MAPPING EMIGRANT TRAILS

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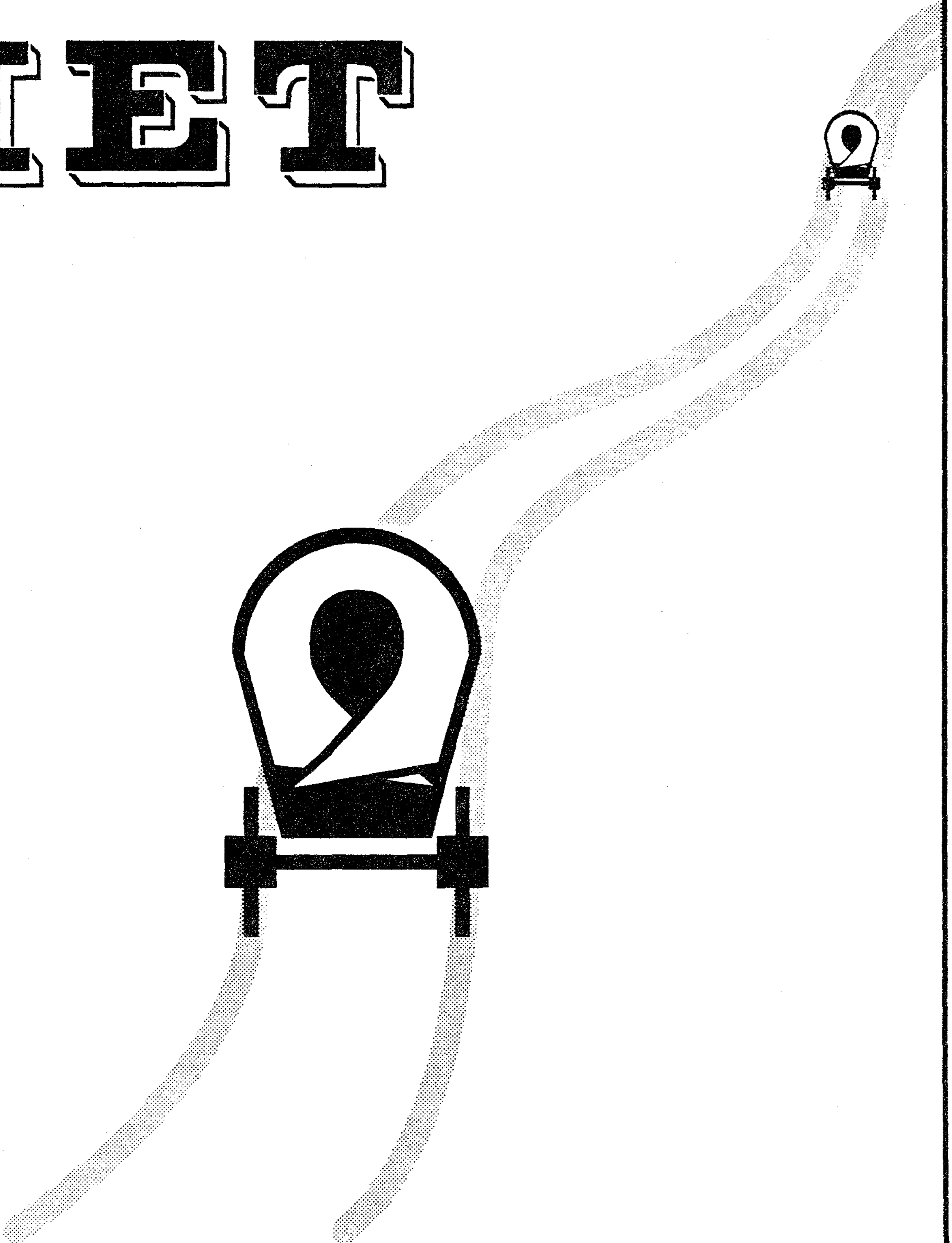

OREGON-CALIFORNIA TRAILS ASSOCIATION

MAPPING EMIGRANT TRAILS
MET Manual

Prepared by the

Trail Mapping Committee

Fourth Edition
(Revised & Expanded)
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(MET)

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The Making of an Emigrant Wagon Trail

"The road on this river is lower than the ground on the sides of it, on some places two feet. It is occasioned by the teams treading the loose soil up and the stronger wind we have here blowing the dust out of the road forming a kind of ditch."

—Lewis Beers, along the Humboldt River on Aug. 4, 1852, "Across the Continent in 1852"

PREFACE

The Fourth Edition of *Mapping Emigrant Trails* reflects continued upgrading of the guidelines and procedures on locating, verifying, classifying and plotting emigrant trails. The original concept for a mapping manual and a preliminary edition came from Tom Hunt. John Maloney developed the word processing format for the next First Edition which has been continued in all subsequent editions. Andy Hammond and David Johnson contributed to the text of the first three editions. And Don Buck has been the editor and principal contributor to all four editions. For any questions or inquiries about the MET Manual, contact the Chair of the OCTA Mapping Committee, James McGill.

Comprehensive revisions were made in the 1996 Third Edition of the MET Manual that included the expansion of existing appendices and addition of new ones. In the Fourth Edition, stylistic changes were made, uses of the Global Positioning System (GPS) and aerial photographs were expanded, trail classification categories were modified to reflect criteria for eligibility of a trail for inclusion in the National Register of Historic Places, and the map coding system was revised. Two new appendices were added on recording artifacts and applying the National Register criteria. Most USGS Fact Sheets were updated.

The Trail Mapping Committee would like to thank the many trail experts within OCTA whose questions, comments, and suggestions have contributed to the improvement of the MET Manual. In particular, we would like to recognize Randy Brown in Wyoming, Richard Silva in California, Rush Spedden in Utah, Rose Ann Tompkins in Arizona, and Don Wiggins in Nevada.

We are indebted to John Latschar of the National Park Service for first recommending the use of trail classification categories. Richard Jenkins, archaeologist for the California Department of Forestry, and Kevin McCormick, archaeologist for the Plumas National Forest in California, made helpful suggestions for the Third Edition. We especially thank historian Donald Couchman of Albuquerque, New Mexico, and planner & interpretive specialist Michael Scialfa of South Lake Tahoe, California, for their comprehensive critique of the Third Edition of MET. For the Fourth Edition Michael Scialfa made valuable recommendations for applying the National Registration criteria to trails, and Anne-Louise Bennett, Executive Director Foundation/Institutional Advancement, Truckee Meadows Community College in Reno, Nevada, made stylistic changes in the text.

The committee is gratified with the continued widespread use of the MET Manual not only by OCTA's trail mappers but also by other trail organizations and public land-use agencies involved in protecting and preserving emigrant trails. 🕮

INTRODUCTION

The Oregon-California Trails Association has several ongoing programs dedicated to researching and preserving emigrant trails. *Graves and Sites* is inventorying for publication all known emigrant graves, emigrant names on record rocks, and significant emigrant sites along the trails, and has marked many with Novalloy pedestal markers; *Trail Marking* is placing Carsonite markers with trail name decals and steel-rail markers with plate descriptions on emigrant trails in many western states; *Census of Overland Emigrant Documents* (COED) is surveying all emigrant documents and entering into a computer database the bibliographical information, people named, locations mentioned, routes taken, and incidents involving Native Americans, all of which researchers can access; and *Mapping Emigrant Trails* (MET) is locating, verifying, classifying and plotting emigrant trails, based on the research methods and procedures covered in this manual. The success that OCTA achieves with these programs will determine the Association's reputation as a major contributor to preserving emigrant trails.

Over the years, many of the overland emigrant trails in the Trans-Mississippi West have been mapped, but never in a systematic way. Only recently, using the methods and procedures in the MET Manual, have OCTA mappers employed extensive field location and verification procedures, including a standard system of trail classification. The Beckwourth Trail was the first to be completed, followed by the Yreka Trail, with the remaining California Trails in Nevada and California nearing completion. Mapping emigrant trails in Oregon, Washington, Utah, Kansas, Arizona, and New Mexico are in progress.

Advances in computer technology and software have led to the availability of digitized USGS. 7.5 minute quadrangle maps on which emigrant trails can be accurately displayed, copied, stored, and transmitted electronically. In addition, Global Positioning System technology (GPS) has become indispensable for accurately recording trail locations on both digitized and conventional quadrangle maps. Although these impressive technological achievements have greatly enhanced the capabilities of OCTA's volunteer mappers, they still have to locate, verify, and classify trails by trudging through fields, sagebrush, and forests after having spent hours researching old plats, aerial photos, and emigrant accounts of overland travel.

The goal of the MET program is to produce the **definitive** mapping of the overland emigrant trails based on the research methods, field verification techniques, and classification system advanced in this manual. Obviously, a mapping program as ambitious as this will take years to complete.

We must keep in mind, however, that parts of our priceless national heritage are being threatened or lost every year simply because of the lack of authoritative knowledge about trail locations. Consequently, it is important that OCTA map the trails as quickly as possible, consistent with historical accuracy, and make this information available to public agencies and private landowners for purposes of trail preservation. Therefore, the sooner the MET program is completed, the sooner our **overland-trails heritage will be protected and preserved.** 🕮

PRIMARY RESEARCH METHODS

OVERVIEW

Because the accuracy and reliability of the MET program rests on quality of research, it is important to emphasize the methods used to locate and verify emigrant wagon trails. Documentary evidence (trail literature of all types) is the main historical resource available to the trail researcher; therefore, MET participants must have a basic familiarity with the literature of the trails. If they do not, such knowledge can be acquired readily. It is a process of identifying and locating the documents needed, then studying them by following the methods recommended in this section. The more knowledge the trail researcher has of trail literature, the easier the task and the more rewarding the fieldwork becomes.

Published and unpublished documents needed for emigrant trail research are found in a wide variety of locations, such as public libraries, museums, national/state/county archives, university research libraries, state and county historical societies, newspaper archives, state and county highway departments, county land records, and state BLM offices. OCTA is developing two research collections, one at the National Frontier Trails Center in Independence and the other at the California State Library in Sacramento.

Emigrant diaries and journals—eyewitness accounts of trails—usually provide the most reliable documentary evidence for trail research and field verification. Several standard emigrant document bibliographies exist: On the northern routes see Merrill Mattes, *Platte River Road Narratives*; John Townley, *The Trail West*; and Marlin Heckman, *Overland on the California Trail.* On the southern routes see Townley, *The Trail West* and Patricia Etter, *To California on the Southern Route, 1849: A History and Annotated Bibliography.* Another source for identifying which emigrant documents relate to which emigrant trails is OCTA's *Census of Overland Emigrant Documents* (COED) computer database program which can be accessed by the program's *Emigrant Trails Research Tool* software.

The following discussion focuses on the primary methods used in documentary research and investigative fieldwork. These methods are designed to impart order and discipline into the use of evidence in locating and verifying emigrant trail segments.

GENERAL PRINCIPLES GOVERNING TRAIL LOCATION AND VERIFICATION

At the most basic level, two general principles govern research in locating and verifying emigrant trail segments:

1. **Probability:**

   All too often the exact location of an emigrant trail segment cannot be verified with absolute certainty. In most situations, however, the trail researcher can strive for a higher degree of probability by utilizing all the available evidence and following correct procedures. Verifying the extent to which a trail is an authentic emigrant trail may pose a problem. What appears as an emigrant trail may have originated as a later period freighting, mining, military, or stage road. In such cases, the researcher must determine the degree of probability that the trail in question did in fact originate as an emigrant trail.

2. **Analogy:**

   The trail historian can only measure the unknown by what is known through analogy. The location of a possible trail segment can be authenticated only by comparing and contrasting it with what is already known about other verified emigrant trails. These analogous relationships include all types of documentary and physical evidence. Thus, to authenticate newly-located trail segments, the trail researcher must apply the accumulated knowledge gained from previously verified trail segments to similar conditions found on the "newly-discovered" segments.

CARDINAL RULES OF TRAIL VERIFICATION

For the location of an emigrant trail segment to be considered as verified, it must conform to the following "Four Cardinal Rules." Where conditions exist such that any of these four rules do not apply, the probability level is reduced accordingly. Essentially, these "Four Cardinal Rules" become a standard for assessing the degree of probability that the researcher/mapper has accurately located an emigrant trail segment .

1. Coherence Rule:

There must be a linear uniformity so that trail segments form a continuous sequence; i.e., the trail segment under investigation has to link coherently with the trail segments that precede and follow it.

2. Corroborative Rule:

There must be confirming documentary evidence of the trail; i.e., the trail segment under investigation has to have valid written or cartographic evidence to support its authenticity. (See below: "Ranking the Reliability of Different Types of Evidence Used to Verify Trail Location.")

3. Collateral Rule:

There must be accompanying physical and/or topographical evidence of a trail; i.e., the trail segment under investigation has to have some geomorphic or artifact evidence to support it as an authentic emigrant trail. (See "Guidelines for Locating Wagon Trails," page 8.)

4. Correlation Rule:

There must be overall agreement between all types of evidence; i.e., the evidence resulting from the first three cardinal rules have to be mutually supporting (not contradicting one another) in order to verify the location of a trail segment.

No set of standards, however well thought out, can cover all cases with equal uniformity. In most instances the "Four Cardinal Rules" will work well. Inevitably, however, situations will arise when the level of authenticity of a trail segment may be much higher than a strict application of the four rules would warrant. In such cases, the researcher-mapper will have to rely on balanced judgment, acquired through experience, to arrive at a final determination. Ultimately, the trail mapper bears the responsibility of reaching a decision on where the trail is located; the rules cannot do that.

RANKING THE RELIABILITY OF DIFFERENT TYPES OF EVIDENCE USED TO VERIFY TRAIL LOCATION

In the best of all situations, the trail researcher examines all the relevant written, cartographic, physical, and artifact evidence and finds them mutually supporting. But what does the researcher do when different kinds of evidence conflict? How does one determine the relative reliability of different types of evidence?

Though it may not apply in all situations, as a general rule **the closer in time the evidence is in relation to the trail under investigation, the more reliable that evidence becomes**. Some examples: An 1849 diary with daily entries is more reliable than a recollection/reminiscence written forty years later by a 49er. Emigrant diaries or journals describing a trail segment are more reliable than the interpretations of trail buffs, unless their conclusions are also solidly rooted in the early emigrant sources. When a General Land Office (GLO) plat completed in 1872 shows the location of an emigrant trail that differs from the location described in early emigrant diaries, the researcher must rely on the earlier evidence, especially in establishing the location of the original emigrant trail. What the GLO surveyors recorded in 1872 may have been either a later alternate emigrant route or even a post-emigrant stage or freighting road that may or may not have received emigrant use.

When adequate diary/journal or physical/artifact evidence is lacking, the researcher must rely heavily on the next best source of evidence, usually later reports or maps, especially GLO plats. In all cases, one must utilize all types of available evidence, keeping in mind that the closer the evidence is **in time** to the period of the trail's use, the more reliable it becomes.

As nearly as possible, the following ranking reflects the relative reliability of available evidence.

1. Written eyewitness descriptions that locate the trail with reasonable accuracy or exactness, such as detailed diaries, journals, letters, newspaper accounts, and reports of the Army Topographical Engineers describing newly-opened trails.

2. Written eyewitness descriptions that locate the trail in a general way or direction, such as less detailed diaries, journals, letters, emigrant guides or logs, and the more detailed recollections/ reminiscences.

3. Remaining physical, vegetation, or artifact evidence of wagon trails that correspond to either diary or plat evidence, such as traces, ruts, swales, wagon parts, differential vegetation, etc.
   - Archaeological reports and surveys either by universities, state, or federal agencies can assist in locating physical remains of emigrant trails.
   - Remote-sensing technology that detects subsurface ground anomalies, using computer-assisted image interpretation, show great potential for locating physical and artifact remains.

4. General Land Office (GLO) cadastral survey plats.
   - The earliest GLO surveys in the west were conducted only along township boundaries.
   - Later GLO surveys were conducted along section lines within each township.

5. Topographic features that serve to confine wagon travel can aid interpretation of sketchy diary accounts and GLO plats. However, emigrant trails often defy modern reasoning on the route these trails should have taken. Be cautious, therefore, of second guessing emigrant reasoning and practices.

6. Reports that describe the location of emigrant trails, such as federal, state, county, territorial, military, and railroad surveys undertaken in the 1850s and later. State highway/transportation department surveys at the beginning of the motor vehicle period, sometimes conducted along or across earlier emigrant trail routes, may prove useful.

7. Maps that show the location of either emigrant trails or possible emigrant trails.
   - The earliest mapping usually was the most general in that the maps covered large regions. Maps of this type include early surveys commissioned by state agencies and legislatures, maps of the Army Topographical Engineers and maps of the Pacific Wagon Road Office of the Department of the Interior.
   - An exception is T. H. Jefferson's large scale 1846 *Map of the Emigrant Road from Independence, Mo., to St. Francisco, California* which has proved very useful in determining the early emigrant route to California.
   - Late 19th century maps that may reveal emigrant routes, such as early USGS. topographic quadrangles and early county maps often located in county records or recorders offices..

8. Recent evidence and documentation (not necessarily in order of reliability).
   - Published trail descriptions and maps by historians and government agencies. Also trail studies/reports produced by consultants for government agency use.
   - Trail-location knowledge of trail buffs, local residents, ranchers, foresters, and government agency personnel.
   - USGS. Orthophoto Quadrangles (7.5 minute) may reveal the location of trail segments not readily visible on the ground.
   - Aerial photographs. (Refer to Fact Sheets on aerial photography and two pages on availability and use of aerial photography at the end of Appendix G.)

Experience has shown that caution must be exercised when using some of the preceding types of evidence and documentation. Even detailed diary accounts can be misleading or confusing. The researcher must evaluate any suspect account by comparing it with other diary descriptions as well as topographic and cartographic information. Because recollections and reminiscences have been written long after the overland trek, when memories have faded, they often include unreliable descriptions. In rare cases, the emigrant author may have based his or her recollections on a diary kept while traveling overland. As a general rule, however, researchers should be wary of recollections and reminiscences.

Among the most useful and readily available documentary resources for western emigrant trails are the GLO survey plats produced from the 1850's through the early 20th century. These are the original federal township surveys, now available in the western states on film at BLM state and district offices (both the plats and surveyor notebooks). Although most GLO plats were the result of conscientious surveys by competent surveyors, some of the plats are not trustworthy. There are historical records of large-scale fraudulent surveys and smaller-scale, so called "hotel room surveys" where no actual field survey was ever conducted. The researcher must compare what is seen on these old plats with other sources. The accuracy of the surveyor's trail identification also depended on his knowledge, and this may have been faulty. In some cases, surveyors labeled a road as an "Old Emigrant Road" or "Old California Road" which can be quite helpful, while others labeled them "Roads" or "Trails" which is less helpful. (For an expanded discussion on the accuracy and use of GLO notes and plats, see the article in Appendix B.)

Even the most competent GLO surveyors only recorded features along section lines within a township. (A section is one mile square, with 36 sections in a township.) Surveyors were required only to walk along section lines and record in their survey books what features they encountered along that section line. Thus, in most cases, field surveyors did not record features **within** the sections when surveying along section lines. When completed, a surveyor's field notes were sent to a draftsman who then transposed the recorded features from the survey notes to the plat, but could only estimate where the trail was located between section lines. Therefore, unless the surveyor either followed a trail between section lines or could see it clearly (and provided that information in his survey notes), the trail route drawn between section lines may be inaccurate. This will not be a problem in areas where the trail is coursing through sections of flat terrain in a relatively straight line. But the possibility of inaccuracies should be considered when judging the reliability of a trail route appearing between section lines in mountainous and forested terrain. As a general rule, **on GLO plats accuracy will exist only where the trail intersects a section line**.

In transposing trail/road information from the old GLO plats to modern USGS 7.5 minute topographical maps, some modern section lines—due to more accurate surveying—may be rendered differently from those on the old plats. In such cases, the researcher will have to estimate where the trail is on the topographical map (in preparation for verification work in the field). Reading the old surveyor's notes may help in attaining more clues on where to look for remains of an emigrant trail.

In areas remote from railroad-building, mining activities, or settlements, GLO surveys often were not completed until the late 19th or early 20th centuries. By this time, unless the emigrant trail had become a freight, stage, or ranch road, it may have fallen into such disuse that surveyors did not record. Therefore, the more recent the GLO plat, the less chance old emigrant trails would have been surveyed and recorded.

Nonetheless, GLO plats, despite their potential for inaccuracies and omissions, are among the most useful and available sources we have for determining the emigrant trail routes. Certainly no mapping effort can be considered complete until this source has been utilized fully. We strongly urge that the relevant GLO plats be consulted and evaluated **before** beginning fieldwork. (All relevant trail information should be transferred onto 7.5 minute topo quads before going into the field.) In conjunction with diary accounts, those plats will provide the best starting point for locating and verifying trails.

Another verification problem is the proliferation of emigrant trails leading out from trail heads or approaching final destinations. Over the years, emigrants and particularly promoters of emigrant traffic tried to improve existing routes by developing shorter or easier routes, some of which became toll roads. This proliferation process is further complicated at the western terminus of emigrant trails by new trails and roads opened up from west to east. Therefore, what constitutes the "original" emigrant trail or destination becomes problematical. And along with these new roads come different kinds of evidence.

Often diary accounts are lacking, particularly during the later periods of emigrant travel, so the researcher has to rely more on county records, county maps, and local newspaper accounts of new road-building activity.

Published studies on the location of emigrant trails can be very helpful. However, because emigrant trail studies have been published does not mean that the work of MET mappers is no longer necessary. As with any piece of evidence, the findings of these studies should be verified, whenever possible, by using emigrant documents of all types and looking for physical remains of the trail. Older studies in particular will contain persistent inaccuracies that will be uncovered only through a determined evaluation process.

Recently, state and federal agencies, employing research methods similar to those described in this manual, have produced several detailed studies that locate emigrant trails on USGS 7.5 minute topographic quadrangles. As useful as these studies are, the trail classification scheme they use generally is not as comprehensive as the five-part classification scheme the MET program advocates. (Refer to the section on "Classification Categories for Overland Emigrant Trails.") Therefore, even in the trail areas covered by these studies, MET's classification categories will necessitate additional field work to assess the current condition of emigrant trail remains.

Information gleaned from trail buffs, local residents, ranchers, foresters, and government agency people can be quite useful. However, as with any piece of evidence gathered by the trail researcher, it must be rigorously evaluated and verified. Just because someone insists the trail is over here or over there does not make it authoritative. The researcher should be open to but cautious about acceptance of this kind of trail information.

Even the USGS. 7.5 minute topographic quadrangles can be misleading. Often these maps will have emigrant trails marked on them; but in a number of cases these trail plots have proven to be inaccurate. In all cases, therefore, the researcher must test this kind of evidence in the same way any evidence is evaluated for accuracy. Also, in the more recent revised and provisional editions of the 7.5 minute quadrangles, the policy of the USGS. is to eliminate most of the cultural/historical data (such as historic trails and ruins). In such cases, having access to earlier editions may prove useful.

One last cautionary note concerns the use of aerial photographs and fly-overs as a means of identifying possible emigrant trail segments. In both cases, the mapper must know the terrain intimately in order to distinguish emigrant trails from other observed features. What appeared to be a trail may on field investigation turn out to be a recent road or irrigation/drainage. Any feature observed from the air and on aerial photographs must be verified on the ground. Particularly useful for identifying trails that have all but disappeared are aerial photographs taken in the 1930's and 40's, often available for viewing at district BLM and Forest Service offices.

GUIDELINES FOR LOCATING WAGON TRAILS

The following guidelines focus on the most common surface characteristics and configurations, as well as other indicators, that can be used to locate and identify emigrant wagon trails.

1. In hilly or mountainous terrain, emigrant wagons generally followed ridges or higher elevations rather than gullies, ravines, or canyons. Evidence of trails is likely to be found on ridges rather than down or up narrow canyons or ravines. However, in very arid regions having hilly and/or rocky terrain, trails frequently followed the easier route of dry, sand-filled washes

2. When encountering hills on steep ascents/descents, wagons normally traveled directly up or down to avoid sideling on steep slopes. Trails traversing along the sides of slopes usually will not be emigrant wagon trails. Exceptions might be where there was either no alternative to a steep slope or the slope angle was not steep enough to make wagons unstable.

3. Traveling up or down hills, wagons often left swales and ruts that eventually caught runoff and took on the appearance of natural drainage features, thereby making it difficult to distinguish between a naturally occurring drainage and one that resulted from wagon use. Generally, wagons ascended and descended on the spine of a ridge rather than up or down gullies. Therefore, an unnatural drainage on the spine of a hill may indicate a one-time wagon trail.

4. Wagon trails that cross gullies often appear as more than one rut, either on the ascending or descending side or both.

5. When possible, wagon-bound emigrants avoided rocky terrain. Do not expect to find wagon traces in rocky areas unless no alternative route was possible.

6. Wagons commonly spread out to avoid alkali dust and deep, loose sandy soils, thereby leaving very wide depressions/swales, several parallel swales, or parallel tracks. Also, as trail deterioration occurred due to use and weather, emigrants established parallel trails to avoid badly rutted and eroded segments.

7. Wagons drawn by draft animals on dirt trails tended to create swales and ruts rather than parallel wheel tracks separated by a center mound which are typical of two-track roads left by motor vehicles. Exceptions are where wagon wheels have worn deep two-track grooves into hard surfaces.

8. In rocky areas, often emigrants cleared larger rocks out of the trail and placed them along the sides of the trail to make wagon passage easier. A line of rocks may mark the edge of trails, often partially embedded in the soil. Also, by way of contrast, in wet or boggy sections rocks may have been placed in trail depressions to facilitate wagon travel.

9. In rocky terrain, wagon trains tended not to spread out because it was difficult to move rocks out of the way to create a parallel trail. However, this does not preclude finding short parallel trail segments in rocky areas.

10. In hard packed, gravel soil, wagon traffic may have left a distinctive "gravel road" appearance that has withstood remarkably well the impact of erosion and weathering. In places, often over long stretches, these gravelly "roads" remain the most authentic appearing, unaltered trails still existing. They are most prevalent in open, sagebrush and desert areas.

11. Wherever wagon passage was difficult—such as either steep descents and ascents or over hot sandy deserts—wagon parts, pottery fragments, and barrel hoops are commonly located. They are the remains of wagon breakdowns or abandoned provisions. For the benefit of future research and verification, and in compliance with State and Federal law, all wagon and emigrant artifacts should be left exactly where they are situated. Particularly significant artifacts should be reported to the managing agency for evaluation and possible curation. (Refer to Appendix F, "Trail Artifact/Feature Form," for a method of recording artifacts found along trails.)

12. Occasionally, rock piles may be found near a trail. These may mark grave sites, particularly if they appear in an oval or rectangular arrangement with an east-west orientation. Small rock cairns a foot or so high also have been found along verified trail routes. Whether these were made by surveyors, road builders, emigrants, or later trail followers is not known.

13. Old wagon traces will often display different vegetation growth than on adjacent areas. This can be evident in grass, brush, or forested areas. On the edges of trails, where softer soil has built up, more vigorous growth can occur leaving a distinctive vegetative border. On trails with hard, compacted soil, little or only stunted growth will occur. And in some cases, where a swale has acted as a rain collector, a line of trees or high shrubs may have grown up over the years.

14. Wagon wheels rolling over alkali flats often left distinctive single or multiple tracks. Continuous tracks, streaked or lined with alkali from evaporation, may give the appearance of alkali "tire tracks." Bare tracks may run through the sparse ground cover on the edges of alkali flats.

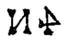
15. On more arid, hard-packed soils (especially where the trail has long been in disuse), the wagon trail will often appear in erratic, scarring patterns that at first glance will not seem like a trail. If possible, the mapper should look for scarring from an elevated position, where the continuity of scarring will be more apparent.

16. In some types of soil, the passage of wagons compressed the earth so that it is less subject to erosion than adjacent areas. In such cases, the trail appears smooth and slightly elevated above the looser material along the side. In other places, where the soil was easily broken up by the passage of animals and wagons, prevailing winds may drift soil into the trailside vegetation and form a berm on the prevailing downwind side of the trail.

17. In some cases, the only evidence of a wagon trail are cattle paths. Cattle tend to take the path of least resistance which often are old wagon traces. So what appears to be only a cattle path may be the vestiges of an old wagon trail.

18. In forested areas, loggers often used emigrant wagon traces for skidding logs which resulted in these traces now appearing as swales. Also, loggers often pulled logging arches and other wheeled equipment up and down ravines and gullies which left swales or ruts that would not be emigrant in origin.

19. Where wagons traversed rocky areas, the iron wheels and hubs may have left rust marks (external oxidation) where they rubbed over rocks or against large boulders and bedrock. Due to the abrasive character of minerals harder than iron (quartz and to a lesser extent orthoclase or plagioclase), many rocks/boulders, especially those that are quartz rich (like granite & rhyolite), will exhibit external rust oxidation from wagon wheels. Often heavily rubbed areas will be much smoother than the surrounding boulder surfaces. On harder rocks, the evidence may be in the form of lighter colored areas, where wagon wheels chipped off small fragments or scraped away the patina surfaces. Along well-traveled sections, wagon wheels may have left striations, even well developed grooves, on boulders and bedrock.

20. Emigrants liked to put their names on suitable rocks either by carving or with axle grease. The most common rocks used for emigrant graffiti are sandstone cliffs, granite outcrops, or very large boulders that have flat surfaces. The names that have resisted weathering and erosion best will be found most often in recessed, sheltered sections of cliffs and outcrops. Emigrant graffiti will evidence typical mid-19th century lettering. Most often names were carved in block letters with decorative wedges at the ends or bases of each letter. Sometimes names, dates and places of origins were in cursive script. Also, whether carved or in axle grease, letters or numbers may be reversed, such as N and 4: 

Other indicators can be either helpful or misleading in locating emigrant wagon trails.

1. One of the most difficult types of topographic evidence to assess is deeply eroded features that originally may have been wagon trails on sagebrush plains. Today they might be dismissed as natural drainage features. But are they? How does one tell the difference? It is not uncommon for a wagon rut or swale, especially in loose soil, to catch rain runoff and over time become part of a well-developed drainage pattern. The only way to evaluate this kind of topographical evidence is to walk the full length of the drainage feature and see if it eventually links together coherently with the trail segments that enter and leave the drainage pattern.

2. Another way to determine if a deeply-eroded feature is a onetime trail is to observe its linear pattern. Often the deeply-eroded feature will abruptly turn at a sharp angle in a different direction and leave the trail that connects with it in a non-eroded condition once again. For the erosion feature to be the remains of a onetime wagon trail, there must be linear uniformity between the non-eroded trail segment that precedes and follows the erosion channel.

