Appendix C: Determining Latitude and Longitude

There are many ways that monitoring groups identify and describe the location of sampling sites. Commonly, monitoring sites are described by stream name and geographic location, such as *Volunteer Creek behind the picnic area in Volunteer Park*. Often these descriptions are accompanied by an assigned station number (e.g. VC001, VC002). Some programs use river miles—the distance from the sampling station to the stream's mouth—as an additional identifier.

The most accurate way to identify a sampling location is by determining its latitude and longitude. Latitude and longitude are defined in degrees, minutes, and seconds. The symbols are:

° = degrees ' = minutes " = seconds

Any volunteer program that wishes to have its data used by state, local, or federal agencies, or that plans to enter its data into a Geographic Information Systems (GIS) either now or in the future, must provide latitudes and longitudes for its sampling locations. USEPA's STORET water quality database, for example, requires latitude/longitude information before any data can be entered.

Section 4.1 in Chapter 4, *Macroinvertebrates and Habitat*, briefly describes using a global positioning system (GPS) to determine latitude and longitude. This hand-held tool is used in the field and receives signals from orbiting satellites to calculate lat/long coordinates.

New tools are continually being developed to help locate sites. For example, USEPA's *Surf Your Watershed* web page ties in with the U.S. Geological Survey's Names Information System to provide latitude and longitude information for locations throughout the U.S. These locations include bridges, schools, rivers, parks, and more. Visit this feature of *Surf Your Watershed* at *www.epa.gov/surf/surf_search.html* for more information.

Section 3.1 in Chapter 3, *Watershed Survey Methods*, discusses the various types of maps used by monitoring programs. In addition to the commonly used U.S. Geological Survey (USGS) 7.5 and 15 minute topographic map series, volunteers often use other types of topographic maps including countywide topographic maps available from state Geological Surveys.

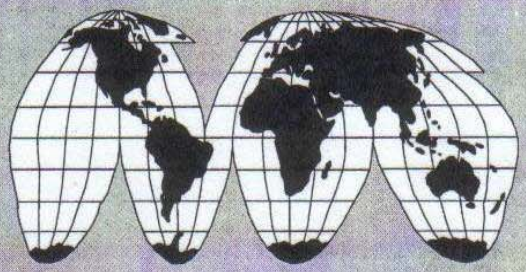
A worksheet is presented on the following pages which can be used for calculating the latitude and longitude of a site using a topographic map. This protocol was adapted from USEPA's 1992 Streamwalk Manual (USEPA Seattle, WA) with revisions by Michael Goodrich of GeoQuest Publications, P.O. Box 1665, Lake Oswego, OR 97034.

Latitude and Longitude

Latitude and longitude are defined and measured in degrees (°), minutes (′), and seconds (″). There are 60 seconds in a minute and 60 minutes in a degree of latitude and longitude.

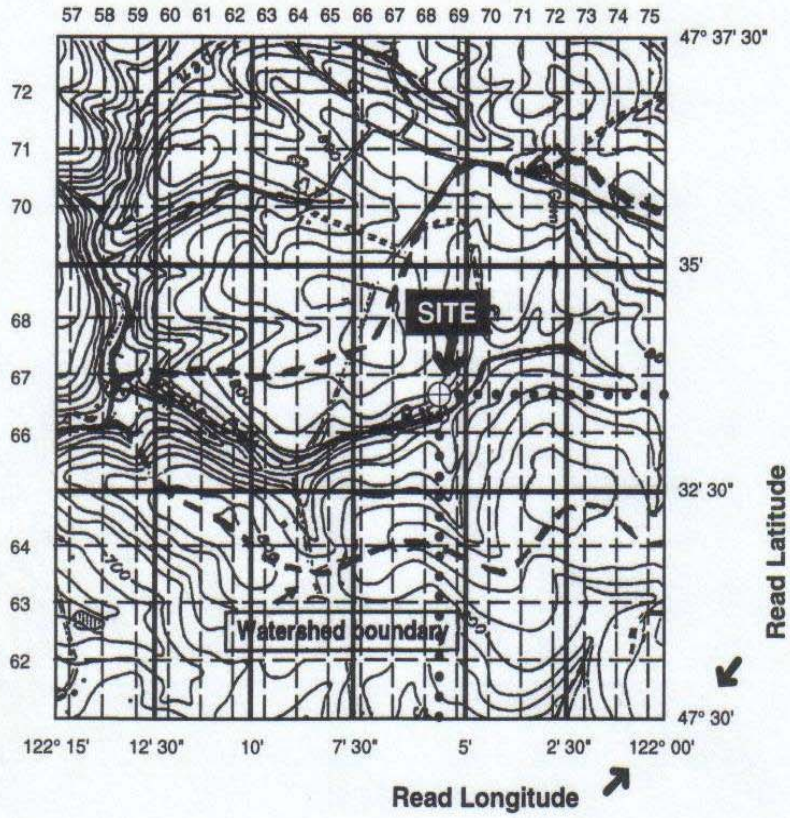
Latitude (lat) is the angular distance of a particular location north or south from the equator. Latitude lines are called *parallels*.

Longitude (long) is the angular distance of a particular location east or west of some prime meridian (usually Greenwich, England). Longitude lines are called *meridians*.



