in the location but you do not know the hot spot's location. How can you find out the location of the hot spot using a compass?

9. Follow the directions in this chapter and determine your pace on level and sloping ground.

10. If your average pace is 5½ feet and you walk 1700 paces on level ground, how many feet did you travel?

11. In general, list three situations that could lengthen or shorten your pace.

12. What are the four standards that you should incorporate when preparing field maps?

13. Why is determining the memory capacity of your GPS receiver important?

14. What information should be in your field notes?