3. Swales and ruts with soil berms on each side are suspect as emigrant wagon trails. Modern mechanized equipment may have been used to dig drainage ditches that over time and disuse have taken on the appearance of old wagon trails. The possibility exists, however, that wind could have piled loose soil on the edge of authentic wagon swales so that they appear as man-made berms. Mappers who encounter berms on the sides of swales, must look closely to determine whether they were made by man or nature.

4. Over time, underground cables and pipe lines can give the appearance of wagon trail scarring or shallow swales. Often they will be laid either parallel to or in the trail. Usually, underground cables and pipe lines will have labeled post/metal stakes placed at intervals for identification.

5. Recent fires are often overlooked aids in locating trails. The intense heat of brush and forest fires will clear the ground cover to bare soil and possibly reveal wagon traces or artifacts that had been obscured by vegetation. After brush or forest fires have burned over a trail area, it is good practice to check the area for possible evidence of trails.

6. In forested areas, blazes or scars on trees may or may not indicate a nearby wagon trail. Some government road surveyors did use blazes but emigrant diary accounts have not documented that emigrants blazed trees to show the way through a forest. Nonetheless, it is possible that the first to open up a wagon trail through forested areas may have blazed trees. There are verified cases where blazes were made by emigrants to mark a nearby grave. Usually a name is carved on the blaze although only a few letters will remain visible due to subsequent scar tissue covering much of the original lettering.

   In a 150 year period, any blaze would have had to be rather large to be visible today after scar tissue has covered much of the original blaze. Moreover, an emigrant blazing a trail would have selected mature trees that 150 years later may have been logged or died. Also, at a later time, someone interested in identifying the trail route may have blazed trees next to the trail. Then, too, in mining areas prospectors used blazes to record claim corners. Land surveyors often blazed trees to mark corner sections.

   Therefore, to rely on tree blazes as evidence for a trail, core samples (taken with an increment borer) must be taken and the growth rings counted to see if the time interval between the blaze and the present equates to the age of the opening of an emigrant trail. (Permission to take core samples must be obtained from either the landowner, if private land, or the managing agency, if public land.)

7. Where emigrants took their wagons twisting and turning through dense forests, wagon wheel hubs rubbing against trees may have left scars at hub heights (anywhere from 1½ to 2½ feet from the ground). Here, too, a core sampling is needed to verify the age of the scar before concluding it was caused by wagons.

8. At the top of steep slopes, emigrants commonly snubbed ropes and chains around tree trunks to lower down and pull up wagons. It is possible that evidence of this practice remains on old trees in the form of scars left by ropes and chains. However, apparent scaring on old trees could be due to other uses that post-date the emigrant period. Again, core sampling is needed to verify the age of the scaring.

9. Rust marks (external iron oxidation) left on rocks—especially in larger patches—can be excellent wagon trail markers. However, small, isolated rust specks could be the result of horse/mule shoes, or even construction equipment, dating from a later period.

CONCLUSION

These guidelines for determining trail remnants and segments can not cover all situations. Even our most experienced trail trackers have encountered puzzling anomalies leading to unanswerable questions. Why has the trail vanished in some undisturbed places while in other undisturbed places—often very near, in similar terrain, and with identical soil conditions—the trail remains in pristine condition? Quite often there is no obvious explanation why no visible trace remains when it can be established beyond doubt that the trail passed that way. Why do some remaining ruts, swales, and depressions appear so differently? Why are some swales twenty feet wide and several feet deep while on a segment perhaps a half mile back, in similar terrain, the trail is no wider than one wagon and consists of a shallow depression? There is much to learn about the conditions that have led to the survival of some trail traces and the disappearance of others.

Most trail segments that remain visible today have been impacted by man and nature during the post-emigrant period. Subsequent human impact on earlier emigrant trails may have taken the form of stage, freighting, or ranch use and even road building. Nature may have been involved, in which case the trail may now appear as an eroded trough, deep swale, or gully. In some sandy areas, wind will have blown away loose soil and sand, leaving huge, deep, wide swales now covered with grass. Where the original emigrant trail has not had some kind of subsequent use or impact, it may have all but vanished—gradually fading into the surrounding terrain. Often, only vestiges of emigrant trails remain, barely kept visible by cattle and humans walking on them. Therefore, the vanishing character of emigrant trails makes it all the more imperative that we locate, verify, and map them before they become indistinguishable from the surrounding landscape.

The Mapping Committee is convinced that careful adherence to the MET research and investigative procedures will lead to increased accuracy in locating and verifying emigrant trails. (For a very effective way of using diary/journal accounts to locate and verify emigrant trail segments, see Appendix C, "The Composite Trail Description Method of Locating and Verifying Trails.") Also, gathering as much information as possible before going into the field—from diaries, GLO plats, old surveys and maps, and more recent public and private surveys—will make the mapping task much more effective. However, all experienced trail mappers have learned that the more research and field verification they conduct the more questions they raise that, in tern, lead to longer hours in the field seeking verification of trails. One should avoid jumping to quick conclusions. When in doubt, contact other MET mappers and engage them in a dialogue. They may have alternative solutions and/or insights. Involving other trail experts is always helpful in resolving conflicting evidence or seemingly unanswerable questions. No single person is capable of furnishing all the right answers. The more questions and alternatives that are raised and reviewed, the closer the record comes to being an accurate representation of the past.

Most importantly, the mapper should conduct field investigation and authentication with an open mind. The easy things are readily resolved; the difficult problems may require additional research and field work. The mapper should avoid going into the field with preconceptions that lead to "make things fit" especially when they don't seem to square with the evidence. The MET program is open-ended. It is designed to allow for doubts and to provide for corrections and additions as new materials and evidence come to light. History is a matter of building upon what has gone before. It isn't a matter of being "right." It is more a matter of putting forth what research has indicated has the highest degree of probability. All mapping endeavors should be considered as the opening of an on-going dialogue. That's the historical process at work.

EMIGRANT TRAIL CLASSIFICATION CATEGORIES

The following five classification categories for overland emigrant trails are designed to assess the condition of trails at the time of mapping and establish a basis on which to recommend levels of preservation and use for trails on public lands. The five categories are OCTA's standard classifications for all emigrant trail mapping.

CLASSIFICATION CATEGORIES

Class 1: Unaltered Trail

Symbol: ①

Description: The trail retains the essence of its original character and shows no evidence of having been either impacted by motor vehicles or altered by modern road improvements. There is visible evidence of the original trail in the form of depressions, ruts, swales, tracks, or other scars, including vegetative differences and hand-placed rock alignments along the trailside.

Preservation: Should be preserved and kept free from all human-made development and intrusions, with a protective corridor adequate to maintain the integrity of location, design, setting, materials, workmanship, feeling, and association.

Use: Restricted to hiking and possibly horseback riding, as long as the physical integrity of the trail is not altered..

Class 2: Used Trail

Symbol: ②

Description: The trail retains elements of its original character but shows use by motor vehicles, typically as a two-track road overlaying the original wagon trail. There is little or no evidence of having been altered permanently by modern road improvements, such as widening, blading, grading, crowning, or graveling. In forested areas the trail may have been used for logging but still retains elements of its original character.

Preservation: Should be preserved from any further human-made alterations and intrusions, including road improvements and use as a pipeline/utility corridor. The trail should have a protective corridor adequate to maintain the integrity of location, setting, feeling, and association.

Use: Restricted to hiking, horseback riding, and motor vehicles as long as the physical integrity of the trail is not permanently altered. Where the Used Trail has been abandoned and is badly eroded and/or overgrown with vegetation, it may be desirable to restrict use to hiking and horseback riding.

Class 3: Verified Trail

Symbol: ③

Description: The trail route is accurately located and verified from written, cartographic, artifact, topographical, and/or wagon wheel impact evidence (as rust, grooved, or polished rocks). But due to subsequent weathering, erosion, vegetative succession, or logging, trail traces will be nonexistent or insignificant. What does remain is a verified trail corridor with no intrusive modern development. Typically this includes trails that once passed through forests and meadows, across excessively hard surfaces or bedrock (such as on ridges), over alkali flats and sandy soils, and through ravines or washes.

Preservation: Should be preserved from any further human-made alterations and intrusions, with a protective corridor adequate to maintain the integrity of location, design, setting, materials, feeling, and association.

Use: Restricted to hiking and horseback riding, consistent with preserving the setting of the trail corridor.

Class 4: Altered Trail

Symbol: ④

Description: The trail location is verified but elements of its original condition have been permanently altered, primarily by road construction, such as widening, blading, grading, crowning, graveling, or paving. In some cases, the original trail has been permanently altered by underground cables and pipelines.

Preservation: Although an altered trail no longer contributes to the integrity of design, setting, materials, workmanship, feeling, or association, a protective corridors may be desirable in some areas as a way to retain the trail integrity of adjacent or connected Class 1, 2, or 3 segments.

Use: Generally unrestricted. However, in protected corridors, use should be consistent with maintaining the integrity of adjacent or connected Class 1, 2, or 3 segments.

Class 5: Approximate Trail

Symbol: ⑤

Description: The trail is either so obliterated or unverifiable that its location is known only approximately. In many cases, the trail has been destroyed entirely by development, such as highways, structures, agriculture, or utility corridors. In others, it has been inundated beneath reservoirs. In some, there is not enough historical or topographic evidence by which to locate the trail accurately. Thus, only the approximate route is known.

Preservation: None recommended.

Use: Unrestricted.

Additional Guidelines for Classifying Trails

Most emigrant trails still retaining evidence of wagon use—in the form of ruts, swales, scaring, or tracks—probably have undergone later 19th century wagon use due to freighting, mining, stage, or ranching activity. Therefore, rarely will visible trail remains be the result solely of emigrant wagon use. Also, because these wagon trails have had little or no use in the 20th century, either erosion or restoration have often changed their appearance where they no longer look like they did in the 19th century. Nonetheless, these trail segments still retain their emigrant wagon-use character and qualify as **Class 1.**

Modern intrusions, such as freeways, powerlines or buildings situated near trails, normally do not affect trail classification. Only the condition of the trail itself, or the trail corridor in the case of "verified trails," determines a trail's classification.

Often an "unaltered trail" will intermittently fade into and out of a "verified trail." In these cases, a **Class 1** designation would be appropriate for the length of the intermittent trail segment.

Occasionally, a two-track road will have been abandoned for decades and reverted in appearance to an "unaltered trail." However, if it is known that the trail was once used as a road for motor vehicles, then it is designated as **Class 2** and noted in the map margin as an abandoned road appearing as an "unaltered trail." (Refer to "Use of Comments in Map Margins" in the section on Instructions for Mapping, p. 17.)

In other cases, a two-track road may have been lightly bladed at one time, therefore technically making it an "altered trail," but subsequent weathering and erosion have restored its appearance and profile to a "used trail." Therefore, as long as there is no permanent alteration apparent, the trail can qualify as **Class 2**. Also, water bars and barrier berms may have been placed across "used trails." Nonetheless, these short, impacted segments are recoverable and should not change the trail classification from a **Class 2**. In both cases, a note explaining the condition can be made in the map margin.

In the case of "verified trails," logging, forest fires, or tree mortality may have altered temporarily the trail corridor but over time new growth has or will have restored the natural setting of the trail corridor. Therefore, as long as the trail route is accurately known, these recoverable settings qualify as **Class 3**.

In most cases, **Class 5** trails have been so obliterated by development that exact trail locations are impossible to determine. However, there will be situations where additional research and field verification may reveal the exact location of a trail segment which presently is known only approximately. Thus, where trail location has not been determined due to insufficient research and field verification, a trail corridor should be protected from disturbance until it has been confirmed that physical or other evidence of a trail segment no longer exists.

No trail classification scheme can cover all situations with equal uniformity. In most situations, the five classification categories will apply rather well. But inevitably there will be situations where more than one trail category might apply. In such cases, where there is no clear determination, the trail classifier will have to make a subjective decision based on thorough observation and assessment.

The same qualification applies to the recommended levels of preservation and use on public lands. They are intended to serve as useful guidelines for purposes of protecting and preserving trails from further man-made degradation. However, unique situations may require exceptions in applying the recommended levels of preservation and use.

Using the classification categories in mapping emigrant trails can provide supporting evidence in determining eligibility of a trail for inclusion in the National Register of Historic Places where aspects of integrity in location, design, setting, materials, workmanship, feeling, and/or association apply. (Refer to Appendix I, "Applying National Register Criteria and Aspects of Integrity to Emigrant Trails," that interprets the eligibility criteria for application to emigrant trails.)

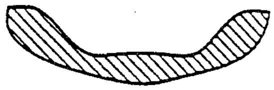
TRAIL TERMINOLOGY

For the purpose of standardizing the definitions of terms used in this manual that describe segments of emigrant wagon trails, refer to the following:

Trace — General term for any original trail remnant.

Depression — Shallow dip in the surface, often very faint and difficult to see.

Swale — A depression, but of deeper dimensions and with sloping sides.



Rut — Deep depression, without a center mound and having steep sides.

Erosion Feature — A trace of any sort that has been deepened and altered by subsequent wind and/or water action. Sides and bottom often irregular.

Track — Visible trace caused by compacting of surface or discoloration due to salt evaporation on alkali flats. Little or no depression. Often seen as streaks across an alkali flat.

Scarring — Irregularly wide flat surface, devoid of vegetation, that no longer shows any wagon depressions or swales. Often seen trailing through sagebrush flats in an uneven pattern.

Two-track — Parallel wheel tracks separated by center mound. Typically an unimproved ranch road used by motor vehicles.

Improved Road or Secondary Road — Bladed, graded, crowned, gravelled, oiled, or blacktop roads usually having side berms, curbs or gutters.

Note: On open sagebrush plains and alkali flats, depressions, swales, scarring, and tracks may be much wider than the width of a wagon (approximately five feet wide). This is due to emigrants either moving their wagons over to a parallel trace or fanning out to avoid heavy dust and deep, loose sand.

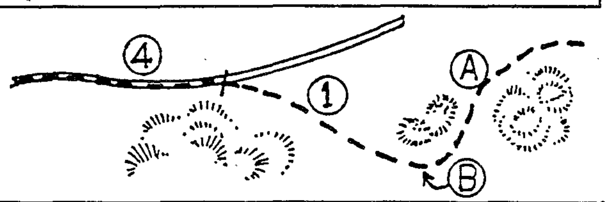
USE OF COMMENTS IN MAP MARGINS

To assist the user of completed USGS 7.5 minute topographic maps, short informative comments should be penciled in **block letters** (for legibility and uniformity) on the left and/or right hand margins of the maps. These descriptive notes should be lettered sequentially in the margins and circled in the same way that trail classification numbers are circled ((A) , (B) , (C) , etc.) using **3/16 inch** diameter circles. A lettered comment in the map margin must correspond to a circled letter on the map, indicating the location to which the margin comment refers. (See example below and in Addendum.)

The short comments in the map margins should be limited to those that provide the map user with **essential information** relating to the verification and location of a particular trail segment, to its particular condition, or to its historical significance. Where a diary or journal account might prove helpful to a map user in understanding more about a particular trail segment or site, record in the margin comments the emigrant author and entry date (for later reference if desired).

For legibility and possible photocopying, prepare the final copy in pencil using **'B' hardness of lead (0.5mm thickness)** for all trail dashed lines, all letters and numbers, and margin notes.

Example:

Map Plot:	Margin Note:
	(A) Trail is deeply eroded here. (B) Byron McKinstry, Aug. 20, 1850, for description of rock formation south of swale.

While not exhaustive in coverage, the following types of relevant margin comments or notes include:

(A) The character or condition of an existing trail remnant.

(B) A difficult trail segment to verify.

(C) The beginning and end of a cutoff, alternate, or branch trail.

(D) An unusual rock formation mentioned in a diary account that either clarifies or confirms a trail location.

(E) Grave descriptions (including any known name, date, and origins).

(F) An important watering source used by emigrants.

(G) A significant trail site mentioned in diaries, such as a pass, river ford, ferry, bridge, trading post, station, fort, etc. (margin comments unnecessary if sites are already named and located on the topographic map).

(H) A common emigrant camping area near the trail.

(I) The location of emigrant wagon artifacts that either confirm or verify a trail location.

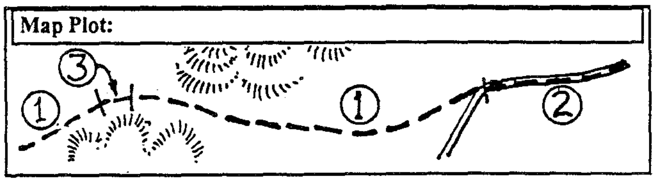
(J) The location of a record rock/bluff.

(K) A pertinent diary reference which may relate to one of the above comments.

PLOTTING TRAIL CLASSIFICATION CATEGORIES

All five trail categories are plotted on USGS 7.5 minute topographic maps in **dashed lines** with the appropriate class number **circled** and placed next to the dashed line. The beginning and end of a trail classification and a change to a different classification are indicated by a short vertical line perpendicular to and crossing the dashed trail. A **3/16 inch** diameter circle encloses the category numbers and . Should the trail segment be too short to place a 3/16 inch circle close to it, the circle may be offset with an arrow or line pointing to the short segment. A trail segments **shorter than 200 feet** need not be set apart by the short vertical line, although the existence of such a short trail segments may be described in a lettered margin comment.

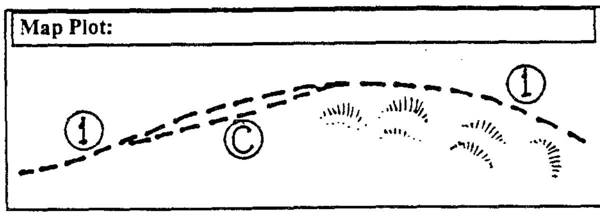
Example:



Old traces are sometimes found running parallel to one another rather closely. Parallel trails were a common occurrence in certain types of terrain and attest to their wagon origins. However, parallel trails that are close to one another may prove difficult to plot on topographic maps. There are several ways to indicate the existing parallel character of these kinds of trails.

1. If the parallel traces are long enough and spaced sufficiently apart to delineate them on the map as separate **Class 1** trails, both are plotted with parallel dashed lines. (For clarity, this parallel situation can be described with a lettered comment on the map margin.)

Example:

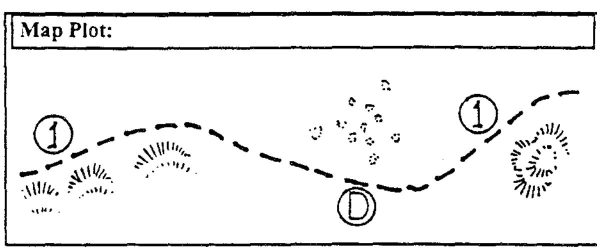


Margin Note:

(C) Parallel scarring very visible.

2. If the parallel traces are too short, intermittent, or too close to one another to plot individually, they should be plotted as a **Class 1** single dashed line and their trail characteristics described in a lettered comment on the map margin.

Example:



Margin Note:

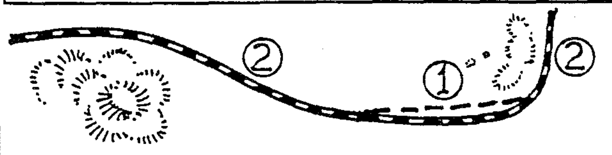
(D) Short, intermittent parallel swales for two-tenths of a mile south of the main swale.

3. If a parallel **Class 1** trace is adjacent to a **Class 2** trail road (i.e., both were one-time emigrant trails), the plotting scheme is the same as described above in situations 1 & 2.

   - If a **Class 1** trace parallel to a **Class 2** trail road is long and distinctive, both are plotted with parallel dashed lines. (A lettered comment in the map margin can make this distinction clearer.)

   Example:

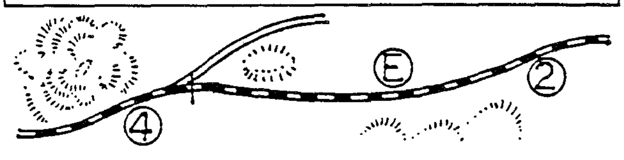
   Map Plot:

   - If a **Class 1** trace parallel to a **Class 2** trail road is either too short, intermittent, or close to the Class 2 road to plot accurately or clearly, it should be plotted as a single dashed line and its trail characteristics described in a lettered comment on the map margin.

   Example:

   Map Plot:

   Margin Note:

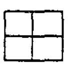
   (E) Short, intermittent parallel swales on north side of Class 2 trail.

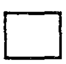
USE OF SITE SYMBOLS IN MAPPING

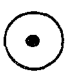
All sites are designated in **1/8 inch** symbols (circle, square, or triangle). Plastic templates that have various sizes of circles, squares, and triangles are readily available at most stationary or art supply stores.

In all cases, the site symbol is placed as close as possible to its location on the map. If a trail marker, grave site, or record rock/bluff already is printed on the topographic map, there is no need to duplicate them with MET site symbols. Important information about a grave, marker, or record rock can be included in a circled letter margin note.

Site Symbols: (enlarged)

 **Identified Grave**

 **Unidentified or Possible Grave**

 **Historical Marker**

 **Register Rock** (emigrant names carved or painted on boulders, cliffs, and rock outcrops)

ASSIGNING A CODE FOR MAP QUADS

1. The Chair of OCTA's Trail Mapping Committee, in conjunction with the mapper and chapter involved, will assist as necessary in providing a coding system for use on each 7.5 minute quadrangle utilized in mapping emigrant trails. The following is a general description of the coding system. In complex cases (listed below under paragraph 3) assigning a code will involve subjective decisions that may require prior coordinating with the Chair of the Trail Mapping Committee to ensure coding accuracy and consistency.

2. The coding system will comprise six letters/numbers: the first two will be letters designating the **state** involved, the second two letters will designate the **trail name**, and the last two will be the **sequential number** of the map within the state. Each part of the code is separated with a hyphen: CA-LA-06 (the sixth map on the Lassen Trail in California).

   State Code

   The state in which the map is listed will be designated by the standard two letter postal abbreviation (i.e., **AZ**, **CA**, **NM**, **NV**, **OR**, **UT**, **WY**, etc.).

   Trail Name Code

   When possible, the two letter trail designation will be the first two letters of the trail name: **HU** for Hudspeth Cutoff, **BA** for Barlow Road, **SE** for Seminoe Cutoff, **OR** for Oregon Trail, **JO** for Johnson Cutoff, **TR** for Truckee Trail, and **SO** for Southern Trail.

   The first letter of each word for trails having two word names would be appropriate: **DH** for Dempsey-Hockaday Cutoff, **SC** for Slate Creek Cutoff, **SL** for Salt Lake Cutoff, **NP** for Natches Pass Trail, **NC** for Nevada City Road, **BT** for Big Tree Road , **LP** for Luther Pass Trail, and **HP** for Henness Pass Road.

   When more than one trail name has the same first two letters, compromises will have to be worked out: **BE** for Beale Road and **BK** for Beckwourth Trail; **AP** for Apache Pass Trail and **AG** for Applegate Trail; **LA** for Lassen Trail and **LD** for Lander Road, **CA** for California Trail and **CR** for Carson Trail.

   Sequential Number Code

   Each map will be numbered sequentially by trail and state from an east-to-west or beginning-to-end orientation (such as **01**, **08**, **12**, **24**, etc.).

   The sequential numbering code will be returned to 01 when the trail crosses a state line. For example, when the Beckwourth Trail leaves Nevada and enters California, the last map for Nevada would be **NV-BK-04** and the next map code would be **CA-BK-01** for the first map in California. If the state line runs through a map, then record both map codes on the same map (double code).

3. The coding procedures described above will apply in most cases. However, some situations require modifications and arbitrary decisions in selecting the map codes. The assigning of codes in these situations may have to be coordinated with the Chair of the Mapping Committee.

   When more than one trail appears on the same quadrangle.

   This would include major trails with established names, not variations or minor alternates that are an integral part of a major trail. Multiple trails on the same quad sheet are a vexing problem in Wyoming where often the main Oregon-California Trail and a cutoff will be on the same quad, such as the Child's, Seminoe, Sublette, Slate Creek, and Kinney cutoffs. In a few cases, there will be three of these trails in one quad. To a lesser extent, the same situation exists in other trail states.

When a trail is plotted through more than one state on the same quadrangle.

For example, the California Trail first branched off the Oregon Trail on the Raft River in 1843 (in SE Idaho) and headed generally southwest to reach the head of the Humboldt River in northeast Nevada. In the process, the trail dipped briefly from Idaho (on the Pole Creek Quad) into the northwest corner of Utah for about 3½ miles along Goose Creek (on the Pole Creek and Nile Spring quads) before entering Nevada (also on the Nile Spring Quad).

When a sequence of maps is disrupted for purposes of sequential numbering.

Quite frequently branches or variations within a designated trail or trails on both sides of a river will result in the use of quads that cannot be arranged for coding in any simple east to west numbered sequence. A case in point is the California Trail along both sides of the Humboldt River in Nevada.

4. The six letter/number map code will serve several purposes.

Computer Database

Every map will be entered into a computer database using the code and quad name, plus any additional relevant information. This will provide a means of storing, cataloging, and retrieving the hundreds of map codes and names that will be used in the MET program.

Filing Maps

Each completed map will be filed by this code for ready reference and access when corrections and revisions are made and when users request photocopies for research or preservation purposes.

Monitoring

With the map code, the map database will serve as a ready means for the Trail Mapping Committee to monitor the status of each trail being mapped in the MET program.

5. The complete map code will be printed in **block lettering** just above the name of the quadrangle in the upper right hand corner of each map.

COMPLETING THE FINAL MAP COPY

1. The mapper will need a minimum of **two copies** of each USGS. 7.5 minute quadrangle for research on and plotting of the emigrant trails. One map will be used in the field and retained by the mapper. The other map will be the final completed copy on file at OCTA headquarters in Independence. Arrangements are being made with the National Park Service Long Distance Trails Office in Salt Lake City to reproduce the final completed map. In this way, quadrangle copies can be retained by the NPS, and other OCTA chapter or state map repositories.

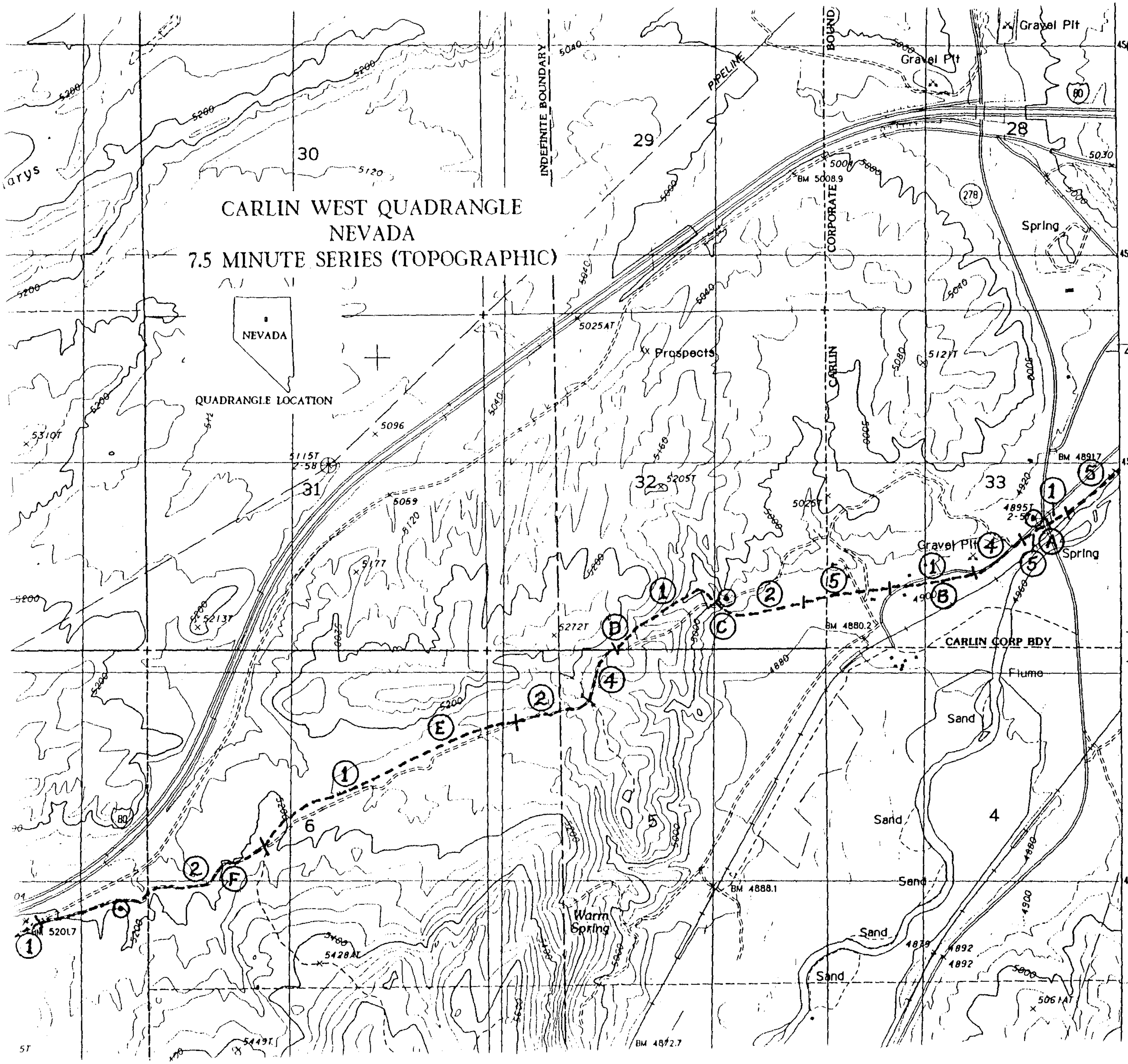
2. The final copy is prepared in pencil using **'B' hardness of lead (0.5mm thickness)** for all trail dashed lines, all letters and numbers, and margin notes (to reproduce legibly on copy machines). All lettering and notes will be printed in **block letters** to ensure legibility and uniformity.

3. The surveyor's name and address and the date on which the final map was completed will be printed in **block letters** in the left hand side of the top margin of the map, just to the right of the three line USGS designation. When a map is either updated or corrected, the name and address of the person making the revisions, including the date of the revisions, should be printed next to the original surveyor name.

4. The six letter/number map code will be printed in **block letters** just above the name of the quadrangle in the upper right hand corner of the map.

Appendix A

Completed Topo Quad Examples



Ⓐ HOT SPRS. ON RIVER BANK MENTIONED IN DIARIES.