Worksheet for Calculating Latitude and Longitude

(With an example using a 7.5 x 15 Minute Series USGS topographic map)



IMPORTANT NOTE!

When working with longitude and latitude you must remember that there are 60 seconds in a minute and 60 minutes in a degree. This system works like time. When you add or subtract, 59 is the highest number you can enter in the seconds or minutes "column."

For example, if you add 20 seconds to your already established line of latitude of 38° 58' 49", your new latitude would be 38° 59' 09".

Step 8 in the worksheet requires you to add or subtract latitude and longitude using this system.

Mathematical determination of LONGITUDE:

	Your Site	*Example*
1. Find and record the numbers of two lines of longitude that exist on either side of your site. Identify which of these lines is closest to your monitoring site.		
a. Record the closest line of longitude east of your site.	___° ___' ___"	122° 05' 00"
b. Record the closest line of longitude west of your site.	___° ___' ___"	122° 07' 30"

(In this example, the line east of the site is the closest)

	Your Site	*Example*
2. Subtract #1b from #1a. Record that number in minutes and seconds.	____ ' ____ "	2 ' 30 "
3. Convert the answer to #2 to seconds by multiplying the minutes by 60 and adding the remaining seconds.	____ "	150 "
4. Measure and record the distance in millimeters (mm) between the two lines of longitude that were identified in #1.	____ mm	16 mm
5. Measure and record the distance from the closest line of longitude to your site. *(In the example, 122° 05' 00" is the closest line of longitude to the site.)*	____ mm	4 mm
6. Convert this distance into seconds by multiplying the distance (#5) by the number of seconds (#3) and dividing that sum by the distance between the two longitude lines (#4). $\frac{\#5 \text{ X } \#3}{\#4}$		$\frac{4 \text{ mm X } 150"}{16 \text{ mm}}$
Round to the answer to the nearest whole number. *(The distance units (mm) cancel each other out and the answer is in seconds.)*	____ "	38 "
7. If your answer to #6 is less than 60, record it as your answer to #7. If you answer is 60 or more, convert your response into minutes and seconds by dividing by 60. Do not use a calculator for this section because you will need to use the remainder, which would not be displayed on a calculator. Record to the nearest whole number. The whole digits are entered in the minutes column. The remainder is entered in the seconds column. *(In the example, the answer to #6 is less than 60. Therefore it is placed directly in the worksheet)*	____ ' ____ "	0 ' 38 "
8. The site's longitude is calculated using one of the following:		122° 05' 00"
a. If the line of longitude you identified in #1 as closest to the site is east of the site, add #7 to that longitude.	____ ° ____ ' ____ "	+ 0' 38" = 122° 05' 38"
b. If the line of longitude you identified in #1 as closest to the site is west of the site, subtract #7 from that longitude.	____ ° ____ ' ____ "	
(In the example, the closest line of longitude is east of the site. Therefore #7 and that longitude were added together.)		

Mathematical determination of LATITUDE:

	Your Site	*Example*
1. Find and record the numbers of two lines of latitude that exist on either side of your site. Identify which of these lines is closest to your monitoring site.		
a. Record the closest line of latitude north of your site.	____° ____' ____"	47° 35' 00"
b. Record the closest line of latitude south of your site.	____° ____' ____"	47° 32' 30"
(In this example, the line south of the site is the closest)		
2. Subtract #1b from #1a. Record that number in minutes and seconds.	____' ____"	2' 30"
3. Convert the answer to #2 to seconds by multiplying the minutes by 60 and adding the remaining seconds.	____"	150"
4. Measure and record the distance in millimeters (mm) between the two lines of latitude that were identified in #1.	____ mm	31 mm
5. Measure and record the distance from the closest line of latitude to your site. *(In the example, 47° 32' 30" is the closest line of latitude to the site.)*	____ mm	14 mm
6. Convert this distance into seconds by multiplying the distance (#5) by the number of seconds (#3) and dividing that sum by the distance between the two latitude lines (#4).		
$\frac{\#5 \text{ X } \#3}{\#4}$		$\frac{14 \text{ mm X } 150"}{31 \text{ mm}}$
Round to the answer to the nearest whole number. *(The distance units (mm) cancel each other out and the answer is in seconds.)*	____"	68"
7. If your answer to #6 is less than 60, record it as your answer to #7. If you answer is 60 or more, convert your response into minutes and seconds by dividing by 60. Do not use a calculator for this section because you will need to use the remainder, which would not be displayed on a calculator. Record to the nearest whole number. The whole digits are entered in the minutes column. The remainder is entered in the seconds column. *(In the example, the answer to #6 is 68". Dividing by 60 equals 1 with a remainder of 8)*	____' ____"	68" ÷ 60 = 1' 08"

	Your Site	*Example*
8. The site's latitude is calculated using one of the following:		
a. If the line of latitude you identified in #1 as closest to the site is north of the site, subtract #7 from that latitude.	° ' " ____ ____ ____	47° 32' 30"
b. If the line of latitude you identified in #1 as closest to the site is south of the site, add #7 to that latitude.	° ' " ____ ____ ____	+ 01' 08" 47° 33' 38"

(In the example, the closest line of latitude is south of the site. Therefore #7 and that latitude were added together.)