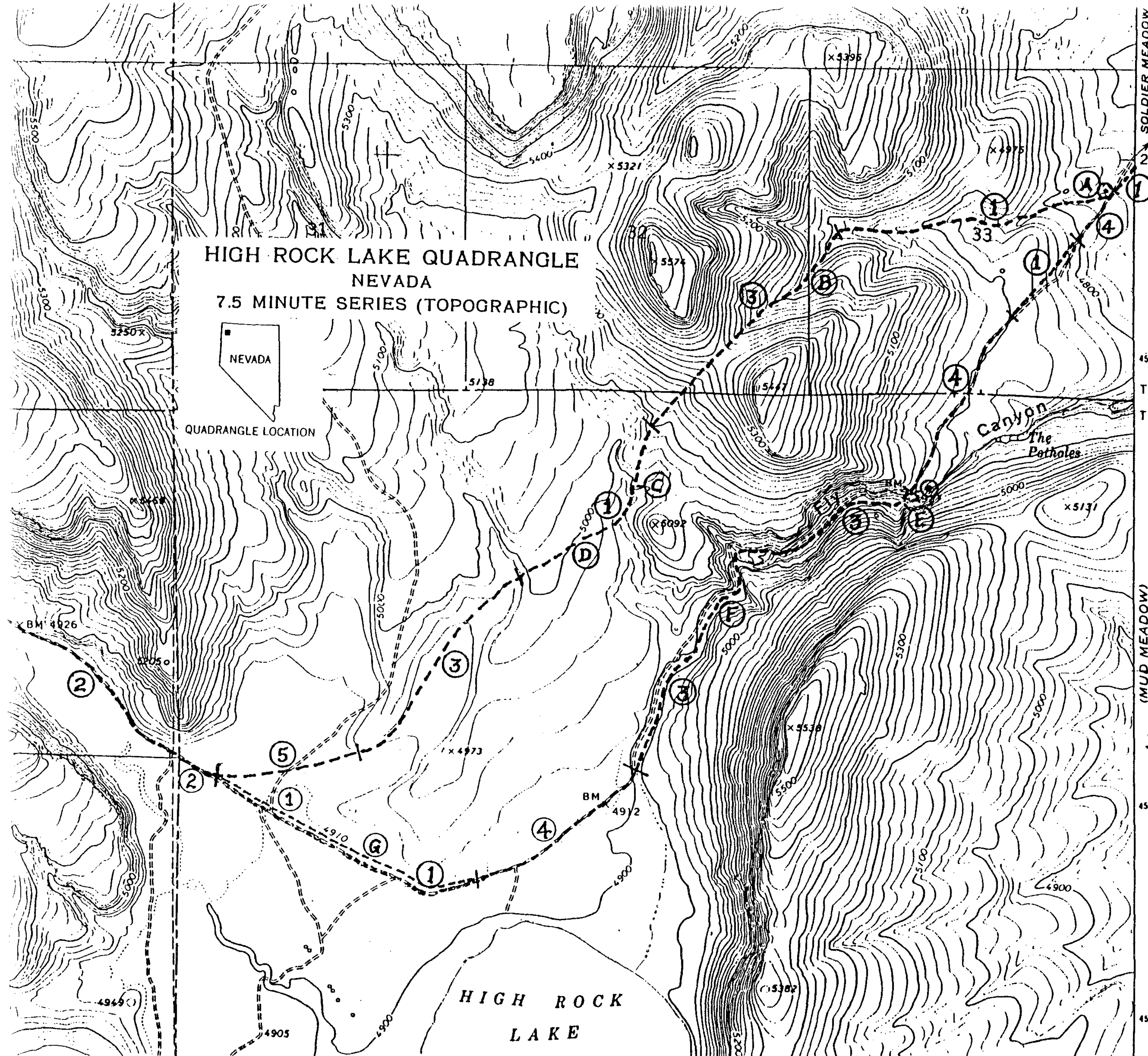
Ⓑ SWALE CLOSE TO ROAD INSIDE FENCED YARDS.

Ⓒ ISRAEL LORD, SEPT. 1, 1849, FOR DESCRIPTION OF TRAIL TO & UP RAVINE.

Ⓓ ONE EMIGRANT NAME ON BASE OF LARGE ROCK AT HEAD OF RAVINE.

Ⓔ DEEP ERODED RUTS.

Ⓕ SCARRING PARALLEL TO SOUTH SIDE OF CL-2 ROAD. ALSO THIS ROAD IS ON 1874 PLAT AS "OLD EMIGRANT ROAD."



Ⓐ ALTERNATE ROUTE USED AS EARLY AS 1849 TO BYPASS STEEP DESCENT INTO FLY CANYON. SEE ISRAEL LORD, SEPT. 21, 1849.

Ⓑ TRAIL IN RAVINE TO SADDLE.

Ⓒ DEEP ERODED RUT.

Ⓓ FAINT TRACE MARKED BY SMALL ROCK CAIRNS.

Ⓔ J. GOLDSBOURGH BRUFF, SEPT. 25, 1849, ON DESCENT INTO FLY CANYON.

Ⓕ TRAIL IN DRY CREEK BED.

Ⓖ SWALE PARALLELING BLADED ROAD

(A) PROBABLE ROUTE UP DRAINAGE.

(B) DEEPLY ERODED EARLIER TRAIL A FEW FEET SOUTH OF ROAD.

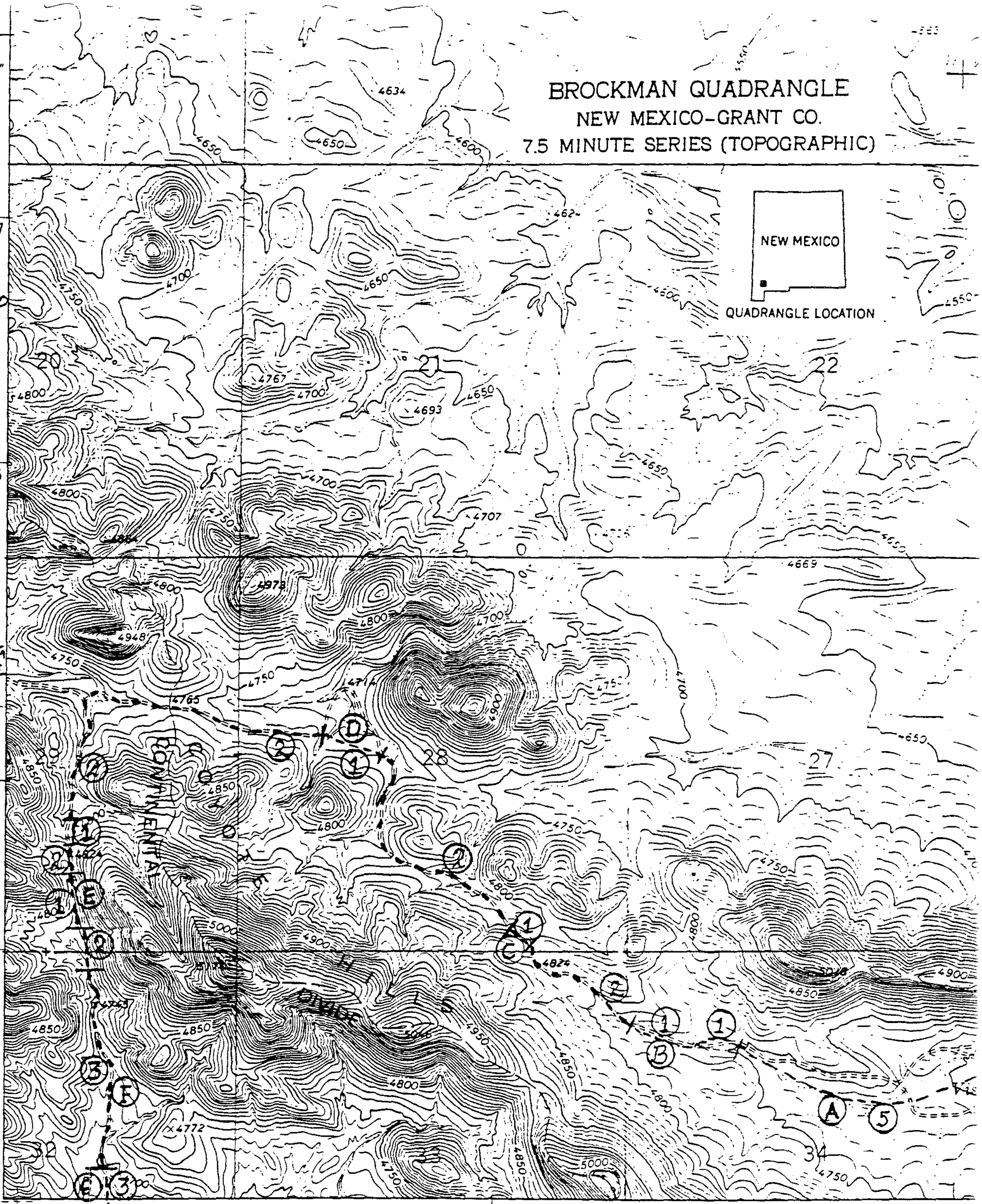
(C) FAINT TRACE SOUTH OF ROAD.

(D) FAINT TRACE LEAVING ROAD TO WEST. NOTE CUT INTO + OUT OF GULLY 0.2 MILE TO WEST BEFORE TRAIL MERGES WITH EXISTING ROAD.

(E) CLEAR TRACE TO WEST OF EXISTING BLADED ROAD. NOTE ROCKS STREWN ON DOWNSIDE OF TRACE. FAINT TRACE AS TRAIL NEARS THE DRY GULLY.

(F) TRAIL IN WASH FOR MOST OF THIS SEGMENT.

(G) TRAIL DEEPLY ERODED.



(PLAYAS LAKE NORTH)
4247 I NE

Mapped, edited, and published by the Geological Survey

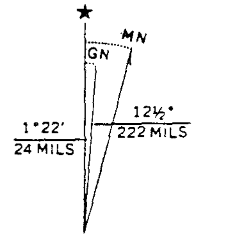
Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1963. Field checked 1964

Polyconic projection. 1927 North American Datum
10,000-foot grid based on New Mexico coordinate system, west zone
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

Fine red dashed lines indicate selected fence lines

To place on the predicted North American Datum 1983 move the projection lines 8 meters south and 56 meters east as shown by dashed corner ticks



UTM GRID AND 1964 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Appendix B

GLO Plat Explanation & Examples

USING GENERAL LAND OFFICE NOTES AND MAPS TO RELOCATE TRIAL RELATED FEATURES

Donald J. Blakeslee

The earliest reliable topographic information for widespread regions of the Midwest and West was compiled by the General Land Office of the United States. This is the agency that sent out teams of surveyors to lay out township and section lines on public land prior to homesteading. Its surveyors imposed a grid system of townships (36 square mile blocks) subdivided into one mile square sections. To accomplish this, the surveyors had to transect the landscape at one mile intervals.

The surveyors kept notebooks in which they recorded features of the landscape that might be of interest to settlers. These included the width, direction of flow, quality of water and nature of the banks and bottoms of streams; the location, species composition and understory of groves of trees; the quality of the soils; items of potential economic interest such as salt springs and stone quarries; and locations of such cultural features as roads, trails, Indian villages and farm fields.

The surveyors also established the boundaries of each section and township with appropriate markers. Where wood was available, these markers were wooden stakes; elsewhere, they tended to be stone posts. When a marker location happened to fall in a forested area, or when trees stood directly on a section line, the surveyor created "witness trees" or "bearing trees" by blazing appropriate marks on their trunks. A section corner might have up to four witness trees, the notes for which included the direction and distance from the corner, the species of tree and the diameter of its trunk.

Because the General Land Office surveys were the basis for subsequent land ownership records, it was important that they be accurate. The rare errors had to be corrected by subsequent government surveys. Lack of such later survey is an indication that the original surveys were accurate.

Larry Jones of the Idaho State Historical Society comments on the accuracy of GLO survey records:

Donald Blakeslee is correct in stating that survey records are a good source of trail information, but some caution is warranted. In some states there were cases of surveyor's fraud. The government sometimes let surveyor contracts without substantiating the credentials of the bidders. This would occasionally result in the surveyors drawing their boundary lines without actually performing any field work, and in such cases it becomes necessary to look at later surveys. A couple of such incidents occurred in Idaho. The cadastral branch of the Bureau of Land Management has been attempting to resurvey a number of such areas during the past few years.

The original surveyors' notes are the primary documents and are generally very accurate *for the portions of the landscape surveyed.* That is, the notes provide accurate descriptions along transects spaced one mile apart. The principal errors are sins of omission; many surveyors, for example, failed to record all of the cultural features they encountered.

While the survey notes are usually reliable, the maps generated from them require careful interpretation. Maps of each township were drawn, not in the field, but in a regional office and by someone other than the original surveyor. This person used the survey notes to draw the map, but this involved marking the known points along each section line and then connecting the dots in a reasonable manner. What this means is that the maps are precise only along section lines and that they are less reliable elsewhere. At times, the survey notes make reference to features away from the section lines, and they make locate them with greater or lesser precision. The only way to determine this is to refer to the notes rather than to the maps.

The problems of map interpretation are especially severe in the case of streams. At the crossing of a section line, the location of a stream would be recorded accurately, and its direction of flow would be indicated in general terms such as "north" or "south-southwest." Away from section lines, the map maker, who had probably never seen the area in question, would fill in the intervals between section lines with a wavy line. Larger scale maps, drawn in the same office, simply repeated any errors of the township maps.

To determine whether a stream has meandered since the original survey compare only the points where it crosses section lines. My own work in northeastern Kansas** indicates that only the largest rivers, such as the Missouri and Kansas, have meandered significantly since the General Land Office surveys.

For researchers trying to relocate trails and trail-related features, the survey notes are far superior to the maps. Unfortunately, the depositories for the notes and maps vary from state to state. In Kansas, both are curated in the library of the State Historical Society. In Nebraska, all of the maps can be found in the State Engineer's office, but the notes are located in county clerks' offices across the state. The notes for the township and section lines are usually located in a volume separate from the section line notes, and notes for the survey of the widely spaced lines of initial survey called principal or

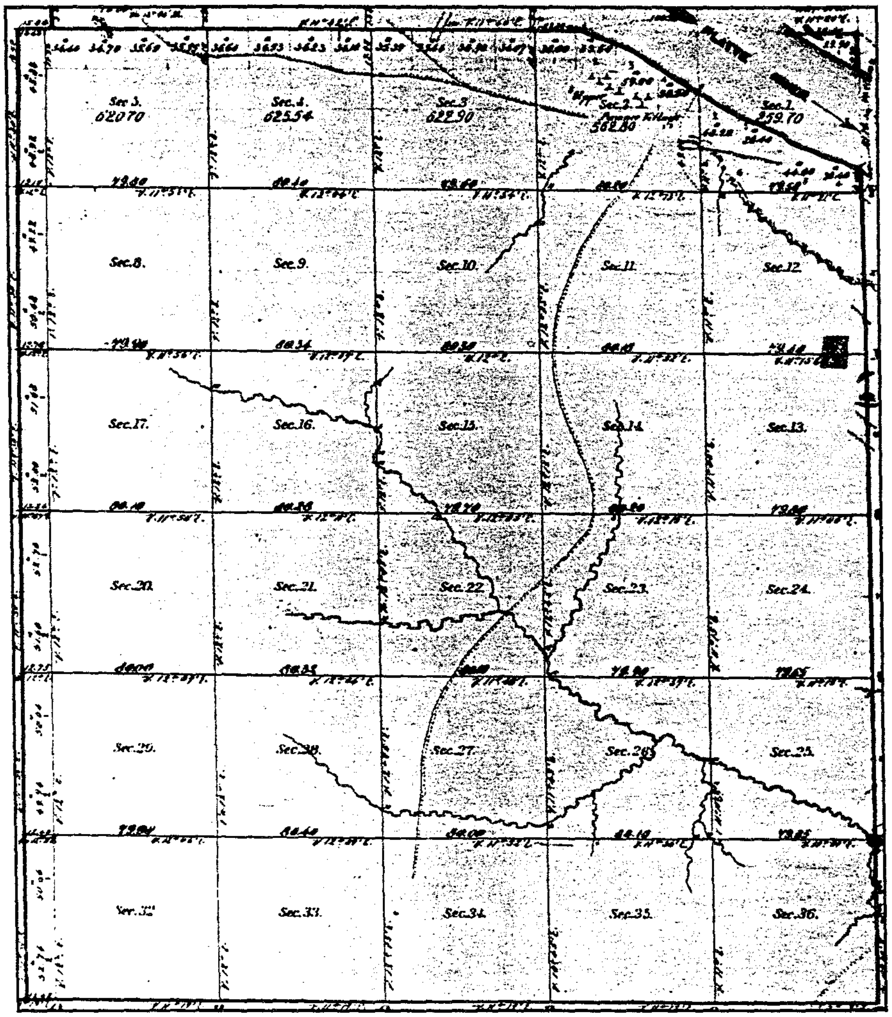
In the western states having large areas under the management of the BLM, the GLO survey notes and maps are located in the State Bureau of Land Management Office.

guide meridians and base lines or standard parallels are also in separate volumes.

Finally, anyone using township maps to locate roads and trails should pay special attention to each township border. The outlines of the townships (called township and range lines) were surveyed first, with the section lines filled in later. More care was taken with these initial surveys, because the accuracy of the section lines depended on them. The surveyors of the township and range lines often were more careful also to note the locations of trails and roads than were the section line surveyors. Therefore, township maps often show roads (as short double lines) or trails (a solid line paralleled by a dotted line) at the borders of the township that were not recorded along the section lines. Occasionally, the reverse is true, and a road marked on the interior of a township will terminate either because the surveyor of the exterior line did not record it or because it was not in existence when the exterior line was surveyed but came into existence before the section lines were laid out.

The legend on the township maps gives the dates and names of the surveyors for each set of surveys along with the date the map was drawn. Very often, the township and range line data refer to one year, the section line data to a later one, while the map date will be later still.

The accompanying illustration is an 1859 General Land Office map for a township in Nebraska that is bordered on the north by the Fourth Standard Parallel (surveyed by Charles A. Manners in August 1856) and on the east by the First Guide Meridian (surveyed by Manners in October 1855). The other two township lines, the south and west borders of the map, were surveyed by Chester Coburn in September 1857, while the section lines were added in November 1858, by Nathan P. Cook. Manners recorded a series of Indian trails along the guide meridian that Nathan Cook failed to notice, but Cook did record one that Coburn did not put in his notes. Other cultural features in the map are a Pawnee Indian village in Section 2 and a cultivated field between Sections 12 and 13.



General Land Office survey map of Township 16 North, Range 8 East, in what is now Saunders County, Nebraska. Drawn in 1859, the map includes data accumulated by three different surveyors between August 1856 and November 1858.

To sum up, the General Land Office survey notes and maps are important sources of historical and environmental information. The survey notes are the primary documents to which the maps are secondary. Like other secondary sources, the maps are interpretations of the survey notes, and they contain errors not present in the notes. This is especially the case in the way streams are drawn, with meanders or bends that were never observed in the field.

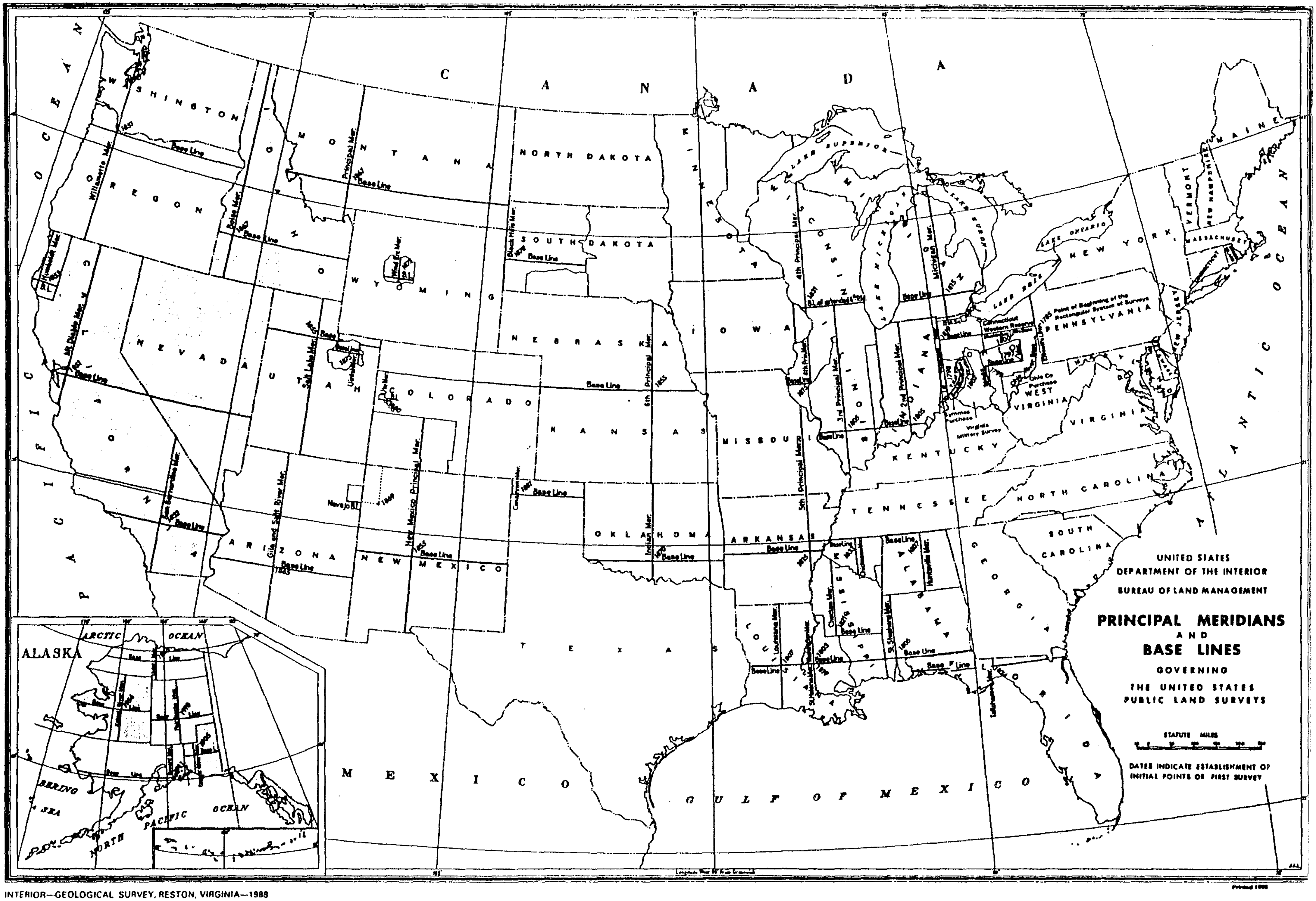
*Morris M. Thompson, *Maps for America: Cartographic Products of the U.S. Geological Survey and Others* (Reston, Va.: U.S. Department of the Interior, 1979), p. 11, 80-88.

**Donald J. Blakeslee and Arthur H. Rohn, *Man and Environment in Northeastern Kansas: The Hillsdale Lake Project* (Kansas City, U.S. Army Corps of Engineers, 1987), p. 53-60.

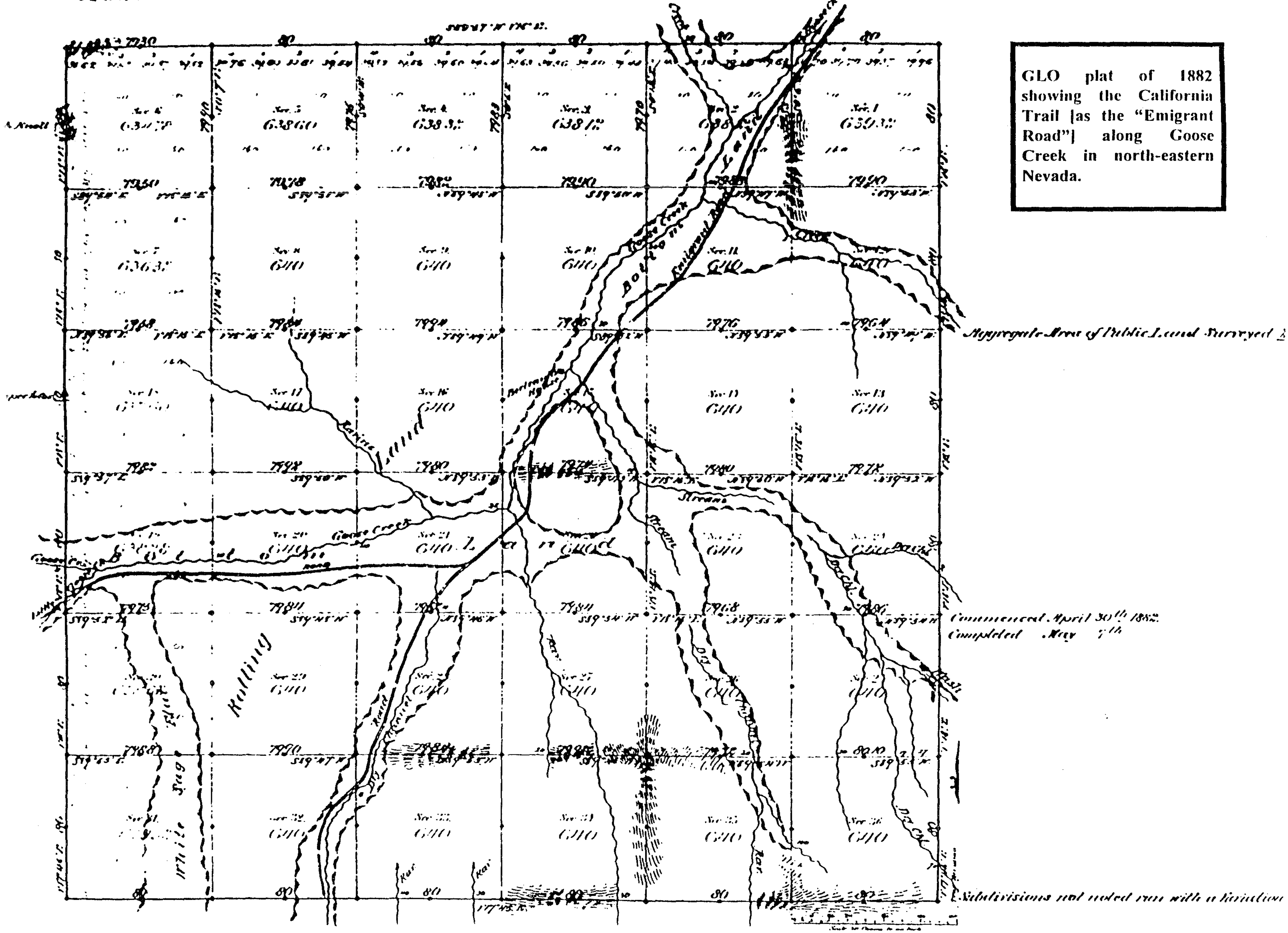
Donald J. Blakeslee
Associate Professor of Anthropology
Wichita State University

{Reprinted from the "Letters" section of the *Overland Journal* [Vol.. 8, No. 3, 1990] pp. 30-32.}

[When ordering or looking up GLO plats, know the Meridian under which the plats are referenced.]

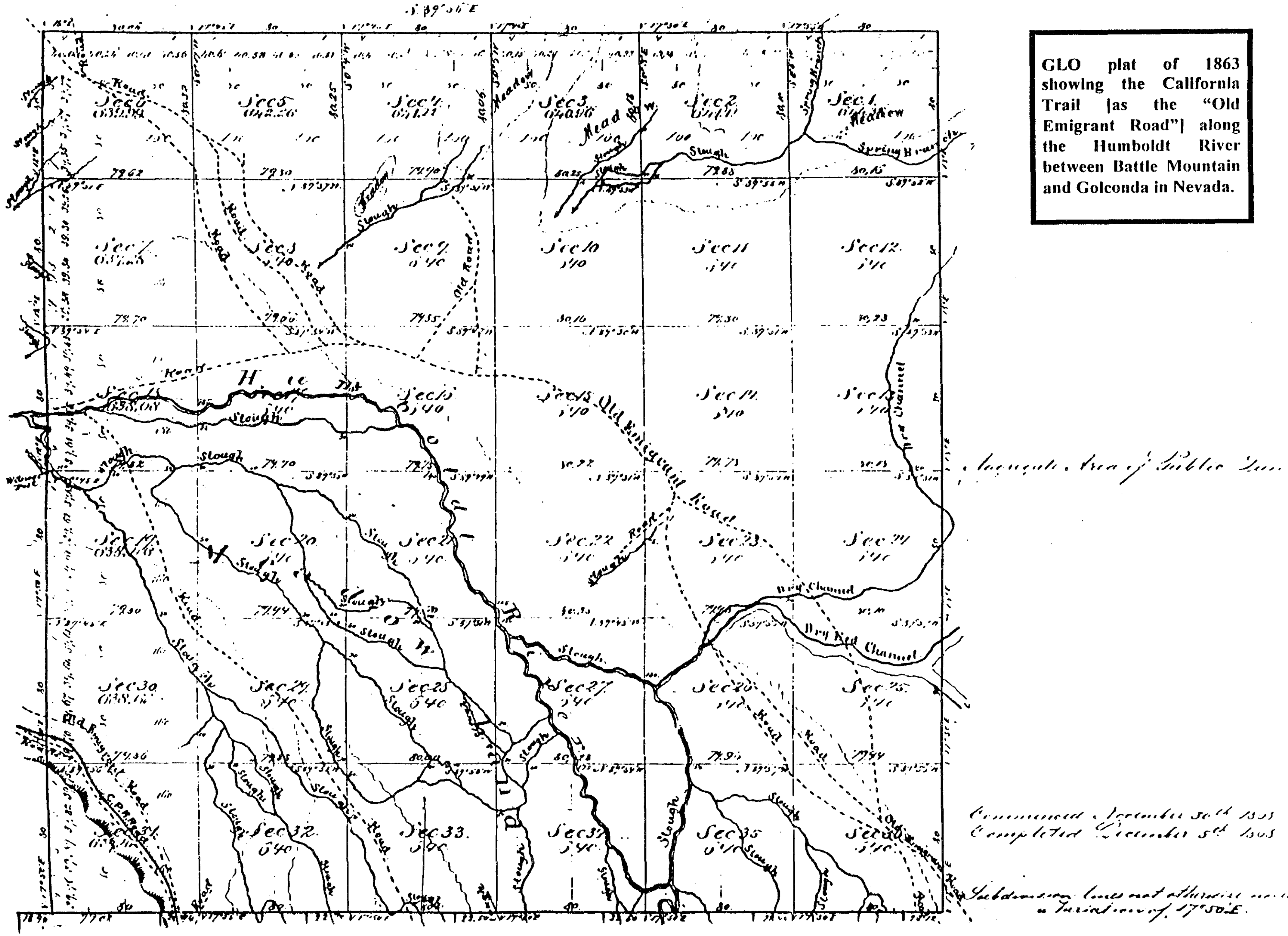


TOWNSHIP Nº 46 NORTH RANGE Nº 69 EAST MOUNT DIABLO MERIDIAN

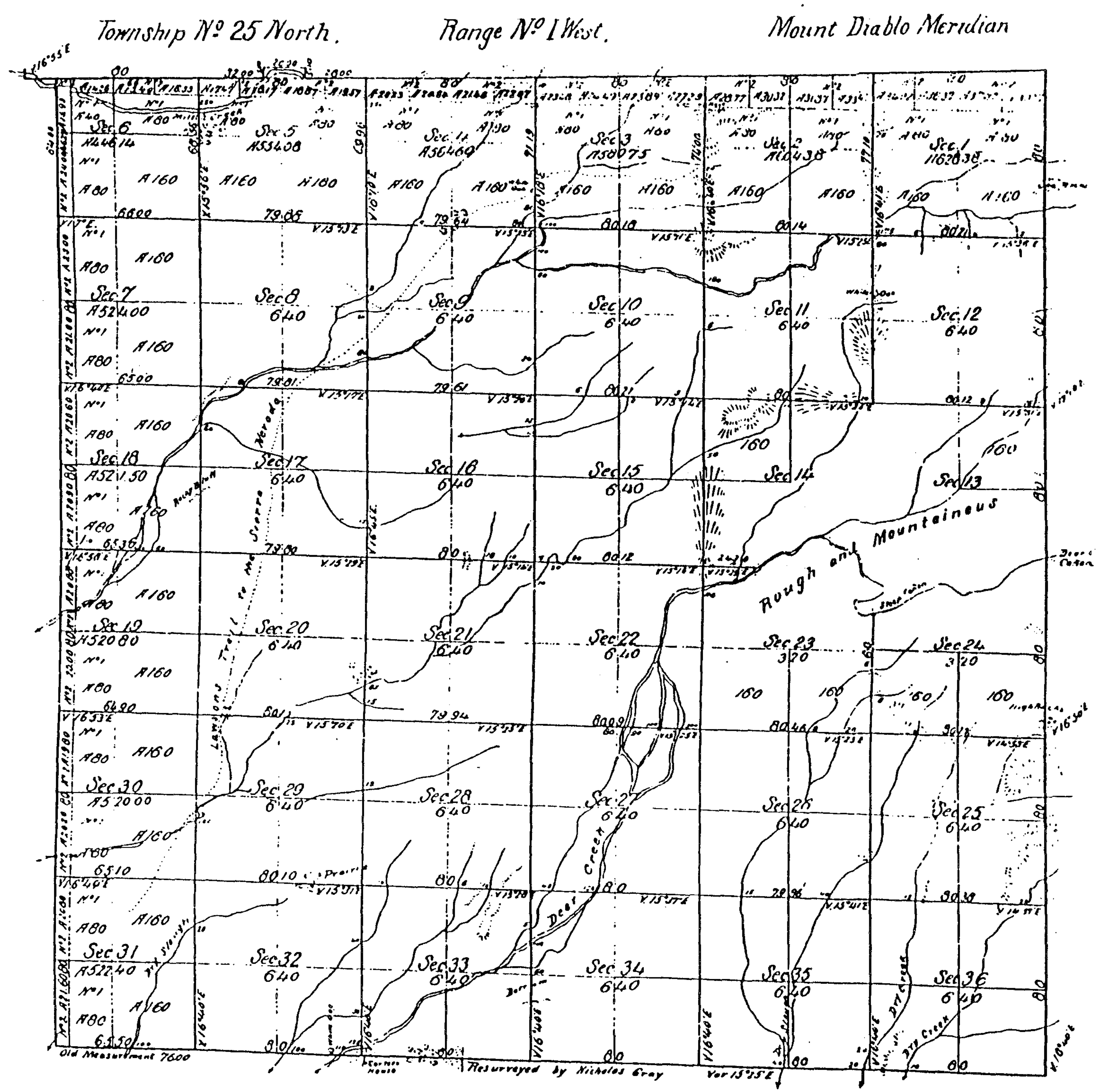


GLO plat of 1882 showing the California Trail [as the "Emigrant Road"] along Goose Creek in north-eastern Nevada.

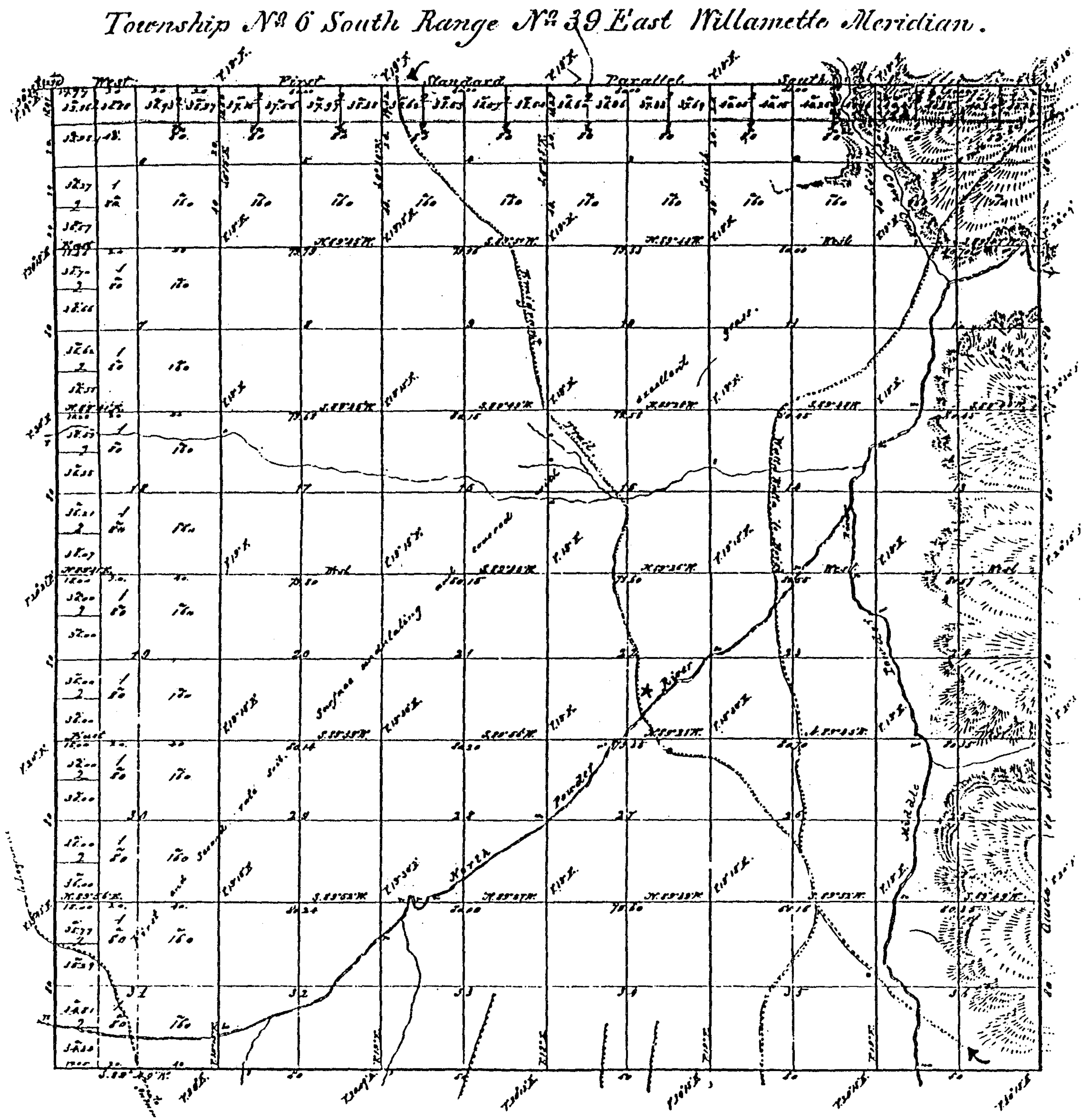
Township Nº 36 North. Range Nº 42 East. Mount Diablo Meridian.



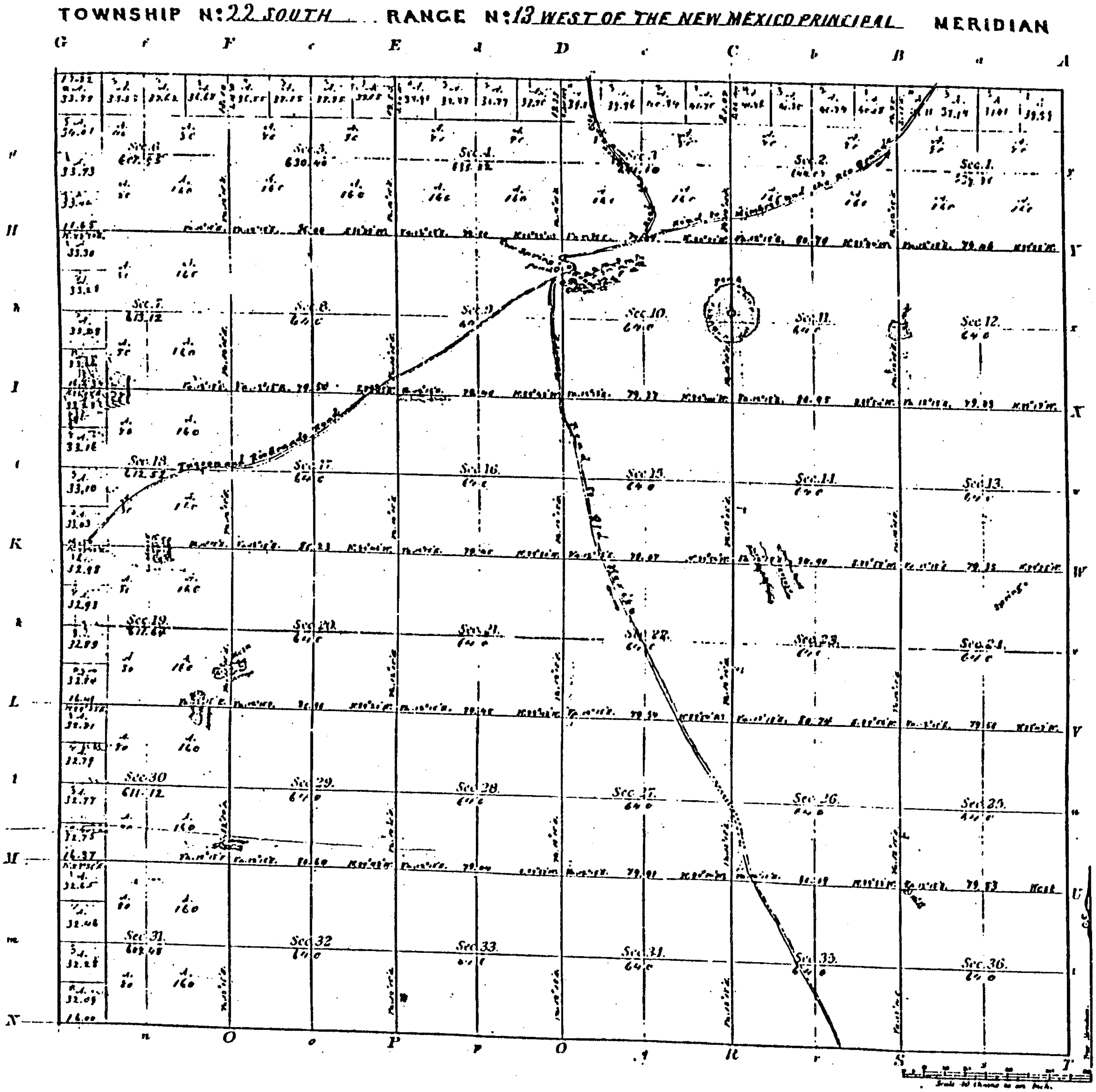
GLO plat of 1863 showing the California Trail [as the "Old Emigrant Road"] along the Humboldt River between Battle Mountain and Golconda in Nevada.



GLO plat of 1853 showing the Lassen Trail [as "Lawsons Trail to the Sierra Nevada"] heading south after crossing Dry Creek to Lassen's Rancho in northern California. The trail is still visible in sections 8, 17, & 20.



GLO plat of 1863 showing the Oregon Trail [as the "Emigrant Trail"] from North Powder to Clover Valley in eastern Oregon.



GLO plat of 1876 showing the Southern Trail [as "Rio Grande Road"] in New Mexico from the Mimbres River to historic Cow Spring, an emigrant camp area, and then heading SW to Soldiers Farewell Hill. The trail is visible through this township. Also shown is the historic trail from Mexico to the Copper Mines north of Cow Spring [as "Road to Old Mexico"].

Appendix C

The Composite Trail Description Method
for
Locating and Verifying Trails

A CASE STUDY OF THE COMPOSITE TRAIL DESCRIPTION METHOD
THE ASCENT FROM TRUCKEE RIVER TO DOG VALLEY SUMMIT

A very effective means of applying diaries/journals/government reports to locate and verify particularly vexing segments of emigrant trails (no more than a few miles in length) is **creating a composite trail description**. You begin by gathering together as many accounts as possible that describe in any way the trail segment under study. Descriptions, for example, could include references to springs, a particular rock formation, creeks, a rocky part of the trail, sand hills, ridges, ravines, forks in the trail, and any distances or directions recorded. Look for similarities and discrepancies among the various accounts. Then arrange all of these descriptions—really clues—in some kind of sequential order that will reveal the course, direction, and location of the trail. In this way, you will have created a detailed composite description of the trail segment under study. Taking this composite trail description into the field will greatly facilitate your search for the trail by showing you where to look for trail traces. Also, if you are confronted by several apparent trail traces in the vicinity, this composite trail description should help in determining and verifying which of the traces are related to emigrant wagon use.

The following example, of the Composite Trail Description Method for locating and verifying emigrant trails, is based on a detailed study undertaken in 1994 and 1995 by Don Wiggins of Reno, Nevada, on a four mile segment of the main Truckee Trail ascending from the river, at present Verdi, Nevada, to the Dog Valley summit, just inside the California state border. To bypass the rugged and nearly impassable Truckee River canyon, west of the California-Nevada state line along Interstate 80, Caleb Greenwood had opened a wagon trail in 1845 that arched northerly then southerly from present Verdi, Nevada, to the town of Truckee, California.

Trail historians had long thought the first segment of this wagon trail (to Dog Valley) kept all of the way in the ravine or canyon of the South Branch of Dog Creek, paralleling or under the existing Dog Valley graded dirt road, for about two-and-a-half miles to the summit of Dog Valley. In surveying diary accounts for OCTA's COED program that covered this segment of the Truckee Trail, Don Wiggins began to question this conventional interpretation. Reading many diary accounts, it became clear that emigrants took to a ridge for most of their travel rather than staying in the canyon bottom. In searching the ridges on both sides of the canyon, several old wagon roads were found. (This search was made much easier by the 1994 Crystal Peak forest fire that burned off all the ground vegetation and uncovered faint traces which otherwise might not have been visible.) However, it was difficult to figure out which wagon trace was the original emigrant wagon trail used between 1845 and 1850 (before the development of the Henness Pass Road, the Dutch Flat Wagon Road, and subsequent logging roads). In this particular case study, it turned out that the GLO plats were of little help.

As a means of verifying which of the old wagon roads was the original emigrant trail, over twenty diary accounts were compiled, dating from 1846 to 1850, that shed some light on the location of the emigrant trail in this area. Next, the most diagnostic descriptions of this segment of the trail were extracted from these diary accounts and listed in a sequence from the river to the summit, a distance of about four miles. Based on these sequential diary descriptions, the original emigrant wagon trail was located. It had taken to the ridge and slopes to the west (from the canyon bottom at its narrowest defile) for one-and-a-half miles before returning to the wider part of the canyon (about a half-a-mile from the summit). With this composite trail description, the original emigrant trail was distinguished from numerous later wagon roads which are still visible on the ridges above the canyon. Using this composite trail description method, once again has demonstrated that close attention given to diary accounts will make the difference in locating and verifying original emigrant trail segments.

On the next two pages are listed the nine best diary accounts, including the composite trail description based on those diagnostic accounts, that allowed Don Wiggins to locate and verify the trail. Using the MET Manual procedures, a measuring wheel, and a GPS receiver, the original emigrant trail was plotted on the Dog Valley topographic quadrangle. (Refer to the last page in this appendix for the plotted trail and explanations on a section of the Dog Valley topo quad.)

Chronological order of diary Accounts of the trail from the Truckee River to Dog Valley with key diagnostic descriptions in bold lettering:

1. *Edwin Bryant: Aug. 24, 1846*

Following the river between two and three miles farther up, we turned abruptly to the right, crossing its channel about the thirtieth time, and **through a ravine or gorge ascended the range of mountains on our right**. We reached the summit of the range by a comparatively easy and gradual ascent, **passing over some rocky**, but no difficult places. ... We reached the summit of the gap that afforded us a passage over the mountain, about eleven o'clock, and **descended a long and very steep declivity on the other side**, bringing us into a small, oval-shaped and grassy valley [Dog Valley], with a faint spring branch [Dog Creek] of pure cold water running through it. [Bryant confirms that initially the trail kept to the South Branch ravine before taking to the ridge to the west and was rocky in places.]

2. *Heinrich Lienhard: Oct. 1, 1846*

From here [at the 27th crossing where the Truckee River turns south] **our road took us directly up the mountain**, through thick forest, **across a difficult, rocky, mountain slope**. We were in constant fear that the **wheels of our wagon would strike against the giant fir trees on the lower side of the road**. .:. After driving upward for some time without making much headway, we reached a grassy and somewhat moist valley [Dog Valley], where we decided to camp. [Lienhard confirms, again, that the trail took to the mountain slope or ridge, that it was rocky, and adds, importantly, that segments were sidling.]

3. *James Godfrey: Aug. 8, 1849*

Crossing (last, and 27th time) the road turned to the right and leaving the river, **ascended the mountain through a ravine**. The ascent was **long and somewhat rocky**, though not as difficult as we had anticipated. ... **near the summit**, where we **found some grass and a fine spring**. [Godfrey confirms, again, that the trail passed through a ravine, the foot of the South Branch, before ascending the mountain slope or ridge, that it was rocky, and adds that a spring is on the route when the trail nears the summit.]

4. *Isaac Jones Wistar: Aug. 17, 1849*

Leaving it here [the 27th crossing of the Truckee River] we **took up the mountain side through a rough and rocky, but at first not very steep, ravine**. Large pines, firs and cedars abound, especially the first, some of which are fully six feet through. At the head of a fine spring branch we came on a secluded valley [Dog Valley] teeming with black-tail deer, its mountain sides showing three several bands of bighorn. [Wistar confirms that initially the trail went through a rough, rocky, but not very steep ravine, the foot of the South Branch canyon, and then took to the mountain side or ridge.]

5. *Edward C. Harrow: Aug. 19, 1849*

Road **rough, rocky**, but good. At 4½ [hours] we **descended a small hill but commenced ascending again**, which we continued till 5½ [hours], when we **descended a very steep abrupt and long hill**, into a small but lovely valley [Dog Valley]. [Harrow confirms the trail descended and then quickly ascended as they neared the summit. See Burbank for a similar description.]

6. *Wakeman Bryarly: Aug. 20, 1849*

We started at daybreak & crossed the river [Truckee River]. The road turned immediately to the right in a north direction & continued for one mile, when it went in a northwest, **ascending a spur of mountain**,one of the chain of the California mountains. We ascended this [the ridge immediately on the west side of the South Branch canyon], **it being in some places very steep**, & then again **coming upon a little table of land upon which had been good grass, & upon one with a cool but small spring**. After **rolling there 5 miles**, we opened upon a beautiful little valley with a **very steep hill to descend** to it [Dog Valley]. [Bryarly confirms the location of two tables on the mountain slope, one having a small grassy area and the other having a small spring on or near it.]

7. *T. or Maurice Beesley: Aug. 23, 1849*

Started early this morning and commenced **winding up and ascending a very steep mountain**, the first ridge we have to pass of the Sierra Nevada. The **road is rocky** and the side of the mountain covered with a dense growth of pine timber of different kinds ... With much difficulty we reached the summit of the first ridge, seven miles from the Salmon Trout river [Truckee River]. **Descended a very steep, difficult mountain** into a level valley [Dog Valley] up which we travelled a Southwest course. [Beesley confirms the trail wound up the mountain slope and was steep and rocky.]

8. *Ansel M. McCall: Sept. 5, 1849*

The trail **wound up a long and difficult hill** this morning and then **led down a tremendous steep** into a small valley [Dog Valley] where there was some grass and a fine cold spring. [McCall confirms that the trail was not direct but winding and for him difficult.]

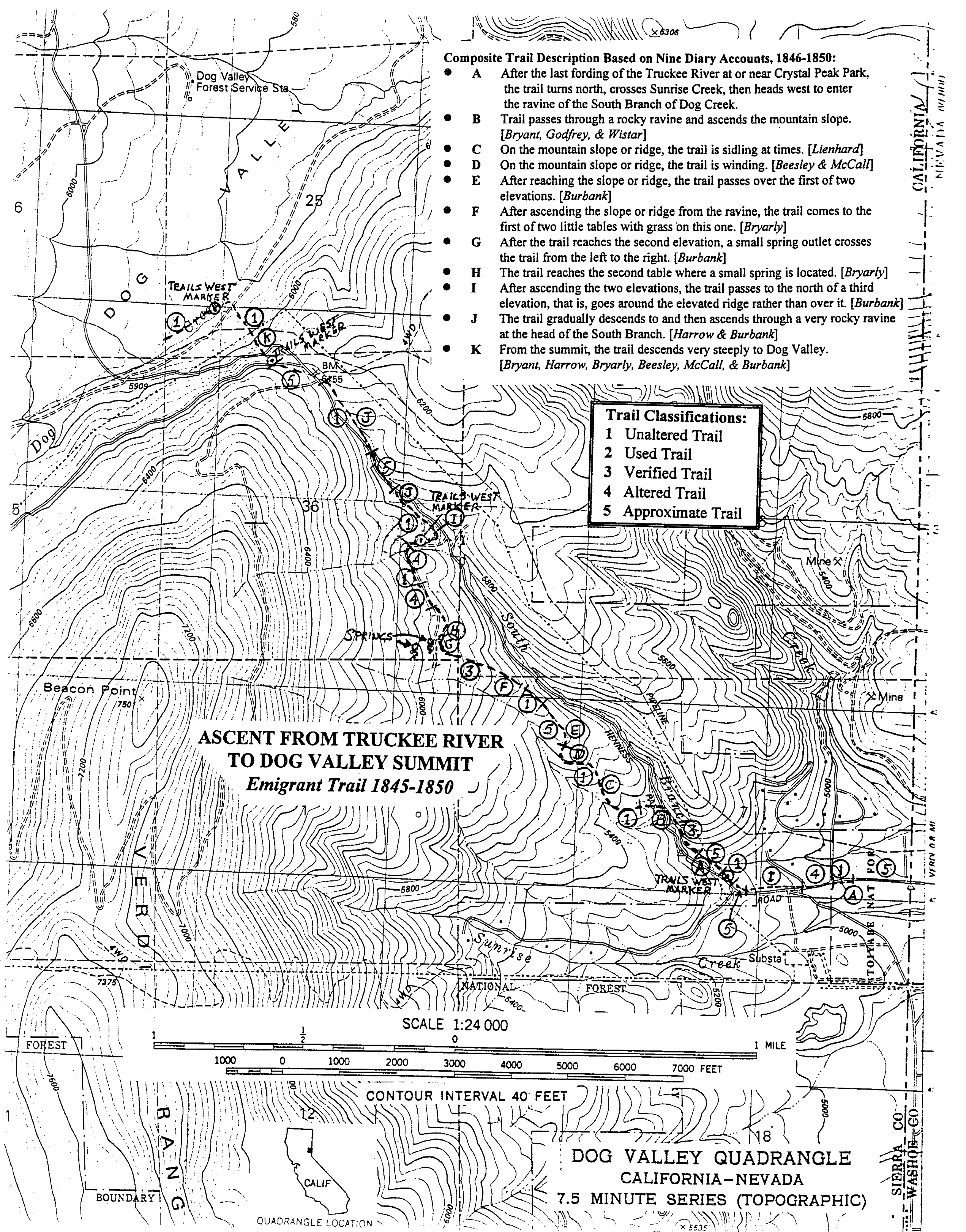
9. *Augustus Ripley Burbank: Sept. 7, 1849*

[In the morning he makes the 27th and last fording of Truckee River.] we nooned ½ mile from the ford & near a spring branch (a tributary) [Dog Creek], passing on we commenced **ascending the mountain** through a thick forest of hearty pine timber. **passed over two high elevations & passed to the North of the third & highest elevation.** passed a **small spring rivulet on the top of the mountain, it crosses the road from the left. descending & passing through a very rocky ravine, we soon came to the mountain descent long & precipitating.** we descended to the small beautiful valley [Dog Valley] and encamped along side of the dog spring. ... the road runs N.W. to the valley & springs, then turns short to the South. ... (The springs are 5 miles from the river). [Burbank's account is the most descriptive and points out several important details. He confirms the trail passing over two elevations or steps in the ascent, as did Bryarly, and upon reaching the third and highest step he passes around it, not over, to the north, then descends (as did Harrow) to a rocky ravine, which takes him to the summit where he drops down into Dog Valley. Thus, the trail, while ascending most of the way, does descend slightly after reaching his third elevation, into a rocky ravine through which he reaches the summit and steep descent to Dog Valley. The fact that the trail is in a rocky ravine (the head of South Branch) to the summit eliminates the possibility of an old wagon swale ascending the hill to the left of the ravine from being the original emigrant trail. Also, Burbank confirms passing a small spring outlet upon reaching the second elevation or step, as did Bryarly, that crossed the trail from left to right, as it still does today.]

Composite Trail Description:

The following composite account of the key diagnostic diary descriptions that were in bold print was used to locate and verify the trail from the entrance to the South Branch canyon up to the steep descent to Dog Valley. Refer to these lettered locations on the topographic map at the end of this report.

- **A** After the last fording of the Truckee River at or near Crystal Peak Park, the trail turns north, crosses Sunrise Creek, then heads west to enter the ravine of the South Branch of Dog Creek.
- **B** Trail passes through a rocky ravine and ascends the mountain slope. *[Bryant, Godfrey, & Wistar]*
- **C** On the mountain slope or ridge, the trail is sidling at times. *[Lienhard]*
- **D** On the mountain slope or ridge, the trail is winding. *[Beesley & McCall]*
- **E** After reaching the slope or ridge, the trail passes over the first of two elevations. *[Burbank]*
- **F** After ascending the slope or ridge from the ravine, the trail comes to the first of two little tables with grass on this one. *[Bryarly]*
- **G** After the trail reaches the second elevation, a small spring outlet crosses the trail from the left to the right. *[Burbank]*
- **H** The trail reaches the second table where a small spring is located. *[Bryarly]*
- **I** After ascending the two elevations, the trail passes to the north of a third elevation, that is, goes around the elevated ridge rather than over it. *[Burbank]*
- **J** The trail gradually descends to and then ascends through a very rocky ravine at the head of the South Branch. *[Harrow & Burbank]*
- **K** From the summit, the trail descends very steeply to Dog Valley. *[Bryant, Harrow, Bryarly, Beesley, McCall, & Burbank]*


Composite Trail Description Based on Nine Diary Accounts, 1846-1850:
A After the last fording of the Truckee River at or near Crystal Peak Park, the trail turns north, crosses Sunrise Creek, then heads west to enter the ravine of the South Branch of Dog Creek.
B Trail passes through a rocky ravine and ascends the mountain slope. [Bryant, Godfrey, & Wistar]
C On the mountain slope or ridge, the trail is sidling at times. [Lienhard]
D On the mountain slope or ridge, the trail is winding. [Beesley & McCall]
E After reaching the slope or ridge, the trail passes over the first of two elevations. [Burbank]
F After ascending the slope or ridge from the ravine, the trail comes to the first of two little tables with grass on this one. [Bryarly]
G After the trail reaches the second elevation, a small spring outlet crosses the trail from the left to the right. [Burbank]
H The trail reaches the second table where a small spring is located. [Bryarly]
I After ascending the two elevations, the trail passes to the north of a third elevation, that is, goes around the elevated ridge rather than over it. [Burbank]
J The trail gradually descends to and then ascends through a very rocky ravine at the head of the South Branch. [Harrow & Burbank]
K From the summit, the trail descends very steeply to Dog Valley. [Bryant, Harrow, Bryarly, Beesley, McCall, & Burbank]
Trail Classifications:
1 Unaltered Trail
2 Used Trail
3 Verified Trail
4 Altered Trail
5 Approximate Trail
ASCENT FROM TRUCKEE RIVER
TO DOG VALLEY SUMMIT
Emigrant Trail 1845-1850
Dog Valley Forest Service Sta
DOG VALLEY
TRAILS WEST MARKER
SPRINGS
Beacon Point
7501
South Branch
HENNESS PASS
PIPELINE
ROAD
Sunrise Creek
Substa
Mine
NATIONAL FOREST
FOREST BOUNDARY
VERDI RANGE
TOIYABE NAT FOR
CALIFORNIA
NEVADA
SIERRA CO
WASHOE CO
SCALE 1:24 000
1 ½ 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
CONTOUR INTERVAL 40 FEET
CALIF
QUADRANGLE LOCATION
DOG VALLEY QUADRANGLE
CALIFORNIA–NEVADA
7.5 MINUTE SERIES (TOPOGRAPHIC)

Appendix D

Plotting UTM & Lat-Long Coordinates

USGS
science for a changing world

The Universal Transverse Mercator (UTM) Grid

Map projections

The most convenient way to identify points on the curved surface of the Earth is with a system of reference lines called parallels of latitude and meridians of longitude. On some maps, the meridians and parallels appear as straight lines. On most modern maps, however, the meridians and parallels appear as curved lines. These differences are due to the mathematical treatment required to portray a curved surface on a flat surface so that important properties of the map (such as distance and areal accuracy) are shown with minimum distortion. The system used to portray a portion of the round Earth on a flat surface is called a map projection.

Grids

To simplify the use of maps and to avoid the inconvenience of pinpointing locations on curved reference lines, cartographers superimpose on the map a rectangular grid consisting of two sets of straight, parallel lines, uniformly spaced, each set perpendicular to the other. This grid is designed so that any point on the map can be designated by its latitude and longitude or by its grid coordinates, and a reference in one system can be converted into a reference in another system. Such grids are usually identified by the name of the particular projection for which they are designed.

The Universal Transverse Mercator grid

The National Imagery and Mapping Agency (NIMA) (formerly the Defense Mapping Agency) adopted a special grid for military use throughout the world called the Universal Transverse Mercator (UTM) grid. In this grid, the world is divided into 60 north-south zones, each covering a strip 6° wide in longitude.

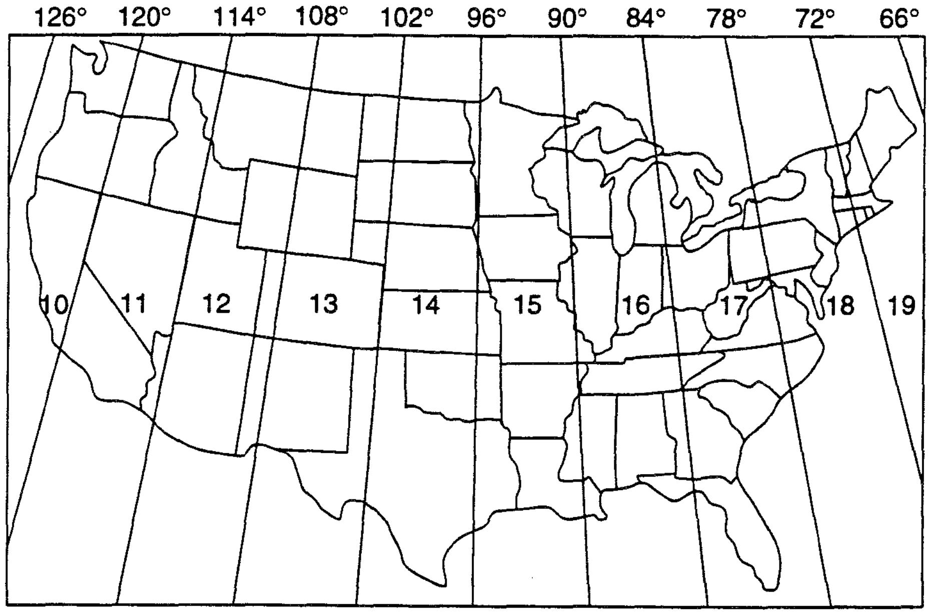


Figure 1. The Universal Transverse Mercator grid that covers the conterminous 48 United States comprises 10 zones—from Zone 10 on the west coast through Zone 19 in New England.

These zones are numbered consecutively beginning with Zone 1, between 180° and 174° west longitude, and progressing eastward to Zone 60, between 174° and 180° east longitude. Thus, the conterminous 48 States are covered by 10 zones, from Zone 10 on the west coast through Zone 19 in New England (fig. 1). In each zone, coordinates are measured north and east in meters. (One meter equals 39.37 inches, or slightly more than 1 yard.) The northing values are measured continuously from zero at the Equator, in a northerly direction. Southerly values are similarly measured from the Equator, south. A central meridian through the middle of each 6° zone is assigned an easting value of 500,000 meters. Grid values to the west of this central meridian are less than 500,000; to the east, more than 500,000.

Virtually all NIMA-produced topographic maps and many aeronautical charts show the UTM grid lines.

Determining a UTM grid value for a map point

The UTM grid is shown on all quadrangle maps prepared by the U.S. Geological Survey. On 7.5-minute quadrangle maps (1:24,000 and 1:25,000 scale) and 15-minute quadrangle maps (1:50,000, 1:62,500, and standard-edition 1:63,360 scales), the UTM grid lines are indicated at intervals of 1,000 meters, either by blue ticks in the margins of the map or with full grid lines. The 1,000-meter value of the ticks is shown for every tick or grid line. In addition, the actual meter value is shown for ticks nearest the southeast and northwest corners of the map. Provisional maps at 1:63,360 scale show full UTM grids at 5,000-meter intervals.

To use the UTM grid, you can place a transparent grid overlay on the map to subdivide the grid, or you can draw lines on the map connecting corresponding ticks on opposite edges. The distances can be measured in meters at the map scale between any map point and the nearest grid lines to the south and west. The northing of the point is the value of the nearest grid line south of it plus its distance north of that line; its easting is the value of the nearest grid line west of it plus its distance east of that line (see fig. 2).

On maps at 1:100,000 and 1:250,000 scale, a full UTM grid is shown at intervals of 10,000 meters and is numbered and used in the same way.

Information

Detailed UTM grid information is available in several NIMA-produced technical publications available for sale to the public. Publication descriptions and prices are available in the online NIMA Public Sale Topographic Maps, Publications, and Digital Products Catalog at http://mapping.usgs.gov/mac/nimamaps/index.html.

For information on these and other USGS products and services, call 1-888-ASK-USGS, use the ASK.USGS fax service, which is available 24 hours a day at 703-648-4888, or visit the general interest publications Web site on mapping, geography, and related topics at http://mapping.usgs.gov/mac/isb/pubs/pubslists/index.html.

Please visit the USGS home page at http://www.usgs.gov/.

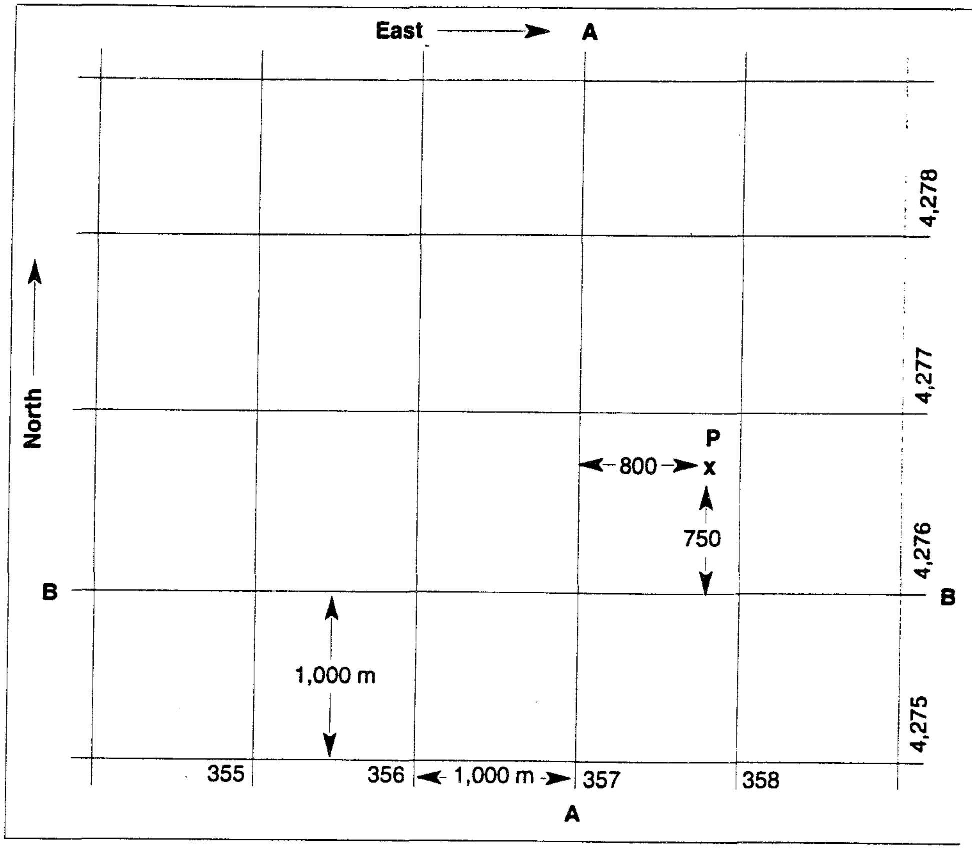


Figure 2. The grid value of line A-A is 357,000 meters east. The grid value of line B-B is 4,276,000 meters north. Point P is 800 meters east and 750 meters north of the grid lines; therefore, the grid coordinates of point P are north 4,276,750 and east 357,800.

PLOTTING UTM COORDINATES

The GPS receiver can be programmed to record positions as waypoints in either Latitude-Longitude or Universal Transverse Mercator (UTM) coordinates. There are numerous plastic plotting aids available for plotting Lat-Long and UTM coordinates. For using two of these plastic overlays in plotting positions on 7.5 minute topographic quadrangles, continue on the next pages in this appendix.

Using small plastic plotting aids, UTM coordinates are much easier to plot, especially in the field, than are Latitude-Longitude. Beginning in the early 1980's on the 7.5 minute topographic quadranges, the UTM coordinates appear as thin black coordinate lines, in a grid pattern, with the UTM numbers printed next to the boundary lines (called "neat lines") around the topo quad margins. This makes plotting UTM coordinates a snap. Prior to the early 1980's, the UTM coordinate numbers also are printed along the neat lines (next to short blue lines called "ticks") but they are not connected across the map in grid fashion. You will need to connect these ticks by linking them on the map with pencil and ruler before going into the field.

When plotting UTM or Lat.-Long. coordinates, keep in mind that not only will your hand-held GPS waypoints have a potential error up to 50 ft. but also the USGS topographic quads may have a potential error factor up to 40 ft. at any point on the map, as determined by the National Map Accuracy Standards. This means that on occasion you may determine that your GPS data is plotting in excess of its margin of error. This could be due to an unusually wild GPS reading but there is always the possibility the error was increased by as much as 40 ft. for that location due to a map error.

TopoTool Coordinate Ruler

For 7.5 Minute, 1:24,000 Topographic Maps

Helps You Plot Points and Determine Coordinates With:

- Latitude/Longitude
- Universal Transverse Mercator (UTM)
- Foot-based State Coordinates
- Public Land Survey (Township-Range)

A Multipurpose Map Tool:

- Measure Distances
- Determine Slope
- Estimate Acreage

All Common Systems Used On 7.5 Minute Topographic Maps Are Included.

Simple, Easy To Use, and Highly Accurate.

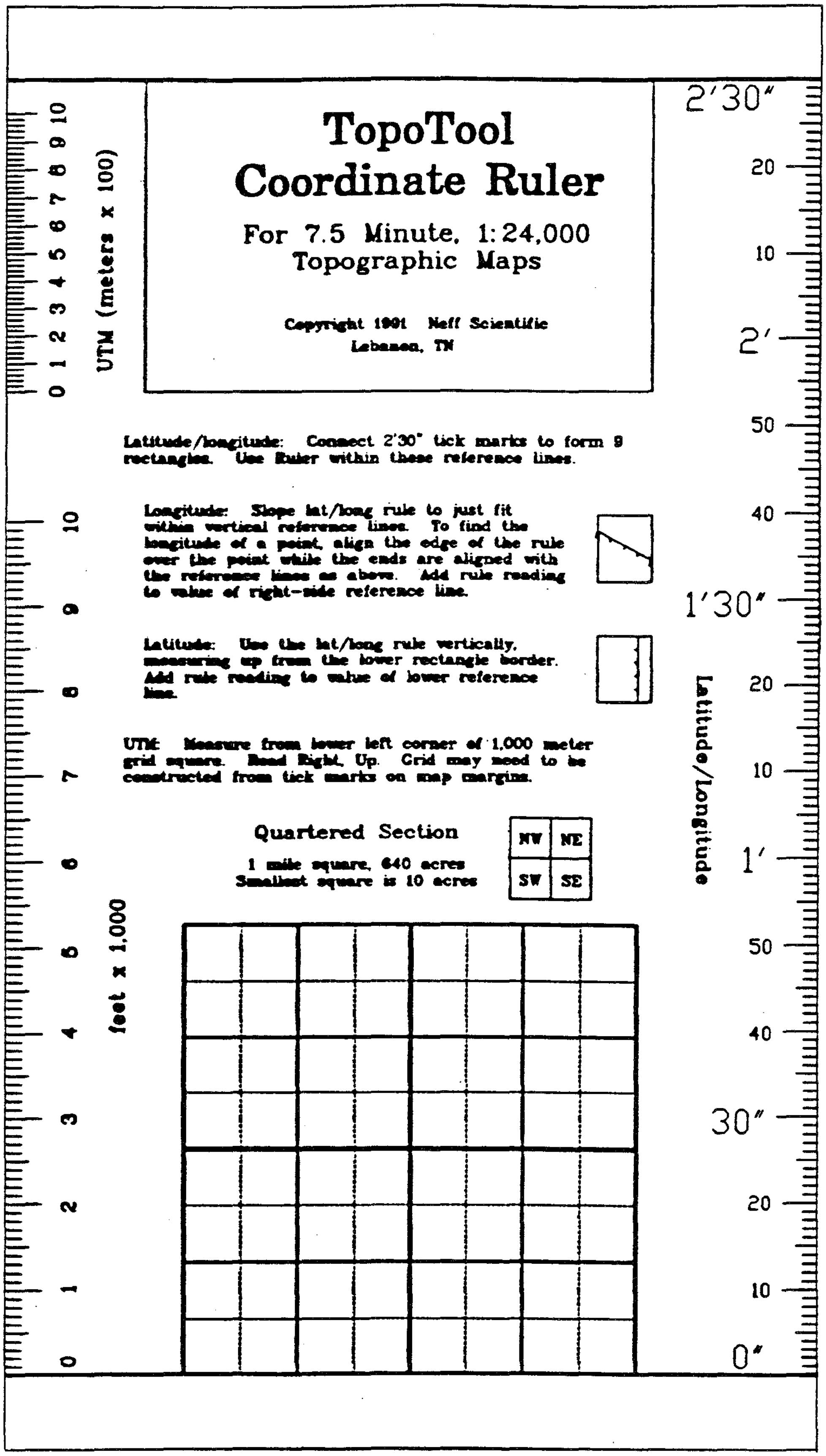
Use: The Coordinate Ruler is a set of scales printed on clear plastic. These scales are used like a ruler to measure in different coordinate systems. The scales are sized to be used with the United States Geological Survey (USGS) system of 7.5 minute, 1:24,000 topographic maps as used in the continential United States.

The scales can be used to measure distance in feet and to determine slope. The Public Land Survey Quartered Section is divided into 10-acre squares which can be used to estimate acreage.

Coverage: The UTM, feet, and PLS scales are useable on any 1:24,000 map. The latitude/longitude scale is useable over the continental United States.

Directions: A discussion of each coordinate system and directions for its use on topographic maps are included. Both determining coordinates and plotting known coordinates are addressed. In most cases, examples are shown. There are directions for determining area and slope, and a graphic aid for converting seconds to decimal minutes.

[ACTUAL SIZE OF THE CLEAR PLASTIC OVERLAY]



NEFF Scientific
4266 Old Rome Pike
Lebanon, TN 37087

TopoTool Geographic Products

The Universal Transverse Mercator Coordinate System

The UTM Coordinate System: The UTM system was developed by the U. S. Army Map Service after World War II. It is rectangular in nature and is based on a view of the Earth called a transverse Mercator projection (hence the name).

There are 60 UTM zones, each 6° wide and covering from 80° South to 84° North (the Poles are covered by a different system). The zones are numbered from 1 to 60, with zone 1 starting at 180° to 174° West and continuing to the east.

The two reference lines for the square grid system in each zone are the Equator and the central longitude meridian (177° in zone 1, for instance), which is the base line for the transverse Mercator projection.

Within a zone, there are two coordinates: an Easting and a Northing. The East number is the distance in meters along a line perpendicular to the central meridian and passing through a given point, where the meridian is assigned a value of 500,000 meters. The North number is the distance in meters from the Equator to where the perpendicular line above crosses the central meridan.

UTM coordinates, then, consist of an easting (in meters), a northing (in meters), and a zone number. The Army nemonic is "Read Right, Up," to express the order of the coordinates.

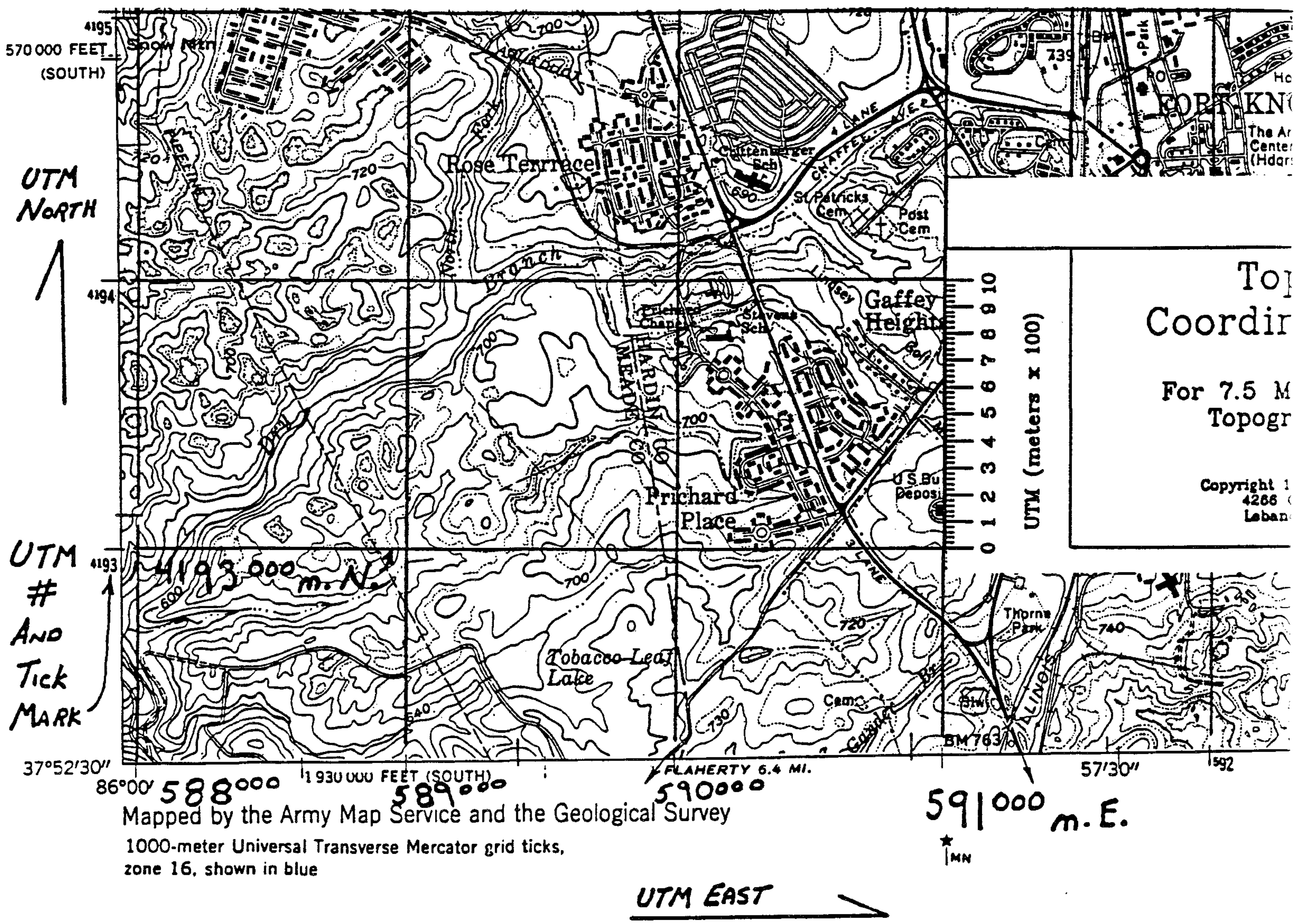
The UTM System on Maps: Most new maps have a pre-printed UTM grid. Older maps may just have tick marks along the borders. Very old maps may have neither. If the map does not have the grid but does have tick marks, you must construct the grid by drawing the lines connecting the same UTM numbers. Most of the UTM numbers are in thousands of meters, with one mark per side showing the entire grid number. The two larger digits are called principal digits and are always in ten thousand and thousands of meters. Note the UTM grid in general is not "square" to the map borders but is slightly tilted.

Finding UTM: The UTM system is very simple to use. The coordinates increase to the north and to the east (up and to the right). Measurements within a 1,000 meter grid square are taken from the lower left corner and are always additive. To find UTM coordinates, measure from the west (left) border of the grid square to the point. This is the Easting. Then measure from the south (lower) border of the grid square to the point. This is the Northing. The zone number is listed in the map margin.

Plotting UTM: Plot UTM coordinates on a map by first locating (by inspection) the 1,000 meter grid square containing the coordinates. Using the UTM scale, measure from the lower left corner the proper number of meters such that the sum of the left grid line and the ruler UTM scale equals the Easting coordinate. Make a reference mark on the lower border and then measure from this mark up the proper number of meters. Mark the point.

Advantages: One advantage of UTM coordinates is that, due to the small size of the squares, folding the map does not affect coordinate accuracy as much as other systems.

Finding the UTM Coordinates of Fort Knox



An example of UTM coordinate determination. We want to find the UTM Coordinates of the Fort Knox Gold Bullion Depository. The UTM grid is not preprinted, but a note in the lower left margin tells us the 1000 meter grid ticks are shown in blue (on the original topo map, not this copy). The Zone Number is 16.

Examining the map borders, we note the UTM numbers and construct our grid by connecting matching tick marks on the opposite borders of the map. To locate one point, only four lines need to be drawn around the point. For convenience, expand a couple of the grid numbers to full UTM coordinates. Remember, the two larger principal digits are in ten thousands and thousands of meters. Number any grid line which does not have a printed value. Note the coordinates should increase from left to right and up.

The Depository lies directly on the 591000 m. East line, so this is its East coordinate. Use the Coordinate Ruler's UTM scale to measure from the lower border line of the square containing the point up to the point itself. The North UTM coordinate is 4193140 m. North, found by adding the scale reading of 140 meters to the lower grid line number of 4193000m. North. The full UTM coordinates of the U. S. Bullion Depository are 591000m East; 4193140m. N.; Zone 16. (Remember the order of the coordinates is "Read Right, Up".)

NEFF Scientific
4266 Old Rome Pike
Lebanon, TN 37087

TopoTool Geographic Products

Using Sloping-Scale Rulers For Latitude/Longitude

Use:

The Coordinate Ruler is sized to fit the common USGS 7.5 minute, 1:24,000 topographic maps as used in the continental United States.

Latitude and Longitude:

Latitude is a measure of the angular distance north or south of the Equator. The Equator is at 0° latitude while the North Pole is at 90° North latitude. Latitude lines are parallel to the Equator. The distance between latitude lines is almost constant (see the horizontal lines in the TopoTool logo above).

Longitude is the angular distance east or west of the Prime Meridian, which runs from the North Pole to the South Pole and through the town of Greenwich, England. In the U.S., our longitude lines increase from right to left. Bangor, Maine, is located near 69° West and San Francisco, California, is located near the 123° West longitude line. The distance between longitude lines varies from north to south, reaching a maximum at the Equator and going to zero at the Poles (see the vertical lines in the TopoTool logo).

Both latitude and longitude are commonly listed in degrees, minutes, and seconds. The degrees are angular units (a 30° angle, for example). Minutes and seconds are parts of degrees, just as feet and inches are parts of a mile. As in a clock, there are 60 minutes in 1 degree and 60 seconds in 1 minute. Note that degrees are shown by the degree symbol ° (like a thermometer degree), minutes with a ' and seconds with a ".

Latitude and Longitude On 7.5 Minute Maps:

A 7.5 minute topographic map is 7.5 minutes high and 7.5 minutes wide. The lower right corner has the smallest values of degrees, minutes, and seconds. There are latitude numbers along both sides of the map, showing the angular distance from the Equator, and longitude numbers along the top and bottom margins, showing the angular distance west of the Prime Meridian.

There are two small lines or "tick marks" showing the location of additional latitude or longitude lines along each margin of the map. These intermediate marks are labeled with minutes and seconds only. Also, there are small crosses inside the map where these lines would intersect. Using a sharp pencil, draw lines connecting equal values of latitude and longitude. By using the crosses, the long edges of the Ruler will enable you to draw these lines. This divides the map into 9 rectangles, each 2.5 minutes (2' 30") on all sides.

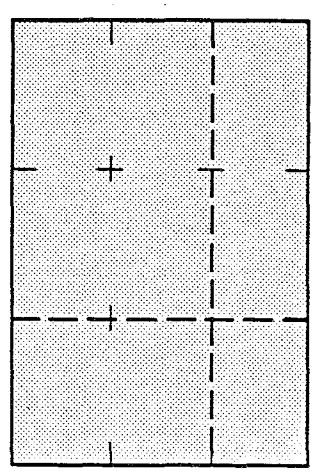


Figure 1: Connect tick marks to form 9 rectangles (two lines shown)

These lines, along with the map margins, are used as reference lines of known latitude or longitude.

Now, imagine a series of horizontal and vertical lines forming a grid, sort of like a piece of window screen, laid on the map. Spaced 1 second apart, there would be 150 horizontal latitude lines and 150 vertical longitude lines in each 2.5 minute rectangle. If these lines were visible, you could determine the latitude of a point by counting the number of lines from a labeled reference line up to the point: Add the number of lines (seconds of latitude) to the value of the reference latitude line to find the latitude of the point.

Finding Latitude: Latitude on a topo map is found in just this way. The latitude/longitude scale is used just like a ruler to measure from a known latitude line to a point. Each Ruler division shows the location of an imaginary latitude line. Measure from the lower labeled latitude (horizontal) line of the rectangle containing the point. Read the minutes and seconds from the Ruler and add this to the value of the reference line. This is the latitude of the point.

Latitude Finding Hints: Paper maps vary somewhat in size with age and humidity. Rectangles typically will not measure **exactly** 2' 30" high. For demanding applications, the scale can be shifted slightly to minimize this inaccuracy when finding (or plotting) latitude. Align the lower line of the Ruler on the lower rectangle border line if the point is in the lower 1/4 of the rectangle and align the upper line of the Ruler with the upper rectangle border line if the point is in the upper 1/4. Center the Ruler over the rectangle borders if the point is in the middle. Add the rule reading to the lower reference line.

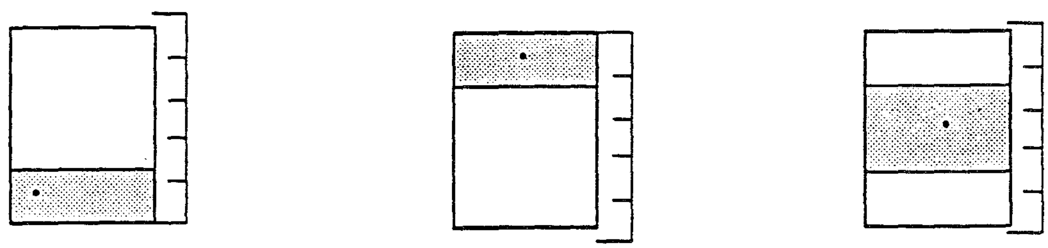


Figure 2: Shifting the scale to minimize Latitude inaccuracies.
(Ruler scale is shown to the right of the rectangle for clarity)

Adding the Ruler's minutes and seconds of latitude to the latitude of the lower border line of the rectangle is treated like time addition. Using a scrap piece of paper to add the coordinates is a good idea, as it is easy to make a mistake with mental addition. On the back of the cover sheet of these instructions are some graphic scales to help you with the addition. See the Some Additional Information section for instructions and an example.

Finding Longitude: The longitude width of a 2.5 minute rectangle is not a constant distance, since the longitude lines converge towards the Poles. To compensate for this, the Ruler uses a technique called sloping-scale. If you are trained in drafting, you are probably familiar with this technique. If not, the concept is sometimes a little difficult to grasp, so look at the example on the last page of these directions if you do not understand the text.

The latitude/longitude scale is too long to fit the width of a 2' 30" rectangle. However, if we tilt the scale, we can adjust it so that the two end lines of the scale lie directly over the side borders of the rectangle. The location of each imaginary longitude line is then at the edge of the rule.

To find the longitude of a point, you align the edge of the rule just over the point while the ends of the scale are precisely aligned with the vertical border lines. Correctly aligning the scale is a little time-consuming, but it is quite accurate. With some practice, it becomes easier! When finding longitude, remember that the longitude lines are all vertical. They do not follow the slope of the Ruler graduations! The longitude lines lie just under the ruler marks at the very edge of the rule. The rule numbers must increase to the left. Add the rule reading at the point to the right-side reference line.

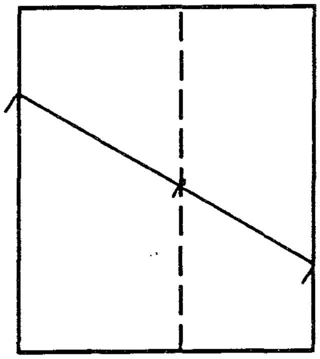


Figure 3: Tilt scale to just fit within rectangle borders. Longitude line of point is shown dashed.

Longitude Finding Hints:

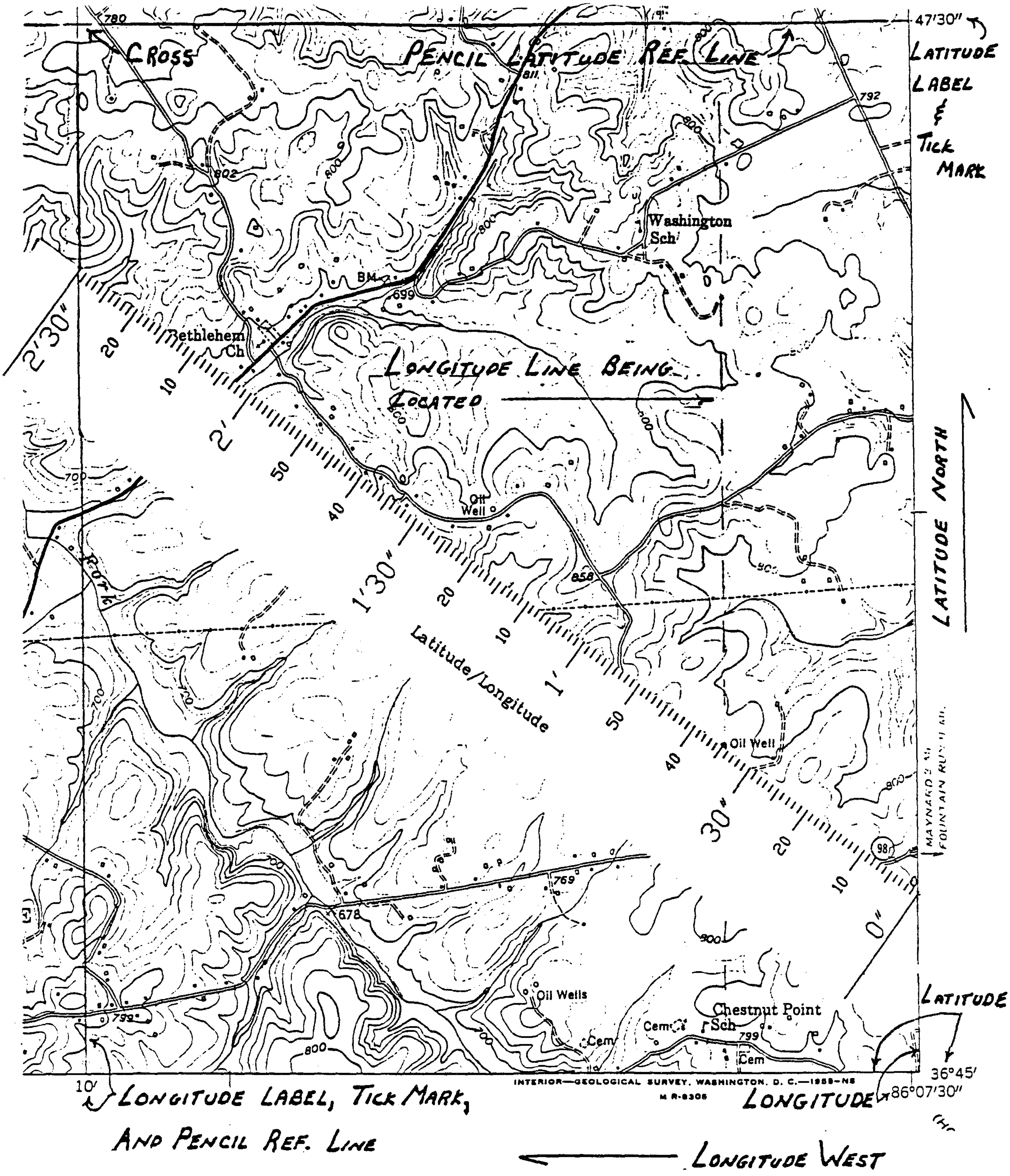
You must use care in adding the rule reading to the value of the longitude reference line. Just remember that angular degrees, minutes, and seconds are added just like time's hours, minutes, and seconds. Use the graphic scales mentioned above to aid your arithmetic. Note that since the borders of the rectangle are always multiples of 2' 30", the units digit for seconds will be the same. Using the example in the "Some Additional Information" section, the Ruler reads 1' 43". The right-side reference line is 17' 30". Thus, you do not need to count each small graduation on the graphic aid--you know the coordinate will end with a "3". Just glance at the aid to see that 1'40" corresponds to _9' 10" (the underline is for the missing tens-of-minutes digit). So, the ruler reading of 1' 43" added to the border line gives the point's minutes and seconds of longitude: 19' 13".

Since the rule must be tilted or sloped to just fit the rectangle borders, it is helpful to extend the vertical reference lines out past the map proper onto the margins. This allows the tilted ruler to still find the longitude of points near the upper and lower borders. However, small triangular-shaped areas at the top margin of the map may not be accessible to the sloped rule. If the rule starts going off the paper because the point is too far up, just use the ruler like a draftsman's triangle to project a small line down into the accessible region of the rectangle: Align the top line of the Ruler with the top margin line of the map and slide the edge of the scale up to the point. You can now mark the longitude of the desired point along the edge of the Ruler further down in the rectangle, where it can be measured.

Plotting:

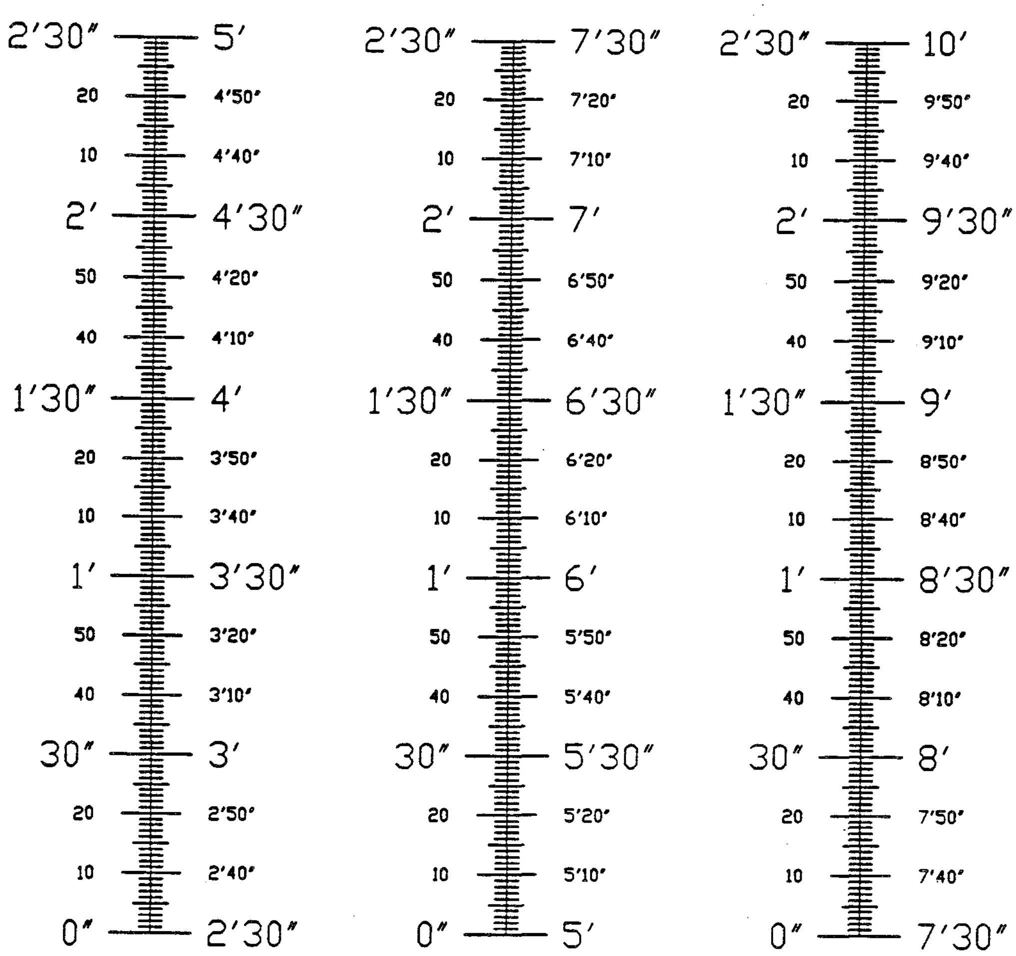
Plotting coordinates is the reverse of finding coordinates and is actually a little easier. Determine longitude first. By inspection of the coordinates and the reference lines, decide which rectangle contains the point. Then align the ends of the rule over the vertical rectangle borders (slope the Ruler). Measure left the required number of minutes and seconds, and make a small vertical mark to indicate the position of the desired longitude line. Then, use the Ruler like a draftsman's triangle to measure up at a right angle from the horizontal latitude reference line the required number of minutes and seconds: By aligning the Ruler's lower line over the lower reference line and carefully sliding the Ruler sideways to the longitude mark made above, the edge of the Ruler is lying directly along the longitude line of the point. Again, just measure up the required number of minutes and seconds of latitude and mark the location of the point. Erase the first longitude reference mark. Good Plotting!

If you have any questions or comments about our products or these instructions, please write Mr. Brad Neff at the address above, or fax it to Mr. Neff at 615-444-2416.

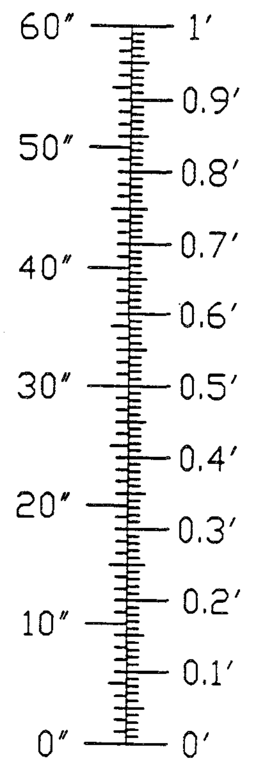


The latitude/longitude scale is being used to find the longitude of an eastern Kentucky oil well. The Ruler is used to connect the tick marks to the cross to form a rectangle with border lines of known latitude/longitude.

Note the position of the Coordinate Ruler's upper and lower lines. This shows how to tilt the Ruler to fit a 2' 30" longitude distance. Add the 35" on the scale to the value of the right-side reference line, 86° 07' 30" W (add the coordinates on a piece of scrap paper to minimize errors) to get the longitude of the well, 86° 08' 05" West. The coordinates of this oil well are 36° 45' 47" North, 86° 08' 05" West.



Convert Map Latitude/Longitude to or from Ruler Measurements using these scales. Note tens digit is not shown.



Convert seconds of latitude/longitude to or from decimal minutes.

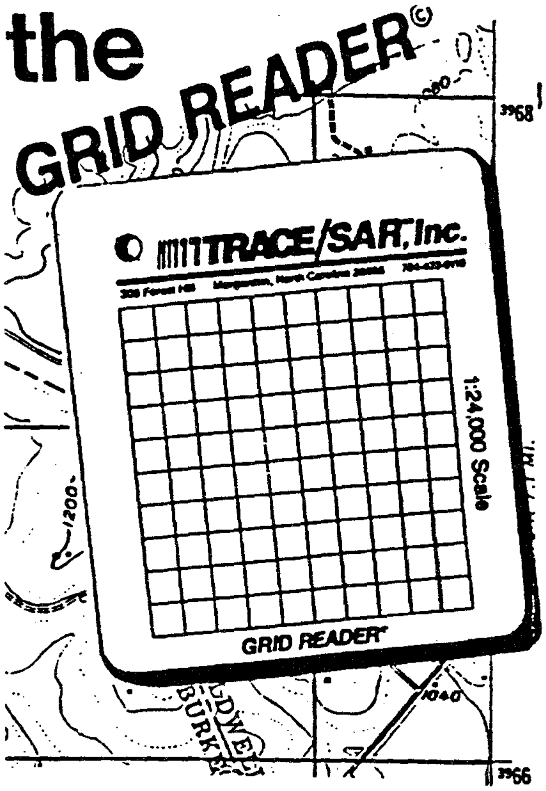
Additional Information

Conversions: Dealing with units like minutes and seconds can be a little difficult. The three graphic scales at the above left are used to help with minute-second addition when finding or plotting longitude. The left side of each scale shows the Ruler's numbers. On the right are the map cooordinates. Note the top and bottom numbers correspond to the minutes and seconds of the border lines (the tens of minutes are left off). Suppose you locate a point with the Ruler. The scale reads 1' 43". The right-side reference line is 17' 30". Use the scale starting with 7' 30". Go up the left side of the scale to the Ruler reading of 1' 43". The right side reads 9' 13" here. Since the tens digit is 1, the point is at 19' 13".

Decimal Minutes: Loran C and GPS receivers often give locations with latitude/longitude in degrees and decimal minutes. The graphic scale on the right converts decimal minutes to and from seconds. Suppose your Loran displayed a latitude of 35° 14.67'. Finding 0.67 minutes on the right side of the aid, we note this corresponds to about 40" on the left side. Thus, the coordinate could be expressed as 35° 14' 40".

Notes: The Coordinate Ruler is silkscreen-printed on clear plastic. The material is durable, but it does get superficial scratches. These are not noticeable when the Ruler is placed on a map. The printing on the Ruler is quite durable as well, but it can be damaged. Use care to avoid unnecessary abrasion.

The Ruler's scales (except the Section) can be used in a pinch on 1:25,000 maps by using the sloping scale technique for both north-south and east-west coordinates.



Technical Resources And Command Equipment for Search And Rescue

THE GRID READER AND THE UNITED STATES GEOLOGICAL SURVEY (USGS) MAP

The black line forming the outside boundry around the USGS map is called the neatline. Take a USGS map (1:24,000 scale) and find the neatline. Next, follow the neatline at the bottom edge of the map, looking from the left bottom corner along the neatline thence to the right bottom corner. Observe two important features of the marginal information:

TICK MARKS - Small vertical lines, a light blue in color, approximately 1/8 inch in length appearing at regular intervals, measuring one thousand meters apart.

TICK MARK IDENTIFICATION NUMBER - Each tick mark has a number printed to its right on top and bottom neatlines, and just below the tick marks on the left and right neatlines.

Follow the tick marks along the top neatline and while doing so, glance at the bottom neatline, directly down and you will see the same tick mark identification number. In like manner follow the map's left side neatline and glance to the right side and observe again, the tick mark numbers are the same - in each direction left to right, bottom to top. Notice also, the tick marks bold print numbers increase in value as you move from left to right and from bottom to top.

It is important to remind you now the movement of your eye, essential to map reading and reading and plotting grid coordinates, will always be TO THE RIGHT AND UP! Keep this in mind.

Important to the tick mark's identification number is the principle number printed in bold black numbers. The small minor number(s) left of each principle number is seldom used.

Example:

PREPARING THE USGS 1:24,000 SCALE MAP

3975

By using a good 24 inch straight edge or ruler [with a raised "inking edge" to prevent pen ink from running back underneath the bottom flat of the ruler], you can carefully connect the tick marks having the same principle numbers together ...all the way across the map, neatline to neatline. Doing this,you establish GRID SQUARES wherein the GRID READER will function as it allows you to read a numerical four digit grid coordinate in establishing the coordinates of your needed destination.

TWO CAUTION: Watch out for the black vertical marks similar in appearance to the light blue tick marks. Connect only the light blue ones. By using the GRID READER as a location guage, you can check from one tick mark to the following one and establish the correct point to connect using the straight edge. Secondly,..select a good black ink ball point or roller ball pen not more than .02mm in size or a sharp "F" pen-black lead pencil. By connecting the wrong mark you will destroy the accuracy of any grid coordinate you may read either-side of the incorrect line. BE CAREFUL, BE ACCURATE!! Take your time and be correct.

3974

You are well on your way to successfully using the GRID READER and USGS map to determine accurate grid coordinates in a professional manner.

You have located the map's tick marks and these tick mark's principle (two digit)identification numbers. You have connected the correct tick marks and established accurately with a .02mm line, grid squares measuring 1,000 meeters by 1,000 meters square. You are about to learn how the GRID READER will determine for you the two additional numbers in the grid coordinates four digit identification number..the numerical coordinate of your destination.

3973

Remember, we are accurately establishing exactly on a topographical USGS, 1:24,000 scale map where you are, or where you want to be.....or where you want someone else to be! It is simple learning how!

PUTTING THE GRID READER TO WORK

Based on accepted principles for reading maps, locations on the map can be determined by grid coordinates by reading the grid number to the RIGHT and UP. This is to say, North-South grid lines and their principle numbers are read to the RIGHT. East-West grid lines and their principle numbers are read UP.

3972000mN

—GEOLOGICAL SURVEY, RESTON VIRGINIA—1981

318 319000mE

TRACE/SAR, Inc.

Technical Resources And Command Equipment for Search And Rescue
308 Forest Hill Morganton, NC 28655
704 - 433 - 6118

Appendix E

Mapping Aids
and
Instruments for Accurate Plotting

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

LAND DESCRIPTION DIAGRAM

Form 9600–5
(May 1978)
(formerly 9180–3)

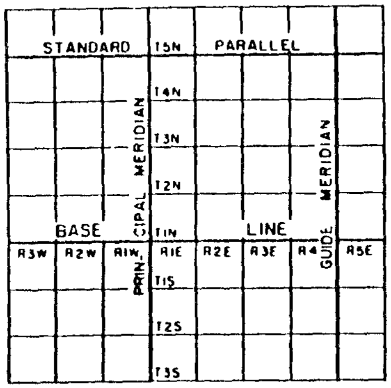


Diagram showing division of tract into Townships

36	31	32	33	34	35	36	31
1	6	5	4	3	2	1	6
12	7	8	9	10	11	12	7
13	18	17	16	15	14	13	18
24	19	20	21	22	23	24	19
25	30	29	28	27	26	25	30
36	31	32	33	34	35	36	31
1	6	5	4	3	2	1	6

Sectional map of Township showing adjoining Sections

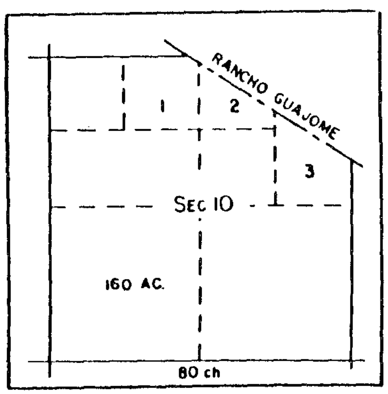
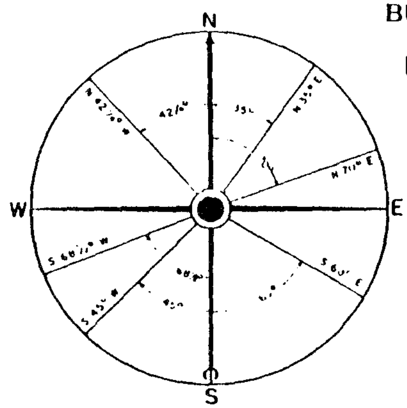


Diagram illustrating division of Fractional Section into Government Lots



60 seconds equal one minute
60 minutes equal one degree

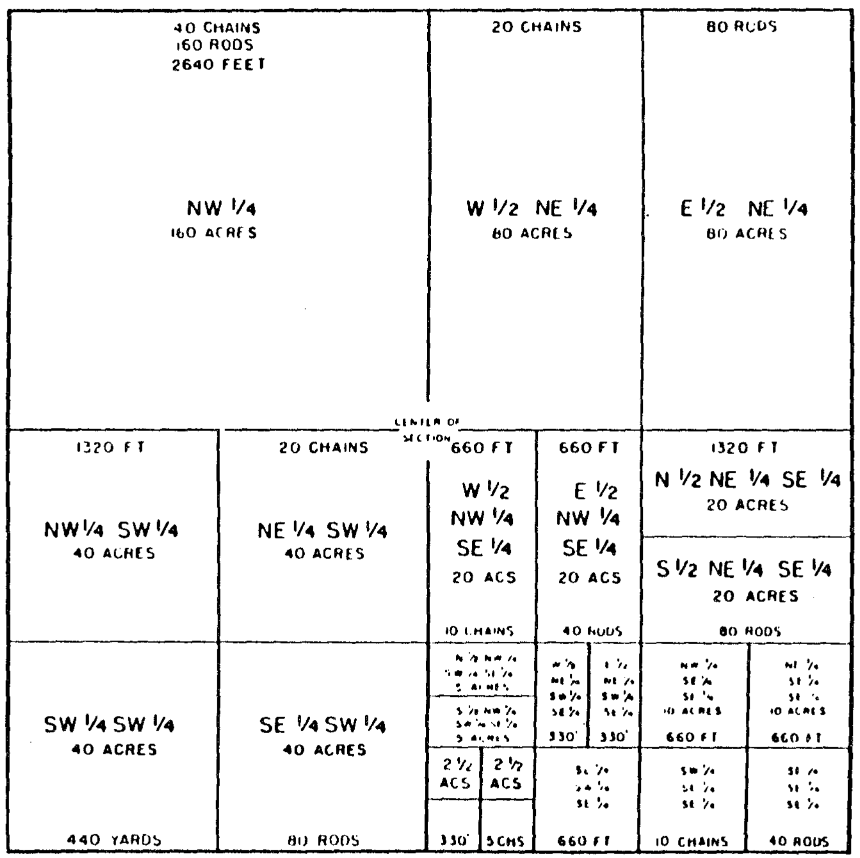


Table of Land Measurements

LINEAR MEASURE		SQUARE MEASURE
1 inch =	.0833 ft.	144 sq. in. = 1 sq. foot
7.92 inches =	1 link	9 sq. feet = 1 sq. yard
12 inches =	1 foot	30¼ sq. yds. = 1 sq. rod
1 vara =	33 inches	16 sq. rods = 1 sq. chain
2¾ feet =	1 vara	1 sq. rod = 272¼ sq. ft.
3 feet =	1 yard	1 sq. ch. = 4356 sq. ft.
25 links =	16½ feet	10 sq. chs. = 1 acre
25 links =	1 rod	160 sq. rods = 1 acre
100 links =	1 chain	4840 sq. yds. = 1 acre
16½ feet =	1 rod	43560 sq. ft. = 1 acre
5½ yards =	1 rod	640 acres = 1 sq. mile
4 rods =	100 links	1 sq. mile = 1 section
66 feet =	1 chain	36 sq. miles = 1 Twp.
80 chains =	1 mile	6 miles sq. = 1 Twp.
320 rods =	1 mile	1 sq. mi. = 2.59 sq. kilm
8000 links =	1 mile	
5280 feet =	1 mile	
1760 yards =	1 mile	

An Acre is:

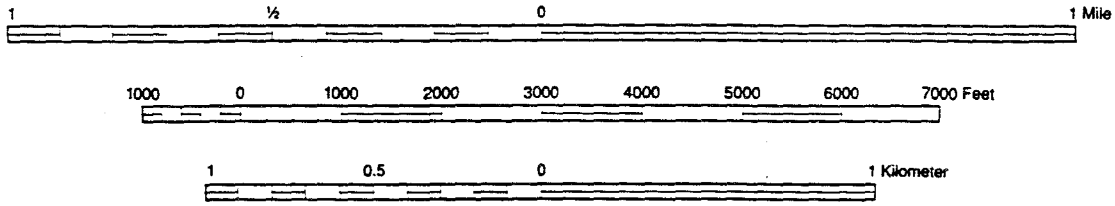
43,560 sq. feet.
165 feet x 264 feet.
198 feet x 220 feet.
660 feet x 66 feet.
160 square rods.
208' 8" square.

or any rectangular tract, the product of the length and width of which totals 43,560 sq. ft.

GPO 845-748

TOPOGRAPHIC MAP LEGEND

Topographic
Scale 1:24,000
One inch equals approximately 2,000 feet



Contour Interval 20 Feet
Dotted Lines Represent 5-Foot Contours

State capitol:	Buildings (barn, warehouse, etc.):
Trail:	Tanks—oil, water, etc. (labeled only if water): Water Tank
Railroad—single track: multiple track:	Campsite:
Bridge:	Picnic area:
Buildings (dwelling, place of employment, etc.):	Index contour:
School:	Intermediate contour:
Church:	Supplementary contour:
Cemeteries:	Depression contours:
Hospital: (labeled)	Checked spot elevation: x 5970

Topographic Map Symbols

CONTROL DATA AND MONUMENTS

Aerial photograph roll and frame number*	3-20

Horizontal control

Third order or better, permanent mark	Neace Neace
With third order or better elevation	BM 45.1 Pike BM 45.1
Checked spot elevation	19.5
Coincident with section corner	Cactus Cactus
Unmonumented*	

Vertical control

Third order or better, with tablet	BM × 16.3
Third order or better, recoverable mark	× 120.0
Bench mark at found section corner	BM 18.6
Spot elevation	× 5.3

Boundary monument

With tablet	BM 21.6 BM 71
Without tablet	171.3
With number and elevation	67 301.1
U.S. mineral or location monument	

CONTOURS

Topographic

Intermediate	
Index	
Supplementary	
Depression	
Cut; fill	

Bathymetric

Intermediate	
Index	
Primary	
Index Primary	
Supplementary	

BOUNDARIES

National	
State or territorial	
County or equivalent	
Civil township or equivalent	
Incorporated city or equivalent	
Park, reservation, or monument	
Small park	

*Provisional Edition maps only

Provisional Edition maps were established to expedite completion of the remaining large scale topographic quadrangles of the conterminous United States. They contain essentially the same level of information as the standard series maps. This series can be easily recongnized by the title "Provisional Edition" in the lower right hand corner.

LAND SURVEY SYSTEMS

U.S. Public Land Survey System

Township or range line	
Location doubtful	
Section line	
Location doubtful	
Found section corner; found closing corner	
Witness corner; meander corner	WC MC

Other land surveys

Township or range line	
Section line	
Land grant or mining claim; monument	
Fence line	

SURFACE FEATURES

Levee	Levee
Sand or mud area, dunes, or shifting sand	Sand
Intricate surface area	Strip Mine
Gravel beach or glacial moraine	Gravel
Tailings pond	Tailings Pond

MINES AND CAVES

Quarry or open pit mine	
Gravel, sand, clay, or borrow pit	
Mine tunnel or cave entrance	
Prospect; mine shaft	
Mine dump	Mine dump
Tailings	Tailings

VEGETATION

Woods	
Scrub	
Orchard	
Vineyard	
Mangrove	Mangrove

GLACIERS AND PERMANENT SNOWFIELDS

Contours and limits	
Form lines	

MARINE SHORELINE

Topographic maps

Approximate mean high water	
Indefinite or unsurveyed	

Topographic-bathymetric maps

Mean high water	
Apparent (edge of vegetation)	

COASTAL FEATURES

- Foreshore flat
- Rock or coral reef
- Rock bare or awash
- Group of rocks bare or awash
- Exposed wreck
- Depth curve; sounding
- Breakwater, pier, jetty, or wharf
- Seawall

BATHYMETRIC FEATURES

- Area exposed at mean low tide; sounding datum
- Channel
- Offshore oil or gas: well; platform
- Sunken rock

RIVERS, LAKES, AND CANALS

- Intermittent stream
- Intermittent river
- Disappearing stream
- Perennial stream
- Perennial river
- Small falls; small rapids
- Large falls; large rapids
- Masonry dam
- Dam with lock
- Dam carrying road
- Perennial lake; Intermittent lake or pond
- Dry lake
- Narrow wash
- Wide wash
- Canal, flume, or aqueduct with lock
- Elevated aqueduct, flume, or conduit
- Aqueduct tunnel
- Well or spring; spring or seep

SUBMERGED AREAS AND BOGS

- Marsh or swamp
- Submerged marsh or swamp
- Wooded marsh or swamp
- Submerged wooded marsh or swamp
- Rice field
- Land subject to inundation

BUILDINGS AND RELATED FEATURES

- Building
- School; church
- Built-up Area
- Racetrack
- Airport
- Landing strip
- Well (other than water); windmill
- Tanks
- Covered reservoir
- Gaging station
- Landmark object (feature as labeled)
- Campground; picnic area
- Cemetery: small; large

ROADS AND RELATED FEATURES

Roads on Provisional edition maps are not classified as primary, secondary, or light duty. They are all symbolized as light duty roads.

- Primary highway
- Secondary highway
- Light duty road
- Unimproved road
- Trail
- Dual highway
- Dual highway with median strip
- Road under construction
- Underpass; overpass
- Bridge
- Drawbridge
- Tunnel

RAILROADS AND RELATED FEATURES

- Standard gauge single track; station
- Standard gauge multiple track
- Abandoned
- Under construction
- Narrow gauge single track
- Narrow gauge multiple track
- Railroad in street
- Juxtaposition
- Roundhouse and turntable

TRANSMISSION LINES AND PIPELINES

- Power transmission line: pole; tower
- Telephone line
- Aboveground oil or gas pipeline
- Underground oil or gas pipeline

USING AND PLOTTING MAGNETIC COMPASS DIRECTIONS

(Don Buck)

Points on Magnetic Compass

Many emigrants used a pocket magnetic compass which had direction points on the face of the compass (8 lettered points in each 90° quadrant). On occasion they made reference in their diary accounts to these lettered compass points to indicate the direction of travel. For purposes of making use of these lettered compass directions, you can easily convert them to degrees. All you need remember is that the angular distance between each lettered point on a magnetic compass will be **11¼ degrees.** Thus, WNW is equal to 292½° or 22½° north of west. The following direction points are from a typical 19th century magnetic pocket compass of the type emigrants carried overland.

Moving clockwise from north the lettered points on the magnetic compass are:

N	*E*	*S*	*W*
N by E	*E by S*	*S by W*	*W by N*
NNE	*ESE*	*SSW*	*WNW*
NE by N	*SE by E*	*SW by S*	*NW by W*
NE	*SE*	*SW*	*NW*
NE by E	*SE by S*	*SW by W*	*NW by N*
ENE	*SSE*	*WSW*	*NNW*
E by N	*S by E*	*W by S*	*N by W*
(E)	*(S)*	*(W)*	*(N)*

Plotting Magnetic Compass Directions

When plotting these magnetic compass directions on topographic maps, either from diary accounts or your own pocket compass, they must be corrected for true directions by using the magnetic declination. The *magnetic declination* is the angular distance between *True North* and *Magnetic North.* This is because the earth is a colossal magnet with a polar axis running through it from the north to the south magnetic pole; and this magnetic pole has a different angularity from the true or geographic north-south pole by which topo quads are oriented. Thus magnetic compass directions will vary from place to place and this variation is called *magnetic declination.*

In the western trail states the magnetic declination will always be to the east of north, anywhere from about 20° in the northwest to about 11° in the southwest and about 8° along the Missouri River. Most 7.5 minute topographic quadrangles will indicate the magnetic declination for the map area on a direction figure (at the bottom left hand side of the map). Provisional quads do not have this direction figure but indicate the magnetic declination in the map information at the lower left hand corner of the map.

West of the Missouri River, this magnetic declination must be **added** (because it is to the east of north) to any magnetic reading in order to find the true direction to plot on topographic quads. For example, if the magnetic reading is NW (315°) and the magnetic declination is 15°, the true direction will be 330°.

There is one added complication in arriving at the magnetic declination for a particular locality. Not only does the magnetic declination vary from place to place, but it varies from time to time, due to the magnetic pole wandering a bit from year to year. In the short run, this is of no major consequence for using or plotting magnetic compass directions. In the western trail states this wandering factor will amount to only a few minutes of variation per year (since the 1920's the variation has been decreasing in the west). But if you are trying to convert an emigrant magnetic compass direction, then you are dealing with a change of up to 150 years. According to the "Estimated Values of Magnetic Declination" tables prepared by the National Geophysical Data Center, the differences between 1850 and 2000 in trail states range from 1° to 6°, with 1° to 3° being more common (and always a decrease from 1850). Fortunately, this means the magnetic declination for a particular locality in emigrant days is very close to what it is today for that same locality.

USE OF INSTRUMENTS FOR ACCURATE PLOTTING ON MAPS

(Don Buck)

Once a trail or site has been located, the problem remains to plot it accurately on 7.5 minute topographic quadrangles (1:24,000 scale), either manually or electronically. To minimize this problem, mappers will find two instruments of immense help in achieving acceptable plotting accuracy—the distance measuring wheel and the hand-held Global Positioning System (GPS) unit.

Distance Measuring Wheel

This instrument measures linear distances in feet (or meters) on mechanical counters. From a known position, which is identified on the topo quad, the mapper guides the measuring wheel in a recorded direction and straight line to the trail or site whose location requires plotting on the quad. Light weight, portable, single wheeled devices measuring up to two miles (with wheels from 3 to 4 feet in circumference) are available from $50 to $100 at hardware, forestry, and surveying equipment stores.

Global Positioning System

Global Positioning System (GPS) is a satellite-based radio-navigation system developed and operated by the U.S. Department of Defense (DoD). A typical hand-held GPS unit consists of a receiver (microchip), with a small battery pack and antenna, that receives radio signals consisting of precise position, velocity, and time information, transmitted from orbiting satellites. Normally, the Operational Constellation consists of 24 satellites (21 working & 3 spares) orbiting the earth every 12 hours about 11,000 miles above the earth's surface. (Sometimes these satellites are referred to as Space Vehicles or SVs.) Often, there are more than 24 operational satellites as new ones are launched to replace older satellites. Satellites use six orbital planes (nominally with four satellites in each), equally spaced (60 degrees apart), and inclined at about 55 degrees with respect to the equatorial plane. Under usual operating conditions, this constellation provides the user with 5 to 8 satellites visible from any point on the earth.

For an accurate position fix (3D), a minimum of four satellites should be located around and well above the horizon. However, the more satellites located (acquired) the more accurate the 3D fix will be. For an accurate elevation reading, the satellites should be more overhead, just the opposite of an accurate horizontal fix. Hence, the hand-held GPS unit does not give accurate enough elevation readings for practical use (the vertical error will be 150% to 200% of the horizontal error).

For accuracy and fast acquisition of satellite data, the newer **12 parallel-channel** GPS receiver processes the best incoming signals from satellites simultaneously to attain a 3D fix (with horizontal accuracy in good reception conditions from 30 to 50 feet and vertical accuracy of +/- 100 feet). The older single or dual channel units, using sequential receivers, cycled through the best incoming signals one by one before arriving at a 3D fix which took more time and resulted in less accuracy due to the time lag (with horizontal accuracy from 60 to 100 feet and vertical accuracy of +/- 200 feet). A third type of GPS unit uses a multiplex receiver that still process incoming data sequentially but shifts back and forth fast enough between satellites to seem as though it is tracking all of them simultaneously. Overall, the 12 parallel-channel receivers will provide the most consistent accuracy and likelihood of a fix under poor conditions.

Now that the Selective Availability (SA) degrading error for civilian use was removed May 1, 2000, 12 parallel-channel GPS hand-held units operate within a designed accuracy of 15 meters (50 feet). Even then, there are errors to contend with in satellite atomic clocks, atmospheric alteration of carrier waves (in the ionosphere & troposphere), receiver noise, interference of reflected signals near the receiver (multipath), and orbital variation (ephemeris), all of which can typically amount to an error value of 10 meters. Most of these errors can be eliminated or reduced significantly by the use of the more expensive Differential Global Position System instruments (DGPS) that government land-use agencies commonly employ. However, 12 parallel channel receivers can achieve 10 meter accuracy (30+ ft.) fairly reliably with a clear sky view and reasonable satellite geometry. So the typical error of a hand-held GPS unit will be about the width of a pencil line on 7.5 minute quads. Should the GPS user be located in walled canyons and ravines or under forested canopy, a significant decrease in accuracy can be expected due to satellites not positioned well enough (poor geometry) to give acceptable readings.

[*continued*]

The **Wide Area Augmentation System (WAAS)**, developed by the FAA primarily for safer aircraft navigation, is the latest technology for improving accuracy that is similar in results to the DGPS capability and is built into newer hand-held GPS units. Instead of a beacon receiver used in DGPS units, the WAAS correction data is sent via a geo-stationary satellite (a GEO) and then decoded by one of the channels already available in the GPS receiver but converted to WAAS use.

This system works through a network of ground reference stations (GRSs) in the U.S., each of which receives data from GPS satellites and then determines errors relative to the area of the country in which they are located. GRSs then relay their corrections to a master station where they are packaged into a set of correction data and uplinked to the geo-stationary satellite, which in turn broadcasts the correction data on the GPS frequency for local use. The hand-held receiver then determines which data is applicable to its current location and applies the appropriate corrections to the receiver. Currently, there are only two GEO satellites in orbit serving WAAS. More are planned but it takes three years to build, orbit, and commission a new one.

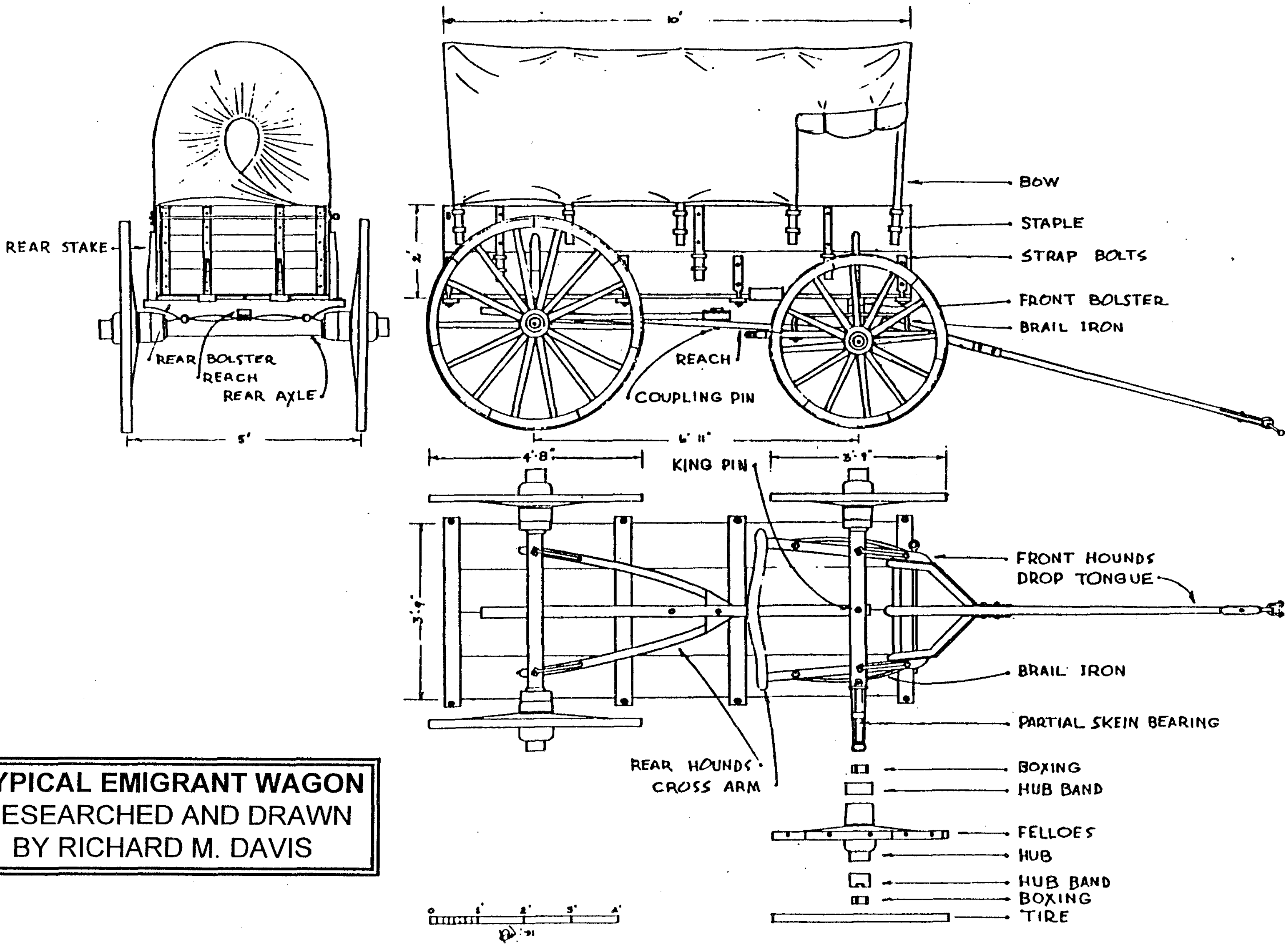
Although WAAS has the potential to improve GPS accuracy to 5 meters, and under some conditions to 1 meter, presently there are limitations for the mapper. First, only 2 GEO satellites are fully operational. Second, because the WAAS satellites are geo-stationary and designed for aircraft, a clear view of the skyline is needed, now the southern sky for the northern hemisphere. Thus, operating in hilly country or forested terrain will minimize or eliminate the WAAS correction capability. Third, for the GPS position to be improved by WAAS signals, a hand-held receiver must be reasonably close to one of the correction stations being serviced through the WAAS satellite. Fourth, because WAAS requires a lot of digital data to be received by a hand-held receiver, it will not function when the GPS receiver is in a "power save" mode ("power save" mode turns off power to the receiver about 4 out of every 5 seconds when GPS signals are stable). Continued improvements in hand-held GPS technology may overcome some of these limitations.

Another factor affecting GPS accuracy is the **map datum** programmed in the GPS unit. World wide, there are hundreds of map datums on which maps are based. Within the continental US, most USGS 7.5 minute quads use the 1927 North American Datum (NAD27 CONUS). However, as these primary series maps undergo "complete revision" (as opposed to the common "minor" and "basic revision" categories), the map datum will be converted to North American Datum of 1983 (NAD83). Because of high costs, few primary series maps have undergone this map datum upgrade.

To verify that a GPS unit is programmed with the appropriate map datum, the user can check in the lower left-hand corner of the 7.5 minute quad—especially if it is a recently revised map—for the map datum date. Dashed corner ticks on the lower left-hand corner margin of 7.5 minute NAD27 maps show the offset (north & east) between NAD27 and NAD83 maps. If the GPS unit was programmed for NAD83, that offset would be the distance the waypoint plots would be in error. Most new GPS units come with a 1984 World Geodetic System (WGS84) default map datum, and must be reprogrammed to a NAD27 CONUS default.

The GPS receiver can be programmed to record positions as waypoints in either Latitude-Longitude or Universal Transverse Mercator (UTM) coordinates. There are numerous plastic plotting aids available for plotting Lat-Long and UTM coordinates. For using two of these plastic overlays in plotting positions on 7.5 minute topo quads, refer to Appendix D, "Plotting UTM and Lat-Long Coordinates."

Using small plastic plotting aids, **UTM coordinates** are much easier to plot, especially in the field, than are Latitude-Longitude. On some more recent 7.5 minute topo quads, the UTM coordinates appear as thin black coordinate lines, in a grid pattern, with the UTM numbers printed next to the boundary lines (called "neat lines") around the topo quad margins. This makes plotting UTM coordinates a snap. On the less recent 7.5 minute topo quads, the UTM coordinate numbers also are printed along the neat lines (next to short blue lines called "ticks") but they are not connected across the map in grid fashion. So users will need to connect these ticks by linking them on the map with pencil and ruler before going into the field. Unfortunately, for UTM users, the USGS no longer plans on putting UTM coordinate lines in a grid pattern on forthcoming 7.5 minute quads, citing that general users find the black grid lines too distracting.



TYPICAL EMIGRANT WAGON
RESEARCHED AND DRAWN
BY RICHARD M. DAVIS

Appendix F

Trail Artifact/Feature Form
(Designed by Richard Silva)

TRAIL ARTIFACT / FEATURE FORM

FIELD ARTIFACT / FEATURE #______ DEPTH: BEGINNING____ ENDING____ AVERAGE____

CREW______________________________ DATE:______________

USGS 7.5 QUAD______________________________ MAP CODE ______________

GPS MARKER CODE______________ Twp________ Rng_____ ¼_____ ¼_____ Sec_______

LONGITUDE ______________ LATITUDE ______________ MAP DATUM________

UTM ZONE _____ EASTING ______________ NORTHING ______________

OWNER______________GENERAL LOCATION ______________________

PHOTOGRAPH, TYPE ______________ ROLL # __________ EXPOSURE #________

TRAIL CLASSIFICATION ________ WIDTH: __________ DEPTH______________

ENVIRONMENTAL CHARACTERISTICS

Vegetation, Soil, Landform ______________________________

Geology ____

DESCRIPTION OF CULTURAL MATERIALS (Characteristics such as material type, color, embossing, measurements, etc.)

____

____

____

COMMENTS ____

____

COLLECTED ______________________ NOT COLLECTED______________

ARCHIVAL DESTINATION: MUSEUM, HISTORICAL SOCIETIES, AGENCIES, ETC.

____

CATALOGUE # ______________________

REFERENCES USED ______________________________________

____

____

RECORDER ______________________ AFFILIATE______________________

GRID ON BACK

ARTIFACT DRAWING **scale:**

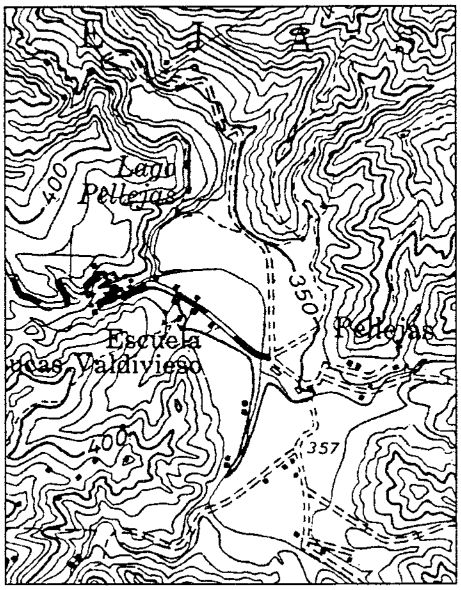
TRAIL SEGMENT DRAWING **(Show artifact/feature location important environmental association and legend**

Appendix G

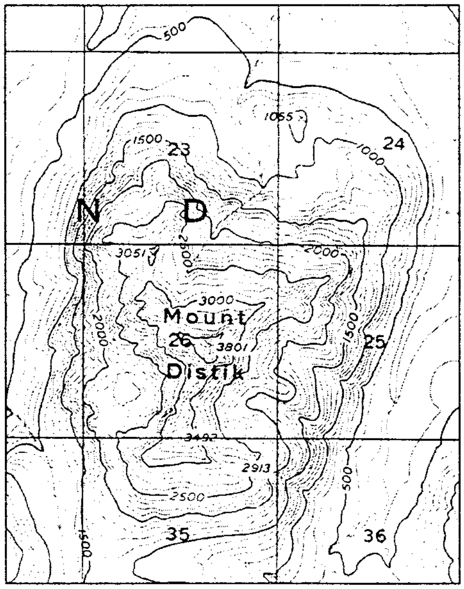
USGS Maps

USGS
science for a changing world

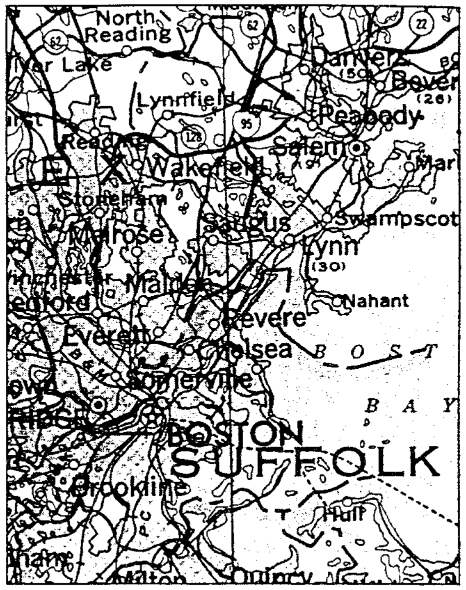
Map Scales



1:20,000-scale map



1:63,360-scale map



1:500,000-scale map

To be most useful, a map must show locations and distances accurately on a sheet of paper of convenient size. This means that all things included in the map—ground area, rivers, lakes, roads, distances between features, and so on—must be shown proportionately smaller than they really are. The proportion chosen for a particular map is its scale.

Large Is Small

Simply defined, scale is the relationship between distance on the map and distance on the ground. A map scale might be given as a drawing (a graphic scale), but usually it is given as a fraction or a ratio—1/10,000 or 1:10,000.

These "representative fraction" scales mean that 1 unit of measurement on the map—1 inch or 1 centimeter—represents 10,000 of the same units on the ground. If the scale were 1:63,360, for instance, then 1 inch on the map would represent 63,360 inches or 1 mile on the ground (63,360 inches divided by 12 inches equals 5,280 feet or 1 mile). The first number (map distance) is always 1. The second number (ground distance) is different for each scale; the larger the second number is, the smaller the scale of the map.

"The larger the number, the smaller the scale" sounds confusing, but it is easy to understand. A map of an area 100 miles long by 100 miles wide drawn at a scale of 1:63,360 would be more than 8 feet square. To make the map a more convenient size, either the scale used or the area covered must be reduced.

If the scale is reduced to 1:316,800, then 1 inch on the map represents 5 miles on the ground, and an area 100 miles square can be mapped on a sheet less than 2 feet square (100 miles at 5 miles to the inch equals 20 inches, or 1.66 feet). On the other hand, if the original 1:63,360 scale is used but the mapped area is reduced to 20 miles square, the resulting map will also be less than 2 feet square.

Such maps would be easier to handle. But would they be more useful? In the small-scale map (1:316,800), there is less room; therefore, everything must be drawn smaller, and some small streams, roads, and landmarks must be left out altogether. On the other hand, the larger scale map (1:63,360) permits more detail but covers much less ground.

Many areas have been mapped at different scales. The most important consideration in choosing a map is its intended use. A town engineer, for instance, may need a very detailed map to locate precise sewers, power and water lines, and streets. A commonly used scale for this purpose is 1:600 (1 inch on the map represents 50 feet on the ground). This scale is so large that many features—such as buildings, roads, and railroad tracks—that are usually represented on smaller scale maps by symbols can be drawn to scale.

U.S. Geological Survey Scales

The U.S. Geological Survey (USGS) publishes maps at various scales. The scale used for most United States topographic mapping is 1:24,000. USGS maps at this scale cover an area measuring 7.5 minutes of latitude and 7.5 minutes of longitude and are commonly called 7.5-minute quadrangle maps. Map coverage for most of the United States has been completed at this scale, except for Puerto Rico, which is mapped at 1:20,000 and 1:30,000, and for a few States that have been mapped at 1:25,000. Most of Alaska has been mapped at 1:63,360, with some populated areas also mapped at 1:24,000 and 1:25,000. Maps at 1:24,000 scale are fairly large and provide detailed information about the features of an area, including the locations of important buildings and most campgrounds, ski lifts, and water mills. Footbridges, drawbridges, fence lines, and private roads are also shown at this scale. Usually these features are omitted from maps in the 1:50,000- to 1:100,000-scale range; these maps cover more area while retaining a reasonable level of detail. Maps at these scales are most often produced using the 30- by 60-minute quadrangle formats.

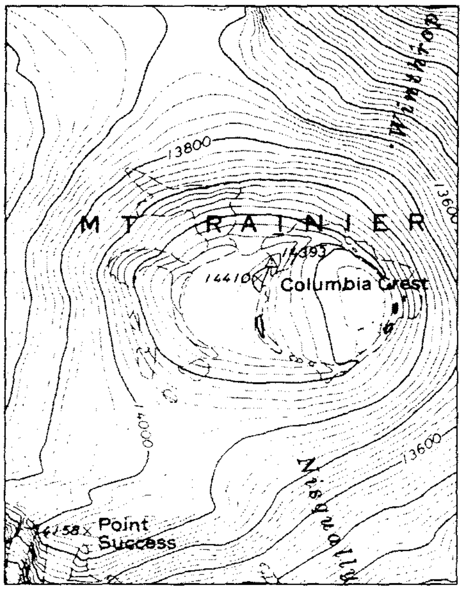
Small-scale maps (1:250,000 and smaller) show large areas on single map sheets, but details are limited to major features, such as boundaries, parks, airports, major roads, railroads, and streams.

Information

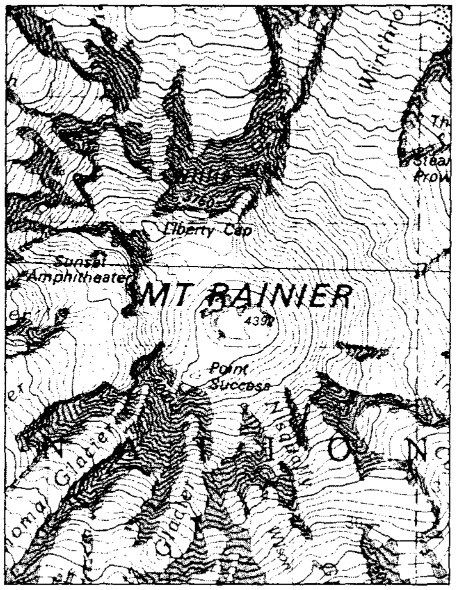
The table below shows information about maps available from the USGS.

For information on other USGS products and services, call 1-888-ASK-USGS, use the ASK.USGS fax service, which is available 24 hours a day at 703-648-4888, or visit the general interest publications Web site on mapping, geography, and related topics at mapping.usgs.gov/mac/isb/pubs/pubslists/index.html.

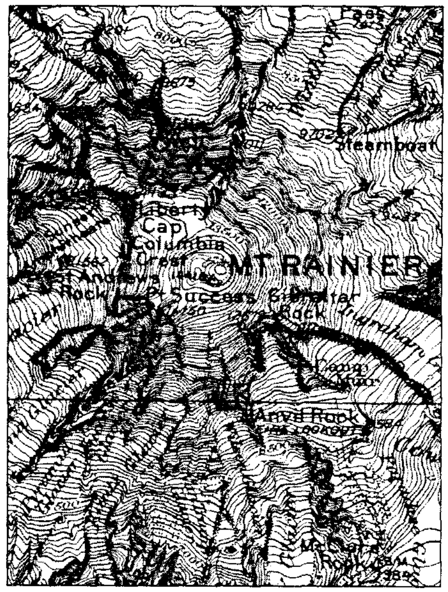
Please visit the USGS home page at www.usgs.gov.



1:24,000-scale map



1:100,000-scale map



1:250,000-scale map

USGS Maps

Series	Scale	1 inch represents approximately	1 centimeter represents	Standard quadrangle size (latitude by longitude)	Quadrangle area (square miles)
Puerto Rico 7.5 minute	1:20,000	1,667 feet	200 meters	7.5 by 7.5 minute	71
7.5 minute	1:24,000	2,000 feet (exact)	240 meters	7.5 by 7.5 minute	49 to 70
7.5 minute	1:25,000	2,083 feet	250 meters	7.5 by 7.5 minute	49 to 70
7.5 by 15 minute	1:25,000	2,083 feet	250 meters	7.5 by 15 minute	98 to 140
USGS-DMA 15 minute	1:50,000	4,166 feet	500 meters	15 by 15 minute	197 to 282
15 minute*	1:62,500	1 mile	625 meters	15 by 15 minute	197 to 282
Alaska Maps	1:63,360	1 mile (exact)	633.6 meters	15 by 20 to 36 minute	207 to 281
County Maps	1:50,000	4,166 feet	500 meters	County area	Varies
County Maps	1:100,000	1.6 miles	1 kilometer	County area	Varies
30 by 60 minute	1:100,000	1.6 miles	1 kilometer	30 by 60 minute	1,568 to 2,240
30 minute*	1:125,000	2 miles	1.25 kilometers	30 by 30 minute	786 to 1,124
1 degree by 2 degree or 3 degree	1:250,000	4 miles	2.5 kilometers	1° by 2° or 3°	4,580 to 8,669
State Maps	1:500,000	8 miles	5 kilometers	State area	Varies
State Maps	1:1,000,000	16 miles	10 kilometers	State area	Varies
U.S. Sectional Maps	1:2,000,000	32 miles	20 kilometers	State groups	Varies
Antarctica Maps	1:250,000	4 miles	2.5 kilometers	1° by 3° to 15°	4,089 to 8,336
Antarctica Maps	1:500,000	8 miles	5 kilometers	2° by 7.5°	28,174 to 30,462

* Abandoned map series, but still available for ordering.

USGS

science for a changing world

Map Accuracy Standards

Map Accuracy

An inaccurate map is not a reliable map. "X" may mark the spot where the treasure is buried, but unless the seeker can locate "X" in relation to known landmarks, the map is not very useful.

The U.S. Geological Survey (USGS) publishes maps and other products at high levels of accuracy. Dependability is vital, for example, to engineers, highway officials, and land-use planners who use USGS topographic maps as basic planning tools.

As a result, the USGS makes every effort to achieve a high level of accuracy in all of its published products. An important aim of its accuracy control program is to meet the U.S. National Map Accuracy Standards.

National Map Accuracy Standards

To find methods of ensuring the accuracy of both location (the latitude and longitude of a point) and elevation (the altitude above sea level), the American Society for Photogrammetry and Remote Sensing— an organization actively involved in the science of making precise measurements from photographs (photogrammetry) and acquiring information from aerial photographs and satellite image data (remote sensing)— set up a committee in 1937 to draft accuracy specifications. Sparked by this work, agencies of the Federal Government, including the USGS, began their own inquiries and studies of map accuracy standards. In 1941, the U.S. Bureau of the Budget issued the "United States National Map Accuracy Standards," which applied to all Federal agencies that produce maps. The standards were revised several times, and the current version was issued in 1947. (The standards are printed on the reverse of this factsheet.)

As applied to the USGS 7.5-minute quadrangle topographic map, the horizontal accuracy standard requires that the positions of 90 percent of all points tested must be accurate within 1/50th of an inch (0.05 centimeters) on the map. At 1:24,000 scale, 1/50th of an inch is 40 feet (12.2 meters). The vertical accuracy standard requires that the elevation of 90 percent of all points tested must be correct within half of the contour interval. On a map with a contour interval of 10 feet, the map must correctly show 90 percent of all points tested within 5 feet (1.5 meters) of the actual elevation.

All maps produced by the USGS at 1:250,000 scale and larger are prepared by methods designed to meet these accuracy standards and carry the statement, "This map complies with National Map Accuracy Standards." Exceptions to this practice involve areas covered by dense woodland or obscured by fog or clouds; in those areas, aerial photographs cannot provide the detail needed for precise mapping. The USGS tests enough of its maps to ensure that the instruments and procedures the Survey uses are producing maps that meet the U.S. National Map Accuracy Standards.

How the Survey Maintains Map Accuracy

In 1958, the USGS began systematically testing the accuracy of its maps. Presently, accuracy testing is performed on 10 percent of the mapping projects at each contour interval as a method of controlling overall quality. It is rare for a 7.5-minute map to fail the test, but this happens on occasion.

In testing a map, the USGS experts select 20 or more well-defined points; a typical point would be the intersection of two roads. Positions are established on the test points by field teams using sophisticated surveying techniques to determine positions from aerial photographs. Field survey methods are the only tests accepted for official accuracy testing. Positions must be obtained by surveys of a higher accuracy. Vertical tests are run separately to determine precise elevations. The mapped positions are checked against the field and (or) photogrammetrically determined positions results. If the map is accurate within the tolerances of the U.S. National Map Accuracy Standards, it is certified and published with the statement that it complies with those standards.

By such rigorous testing of some of its maps, the USGS is able to determine that its procedures for collecting map information ensure a high level of map accuracy.

Factual Errors

There are other kinds of errors in mapmaking. Names and symbols of features and classification of roads or woodlands are among the principal items that are subject to factual error. Mapmakers cannot apply a numerical value to this kind of information; they must rely on local sources for their information. Sometimes the local information is wrong. Sometimes names change or new names and features are added in an area. The USGS cartographers and editors check all maps thoroughly and, as a matter of professional pride, attempt to keep factual errors to a minimum.

"Errors" resulting from selection, generalization, and displacement are necessary results of mapping complex features at reduced scales. In congested areas, large buildings may be plotted to scale and the smaller buildings may have to be omitted; in showing buildings of irregular shape, small wings, bays, and projections usually are disregarded, and the outline is shown in general form. At map scale, it may not be possible to show each of several closely spaced linear features in its correct position. In such cases, one feature, such as a railroad, is positioned in its true location and others, such as parallel roads or rivers, are displaced the minimum amount necessary to make each symbol legible or are omitted to make the highest priority symbol legible.

United States National Map Accuracy Standards

With a view to the utmost economy and expedition in producing maps that fulfill not only the broad needs for standard or principal maps, but also the reasonable particular needs of individual agencies, the Federal Government has defined the following standards of accuracy for published maps:

1. Horizontal accuracy. For maps on publication scales larger than 1:20,000, not more than 10 percent of the points tested shall be in error by more than 1/30 inch, measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, 1/50 inch. These limits of accuracy shall apply to positions of well-defined points only. Well-defined points are those that are easily visible or recoverable on the ground, such as the following: monuments or markers, such as bench marks, property boundary monuments; intersections of roads and railroads; corners of large buildings or structures (or center points of small buildings). In general, what is well-defined will also be determined by what is plottable on the scale of the map with-in 1/100 inch. Thus, while the intersec-tion of two roads or property lines meeting at right angles would come within a sensible interpretation, identi-fication of the intersection of such lines meeting at an acute angle would not be practicable within 1/100 inch. Similarly, features not identifiable upon the ground within close limits are not to be considered as test points within the limits quoted, even though their positions may be scaled closely upon the map. This class would cover timber lines and soil boundaries.
2. Vertical accuracy, as applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error by more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale.

3. The accuracy of any map may be tested by comparing the positions of points whose locations or elevations are shown upon it with corresponding positions as determined by surveys of a higher accuracy. Tests shall be made by the producing agency, which shall also determine which of its maps are to be tested, and the extent of such testing.

4. Published maps meeting these accuracy requirements shall note this fact in their legends, as follows: "This map complies with National Map Accuracy Standards."

5. Published maps whose errors exceed those aforestated shall omit from their legends all mention of standard accuracy.

6. When a published map is a consid-erable enlargement of a map drawing (manuscript) or of a published map, that fact shall be stated in the legend. For example, "This map is an enlargement of a 1:20,000-scale map drawing," or "This map is an enlargement of a 1:24,000-scale published map."

7. To facilitate ready interchange and use of basic information for map construc-tion among all Federal mapmaking agencies, manuscript maps and published maps, wherever economically feasible and consistent with the use to which the map is to be put, shall conform to latitude and longitude boundaries, being 15 minutes of latitude and longitude, or 7.5 minutes, or 3.75 minutes in size.

How To Obtain More Information

For information on these and other USGS products and services, call 1-888-ASK-USGS, use the Ask.USGS fax service, which is available 24 hours a day at 703-648-4888, or visit the general interest publications Web site on mapping, geography, and related topics at http://mapping.usgs.gov/www/products/mappubs.html.

Please visit the USGS home page at http://www.usgs.gov/.

United States Map Indexes

Each year the U.S. Geological Survey (USGS) produces thousands of new and revised topographic and geologic maps, as well as other types of cartographic products. To provide easy access to these maps, the USGS publishes indexes that are updated periodically.

State Indexes

[State] Index to Topographic and Other Map Coverage and [State] Catalog of Topographic and Other Published Maps—A State index is designed to inform map users of the various series of topographic maps produced and distributed by the USGS and to assist users in selecting and purchasing maps. Printed on a State base map, each State index identifies quadrangle areas and other format maps by reference code, map name, and scale. This new single-sheet index is a combination of two older products, a booklet-style index and a supplemental sheet that was inserted in the booklet.

A companion publication to a State index, a State catalog lists alphabetically, by map type and scale, the names, dates, and prices of all available maps. These lists include published topographic maps, orthophoto maps, State maps, county maps, national park and monument maps, vicinity maps, satellite image maps, U.S. maps, and some world maps. The catalog also lists unpublished products available from any Earth Science Information Center (ESIC), including diazo-print orthophotoquadrangles and land use and land cover map products. In addition, the catalog includes a list of Federal depository libraries and commercial map dealers located in the State.

State catalogs are being replaced by State map lists, which contain alphabetically, by map type and scale, the stock numbers, names, product codes, and dates of all available maps. State map lists are updated and reissued periodically.

Geologic Map Index of [State]—This computer-generated index shows the location and scale of geologic maps published by Federal, State, and private organizations, along with a list identifying these maps and their producing agencies. This index is updated and reissued periodically.

United States Indexes

The United States Index Program is now updating some indexes through digital cartographic technology.

Status of Topographic Mapping—This index shows, by color coding, published topographic maps and maps in progress by the USGS and other Federal agencies in the 7.5-minute and Alaska 15-minute series. It is updated and reissued annually.

Index to Orthophotoquadrangle Mapping—This index identifies the status of orthophotoquadrangles available as diazo prints from ESIC offices and planned orthophotoquadrangle coverage. It is updated and reissued annually.

Index to National High Altitude Photography (NHAP I)—From 1980 to 1988, the USGS acquired high-altitude aerial photographs covering the conterminous United States during the leaf-off season for the NHAP I program. One side of this index is a U.S. base map depicting areas for which NHAP I color-infrared photographs at 1:58,000 scale are available; State and county boundaries are brown and 1:250,000-scale quadrangle outlines are black. The reverse side depicts (on a similar U.S. base map) areas for which NHAP I black-and-white photographs at 1:80,000 scale are available. Both sides are color coded by the year that the photographs were collected. This index is reissued when the stock is depleted.

Index to National High Altitude Photography (NHAP II) Leaf-on Photography—From 1985 to 1989, the USGS acquired high-altitude aerial photographs covering select areas of the conterminous United States during the leaf-on season for the NHAP II program. One side shows a U.S. base map depicting areas for which NHAP II color-infrared photographs at 1:58,000 scale are available; State and county boundaries are brown and 1:250,000-scale quadrangle outlines are black. The reverse side depicts (on a similar base map) areas for which NHAP II black-and-white photographs at 1:80,000 scale are available. Both sides are color coded by the year that the photographs were collected. This index is reissued when the stock is depleted.

Index to National Aerial Photography Program (NAPP I-II-III)—Since 1987, the USGS has been acquiring 1:40,000-scale medium-altitude aerial photographs covering the conterminous United States; this was done first on a 5-year cycle (NAPP I and II) and later on a 7-year cycle (NAPP III). There are three separate index maps, which depict the status of aerial photographic coverage for NAPP Cycle I (contracted from 1987 to 1991), Cycle II (contracted from 1992 to 1996), and for Cycle III (contracted from 1997 to the present). One side of the index base map shows the location of color-infrared photographs; the reverse side shows the location of black-and-white photographs. The base for both sides is a U.S. map that shows State and county names and boundaries in brown. Both sides are color coded to depict the year of the photographs. These indexes are updated semiannually.

Index to USGS/DMA 1:50,000-Scale, 15-Minute Mapping—Under a cooperative program between the USGS and the National Imagery and Mapping Agency (NIMA), the USGS prepares and distributes 1:50,000-scale topographic maps to meet DMA'S domestic area requirements. This index identifies published USGS and DMA topographic quadrangle maps at the above scale and also quadrangles for which work is in progress; published maps are listed on the reverse side. (Complete U.S. coverage is not planned.) This index is updated and reissued annually.

Index to Intermediate-Scale Mapping and 1:100,000-Scale Quadrangle Mapping, and Index to 1:50,000- and 1:100,000-Scale County Maps—Published USGS topographic and planimetric maps and Bureau of Land Management (BLM) Surface Management and Surface Minerals Management maps at 1:100,000-scale are color coded on this index. The status of work in progress and the availability of advance materials for both topographic and planimetric USGS quadrangle maps are also indicated. The index on the reverse side shows published maps and the status of work in progress for topographic or planimetric county maps at scales of 1:50,000 or 1:100,000. This map index is updated and reissued semiannually.

Index to Land Use and Land Cover Information—This index shows the availability of land use and land cover published maps and associated information in the form of overlays, at scales of 1:250,000 or 1:100,000. The reverse side provides information on data available in digital format, such as land use and land cover, political units, hydrologic units, census county subdivisions, Federal land ownership, and State land ownership. This index is updated and reissued periodically.

Index to Small-Scale Maps of the United States—This index shows 1:500,000-scale State map series depicting base map topographic or shaded-relief map information, 1:250,000-scale quadrangles, including topographic bathymetric and ecological inventory editions, and 1:2,000,000-scale sectional maps. U.S. base maps are listed and described. This index is updated and reissued periodically.

Index to USGS Topographic Map Coverage of the National Park System—This index, on a shaded-relief base map, shows the locations of national parks, preserves, monuments, recreational areas, seashores, and other reservations in the national park system. The reverse side lists published USGS national park system maps alphabetically by State, along with standard USGS topographic maps that include these park areas within their borders. This index is updated and reissued periodically.

Index to Digital Line Graphs (DLG) From 1:24,000-Scale Maps and Digital Elevation Model (DEM) Data—The index shows the availability of DLG or DEM cartographic data and data categories in progress in 7.5-minute formats. One side shows six categories: public land survey system, hydrography, boundaries, hypsography, transportation, and DLG cartographic feature files from Forest Service digital data. The other side shows five categories: digital elevation models, cultural features, vegetative surface cover, survey control and markers, and nonvegetative features.

Index to 1:12,000-Scale Digital Orthophoto Quadrangles (DOQ) Data—The front of the index shows the availability of black-and-white and color DOQ's, along with 1:12,000-scale DOQ's that are in progress. The back of the index shows county data on CD-ROM; these data are compressed approximately 10 to 1. The index is color coded to show the different images (color infrared and black and white) available.

Index to 1:25,000-Scale United States-Mexico Border Color Image Maps—This index, produced in cooperation with the U.S. Customs Service, shows the locations of 203 simulated natural color image maps of the United States-Mexico border, depicted on two strip maps of the southern borders of California, Arizona, New Mexico, and Texas. The maps show the international boundary, State and county boundaries of the United States, and names of major cultural and physical features. The map locations are color coded to show the years of the photographs. This index is reissued when the stock is depleted.

Antarctica Index

Index to United States Topographic and other Map Coverage of Antarctica—This index shows published maps, as well as open-file, topographic, reconnaissance, and satellite image maps at various scales. Geologic maps are also depicted. The index is updated and reissued periodically.

Ordering Information

To obtain these free USGS map indexes by mail, contact:

USGS Information Services
Box 25286
Denver, CO 80225

For information on other USGS products and services, call 1-800-USA-MAPS, or receive information from the EARTHFAX fax-on-demand system, which is available 24 hours a day at 703-648-4888.

Please visit the USGS home page at <URL: http://www.usgs.gov/>.

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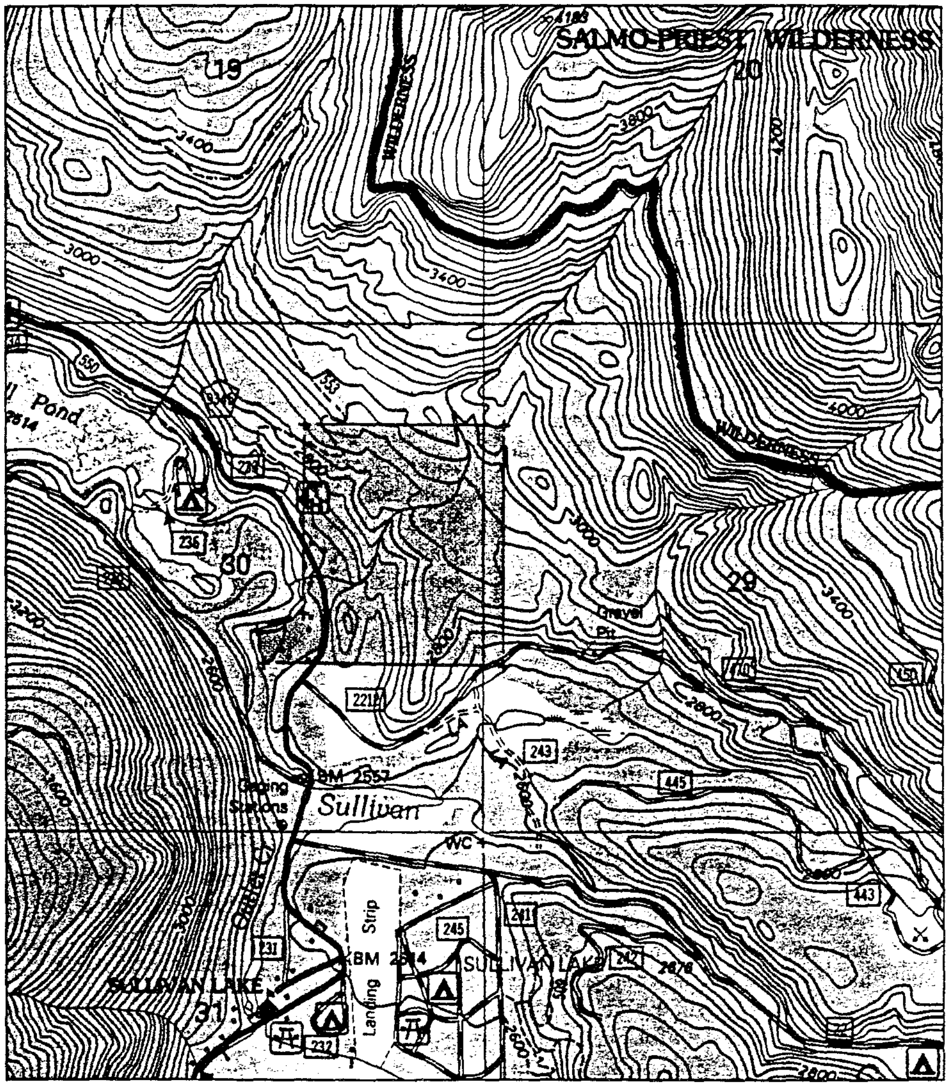
Single-Edition Quadrangle Maps

Introduction

In August 1993, the U.S. Geological Survey's (USGS) National Mapping Division and the U.S. Department of Agriculture's Forest Service signed an Interagency Agreement to begin a single-edition joint mapping program. This agreement established the coordination for producing and maintaining single-edition primary series topographic maps for quadrangles containing National Forest System lands. The joint mapping program saves money by eliminating duplication of effort by the agencies and results in a more frequent revision cycle for quadrangles containing national forests. Maps are revised on the basis of jointly developed standards and contain normal features mapped by the USGS, as well as additional features required for efficient management of National Forest System lands. Single-edition maps look slightly different but meet the content, accuracy, and quality criteria of other USGS products.

The Forest Service is responsible for the land management of more than 191 million acres of land throughout the continental United States, Alaska, and Puerto Rico, including 155 national forests and 20 national grasslands. These areas make up the National Forest System lands and comprise more than 10,600 of the 56,000 primary series 7.5-minute quadrangle maps (15-minute in Alaska) covering the United States. The Forest Service has assumed responsibility for maintaining these maps, and the USGS remains responsible for printing and distributing them.

Before the agreement, both agencies published similar maps of the same areas. The maps were used for different purposes, but had comparable types of features that were revised at different times. Now, the two products have been combined into one so that the revision cycle is stabilized and only one agency revises the maps, thus increasing the number of current maps available for National Forest System lands. This agreement has improved service to the public by requiring that the agencies share the same maps and that the maps meet a common standard, as well as by significantly reducing duplication of effort.



A part of the Metaline Falls, Wash., single-edition quadrangle.

Are Single-Edition Maps Different?

'Yes' and 'No.' Single-edition maps are different in some ways when compared with the standard quadrangle map, but they are the same in most other ways because single-edition maps are produced with the same set of standards. Nevertheless, the differences are actually beneficial for map users because single-edition maps provide more information than standard maps. Standard maps also have been improved by the incorporation of international symbols for recreational features, such as campgrounds and picnic areas, and the enhancement of Federal land boundaries.

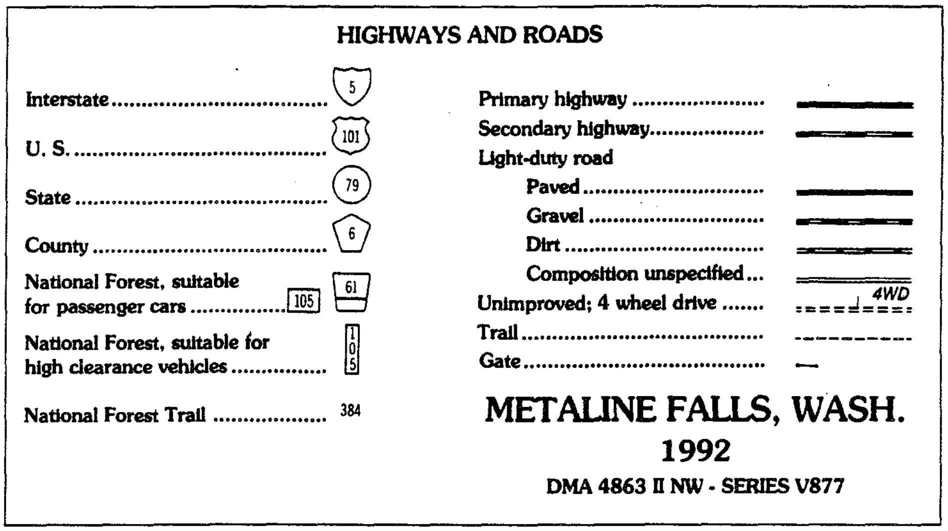
Single-edition maps are different because they have about 25 additional features. Several features needed by the Forest Service to manage our national forests efficiently have been combined with features traditionally shown on USGS general-purpose topographic maps. For example, the surface construction of light-duty roads is further defined as paved, gravel, dirt, or unspecified. Symbols for forest routes provide information on whether or not a road is passable by high-clearance or low-clearance vehicles. Single-edition maps show additional forest administrative and land status boundaries, as well as protracted and surveyed township and range information of the Public Land Survey System. Private property inside the national forest boundary is portrayed with a light-gray tint. The maps are still projected on the NAD27 datum. Lastly, these maps show Forest Service campground names, indicate trailheads, and use a few cartographic enhancements of other symbols and margin information to emphasize some of the multiple public uses of the Forest System lands.

Single-edition maps are the same as traditional quadrangle maps in that they retain the same 7.5-minute, 1:24,000-scale format, contours, and other conventional features and symbols. The standards for revising all quadrangle maps were developed jointly by the USGS and the Forest Service. The quality in terms of content, names, and labels is the same. The positional accuracy of well-defined features shown on the existing map is maintained during revision. Therefore, maps having the National Map Accuracy statement should continue to meet accuracy standards.

Single-Edition Map Revision

In a perfect world, all features on all quadrangle maps would be revised at the same time, giving a true and complete snapshot of the ground on the date of map publication. Unfortunately for map users, this is not economically possible; thus, for all quadrangle maps we have defined two kinds of revision: basic and complete. For basic revision, only certain features that can be positively identified from imagery (for example, aerial photographs, digital orthophotos, satellite images, and so on) are revised. Map content is revised by adding new features, modifying features that change, and deleting features that no longer exist. Generally, there is no field checking and the contours are left as they were originally drawn. The positional accuracy of features on the previous edition of the map is maintained.

For complete revision, all feature content is revised, there is field verification, and the contours are updated. The positional



The expanded "Highways and Roads" legend for single-edition maps.

accuracy of each feature is improved as necessary.

Revision of single-edition maps, like that of most standard USGS maps, usually follows basic revision guidelines, with some notable exceptions. The Forest Service does some field checking, especially for areas within the national forest boundaries. On quadrangles having both Forest System lands and non-Forest System lands, the revision is not exhaustive; that is, features inside the national forest boundary are comprehensively revised, but only certain features may be revised outside the boundary. The kinds of features that may be revised outside of Forest System lands are those that provide access to public land, those that continue from one map to the next, or those features that are large in area and highly visible. Examples include four-lane highways, large reservoirs, high-voltage powerlines, public access roads, and the Public Land Survey System.

Availability

Standard USGS 7.5-minute maps (15-minute in Alaska) cover the entire United States and its possessions. The USGS and the Forest Service are in the process of converting the maps covering National Forest System lands to single-edition versions. Currently, not all national forests have single-edition map coverage; however, complete coverage could be realized near the year 2010.

Single-edition maps, as with standard USGS quadrangle maps, are available from map dealers, USGS Earth Science Information Centers, and National Forest Visitor Centers, or by ordering through the Internet.

For more information about the single-edition program contact:

U.S. Geological Survey
Attention: RMMC Standards Team
Box 25046, Mail Stop 509
Denver Federal Center
Denver, CO 80225
Telephone: 303-202-4200
E-mail: RMMC-Standards@usgs.gov
Fax: 303-202-4188

USDA Forest Service
Geometronics Service Center
2222 West 2300 South
Salt Lake City, UT 84119-2083
Telephone: 801-975-3473
Fax: 801-975-3478

or

USDA Forest Service
Engineering Staff Unit
201 14th Street SW.
Washington, D.C. 20250
Telephone: 202-205-0926
Fax: 202-205-0861

Ordering paper maps from the Internet
http://edcwww.cr.usgs.gov/webglis.

For information on these and other USGS products and services, call 1-800-USA-MAPS, use the EARTHFAX fax-on-demand system, which is available 24 hours a day at 703-648-4888, or visit the general interest publications website at http://mapping.usgs.gov/www/products/mappubs.html.

Please visit the USGS home page at http://www.usgs.gov/.

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Revision of Primary Series Maps

In 1992, the U.S. Geological Survey (USGS) completed a 50-year effort to provide primary series map coverage of the United States. Many of these maps now need to be updated to reflect the construction of new roads and highways and other changes that have taken place over time. The USGS has formulated a graphic revision plan to help keep the primary series maps current.

Primary series maps include 1:20,000-scale quadrangles of Puerto Rico, 1:24,000- or 1:25,000-scale quadrangles of the conterminous United States, Hawaii, and U.S. Territories, and 1:63,360-scale quadrangles of Alaska.

The revision of primary series maps from new collection sources is accomplished using a variety of processes. The raster revision process combines the scanned content of paper maps with raster updating technologies. The vector revision process involves the automated plotting of updated vector files. Traditional processes use analog stereoplotters and manual scribing instruments on specially coated map separates. The ability to select from or combine these processes increases the efficiency of the National Mapping Division map revision program.

Categories of Revision

There are two categories of map revision: complete revision and basic revision.

In the complete revision process, all features are corrected and updated. Content is validated by field checking against ground truth. Contours are revised. The revised map meets all current National Mapping Division standards for feature content and National Map Accuracy Standards for positional accuracy.

In the basic revision process, many features are revised through interpretation of image sources, such as orthophotos or aerial photographs. The features are not verified through ground truth, and contours are generally not revised. The revised map maintains the positional accuracy of the previously published map. Most resources are focused on basic revision because this method is less expensive and more maps can be revised in a given period of time.

Map Characteristics

Map Scale

Map revision generally results in the production of maps at the same scale as the original map.

Contour Interval

Map revision generally results in the production of maps at the same contour interval as the original map.

Projection

Most revised maps are cast on the Universal Transverse Mercator projection. However, those revised by the U.S. Department of Agriculture Forest Service are cast on the appropriate State plane projection.

Horizontal Datum

Most revised maps are converted to the North American Datum of 1983 (NAD 83). However, maps revised by the Forest Service are currently left on the North American Datum of 1927. Maps of Hawaii, Puerto Rico, American Samoa, Guam, and the Alaskan Islands of St. Lawrence, St. Paul, and St. George are converted from their own horizontal datums to NAD 83.

Vertical Datum

Revised maps are left on the vertical datum used for the most recently published map. In most cases, this is the National Geodetic Vertical Datum of 1929.

Reference Systems

On most revised maps, the Universal Transverse Mercator (UTM) system is shown as a full line grid. However, on maps revised by the Forest Service, only UTM grid ticks are shown.

The State Plane Coordinate System for the appropriate horizontal datum is shown as grid ticks on all revised maps.

Symbology

The symbology of new features on the revised map matches the symbol set used on the previous version of the map as closely as is economically possible. An entire group of features may be revised using a different symbol set for economic reasons.

During basic revision, existing purple symbols are converted to standard color symbols.

Names

During complete revision, feature names and labels are verified through field work and information obtained from local sources, including the public. All names are compared to approved Geographic Names Information System (GNIS) sources.

During basic revision, names shown on the original map are retained if the features to which they apply are retained. Previously published names and labels are validated from information received since the publication of the original map. This information is provided by other agencies, as well as by map users and the public. Generally, the only new names and labels that are added are those identified with updated boundary information. However, other new names that are submitted may be added if supported by GNIS sources. All new or changed names are checked against approved GNIS sources.

Feature Content-Complete Revision

During complete revision, all map content, including contouring, is revised and field verified.

Feature Content-Basic Revision

Feature types that can be reliably identified on imagery or ancillary sources are revised during basic revision. However, individual instances of these types of features may not be revised because they may not be identifiable on the specific image or source used.

Feature types that cannot be reliably identified on imagery or ancillary sources are retained unless it is obvious that they no longer exist. If it is obvious that they no longer exist, they are deleted. The continued portrayal of retained features on the revised map does not necessarily mean that they still exist.

The following guidelines pertain to specific feature categories in basic revision:

Hydrography

New bodies of water are added. Previously mapped water bodies are modified if there is obvious evidence of change. Streams or small ditches are not added or modified unless there is obvious evidence of change.

Characteristics describing streams as perennial or intermittent are not revised unless the information has been verified on the ground.

Transportation

Aircraft facilities, bridges, highways, roads, trails, and so on are revised where there is obvious evidence of change.

Boundaries

Boundaries are revised using ancillary sources.

Public Land Survey System (PLSS)

The PLSS is not revised unless there is a memorandum of understanding with another mapping agency. The PLSS information may be added where the existing map had no previous survey and if the new survey information is available from the Bureau of Land Management's Geographic Coordinate Data Base.

Built-Up

Previously mapped houses of worship, schools, building labels, landmark buildings in built-up areas, and fence lines are retained unless it is obvious that they no longer exist. New houses of worship, schools, and labels on landmark buildings are not added unless the information is provided by a cooperator or member of the Earth Science Corps in the Volunteer for Science Program. The currentness of the houses of worship, schools, and other landmark building information is reflected with a note in the map collar.

Hypsography

Contours are generally not revised during basic revision unless requested by a cooperator.

Nonvegetative Surface Cover

Barren land, beaches, dunes, and moraines are revised if there is evidence of obvious change.

Vegetative Surface Cover

Vegetative surface cover is evaluated on an individual map basis to determine if it requires revision. If revision is required, the orchards, vineyards, and various types of woodland are revised where there is evidence of obvious change.

Named Landforms

Names of prominent islands, ridges, valleys, and so on may be added if reliable information is available. All new landform names are checked against approved GNIS sources.

Information

For more information about revised primary series maps, contact:

U.S. Geological Survey
Attn: Revised Primary Series Maps
1400 Independence Road
Mail Stop 231
Rolla, MO 65401
Telephone: 573-308-3500
Fax: 573-308-3615
E-mail: mcmcesic@usgs.gov

For information on National Mapping Program standards, visit the Web site mapping.usgs.gov/standards.

For information on other USGS products and services, call 1-888-ASK-USGS, use the Ask.USGS fax service, which is available 24 hours a day at 703-648-4888, or visit the general interest publications Web site on mapping, geography, and related topics at mapping.usgs.gov/mac/isb/pubs/pubslists/index.html.

Please visit the USGS home page at www.usgs.gov/.

USGS Topographic Map Revision

The papers on this page were originally prepared for mapping and geographic information system conferences. (May, 2000)

The U.S. Geological Survey's Revision Program for 7.5 Minute Topographic Maps.

The 1:24,000-scale, 7.5-minute topographic quadrangle is the primary product of the U.S. Geological Survey's (USGS) National Mapping Program. This map series includes about 53,000 map sheets for the conterminous United States and is the only uniform map series that covers this area at such a large scale. The 7.5-minute mapping program lasted almost 50 years, from the mid-1940's until the early 1990's, and consisted of new mapping. New aerial photographs were taken, field control was obtained, and field-based photo interpretation was done for every quadrangle. Feature names were verified by personal contacts with local residents and local government agencies.

Various processes are used to revise these maps. Some revisions use traditional analog processes, some use digital processes; some work is done by USGS employees, some by contractors. There are **four main categories of map revision**: *minor*, *basic*, *complete*, and *single edition*. ***Minor revision*** is done on maps that have few changes since the last revision; it includes boundary updates and corrections of previously reported errors. ***Basic revision*** updates features from digital orthophoto quadrangles (DOQ) and aerial photographs. Contour update is an optional part of basic revision and is not often done because of the high cost. ***Complete revision*** of all layers is seldom performed because of the high cost. ***Single-edition revisions*** are done by the U.S. Department of Agriculture Forest Service using procedures similar to basic revision. The current revision program was not designed to do replacement mapping. Most map revision is done from remote and secondary data sources, including the following:

- Geometry is controlled and some feature content interpreted from DOQ's.
- Most feature content is interpreted by using stereophotographs from the National Aerial Photography Program.
- Boundary and name information is collected from Federal databases, other maps, and State and local agencies.
- Some content may be field checked by Earth Science Corps volunteers (private citizens who donate time to do field verification work) or by State agencies participating in cooperative mapping projects.

URL: *http://mcmcweb.er.usgs.gov/topomaps/revision.html*

U.S. Department of the Interior
U.S. Geological Survey
Earth Science Information Center (ESIC)

Factsheet

Orthophoto Products

The U.S. Geological Survey has introduced a series of maps that can be produced quickly, economically, and accurately.

Orthophotos are images that are produced from aerial photographs. Positional errors, caused by camera angle or the displacement of terrain features because of elevation, are removed. These distortion-free images are formatted into orthophoto products in either black-and-white or natural color versions.

Orthophotomaps

Orthophotomaps are published topographic maps, at scales of 1:24,000 or 1:25,000, prepared by superimposing the names, symbols, patterns, and topographic features of standard 7.5-minute maps on natural color orthophoto bases. These maps are principally prepared to show subtle topographic and vegetative details in areas of low relief, such as coastal marshes and flats, with the topography represented by spot elevations and one or two contour lines. Orthophoto-map coverage is mainly along the Gulf and Atlantic coasts, from Texas to Maryland, and some flat areas in scattered States.

Orthophotoquads

Orthophotoquads are orthophotos that are produced in standard quandrangle formats with no contours and only a few location names and symbols. They were initially produced as preliminary 7.5-minute quadrangles. Because they show a wealth of planimetric details and land use and land cover information that is not shown on conventional line maps, they make excellent supplements to the published maps.

Orthophotoquads have also been produced for other Federal agencies, who use them as base maps for thematic data, such as land use classifications.

A limited number of natural color orthophotoquads, mainly of the east coast of the United States, are available as published maps. Published orthophotoquads include a series of 203 natural color maps that bracket the United States-Mexico border and the 24 Port-of-Entry natural color maps along the United States-Canada border from Massena, New York, to Norton Pond, Vermont. Some black-and-white orthophotoquads published in the 1970's are also available.

Accuracy

Orthophotoquads and orthophotomaps are prepared to meet National Map Accuracy Standards. Various accuracy tests performed verified that 90 percent of the well-defined points were within 40 feet of their true position—the horizontal accuracy standard for 1:24,000-scale maps.

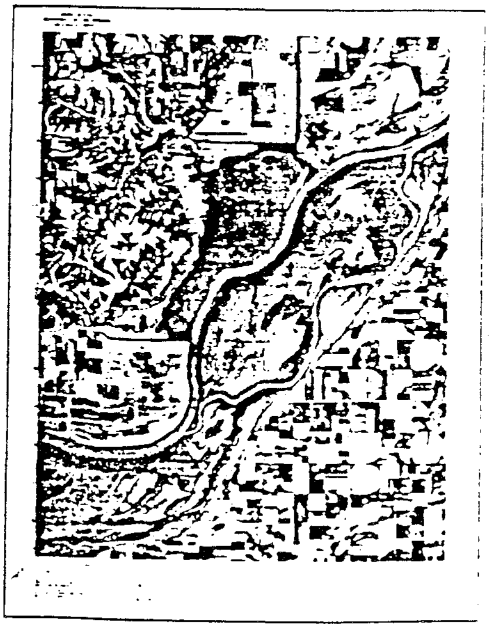
Availability

Published and unpublished orthophotoquads and published orthophotomaps are identified by name and symbol in the "Catalog of Topographic and Other Published Maps," published for each State. United States-Mexico and United States-Canada border maps are listed separately in these catalogs for States that include these borders. Additional sources of information are the "Index to Orthophotoquad Mapping," published annually, which updates information on State catalogs pending revision, and the "Index to 1:25,000-Scale United States-Mexico Border Color Image Maps."

Advance black-and-white copies of orthophotoquads are available at scales of 1:12,000, 1:24,000, and 1:25,000 for the conterminous 48 States and Hawaii and 1:63,360 scale for Alaska. These advance copies are produced from master negative or positive transparencies on diazo or photographic paper or as film negatives or positive copies.

Features:

1 color (black)
Size 22 x 27" (1:24,000 scale)
18 x 22"(1:63,360 scale, Alaska)
Universal Transverse Mercator projection
Names of selected towns and cities
Names of major streams and rivers
Marginal information such as Universal Transverse Mercator grid, scale, quad name, and survey date



Orthophotoquad

Orthophotoquads are black-and-white distortion-free photographic image maps. They are produced in standard 7.5-minute quadrangle format from aerial photography but have no contours and only minimal cartographic treatment (names, symbols, etc.)

Digital Orthophoto Quadrangles

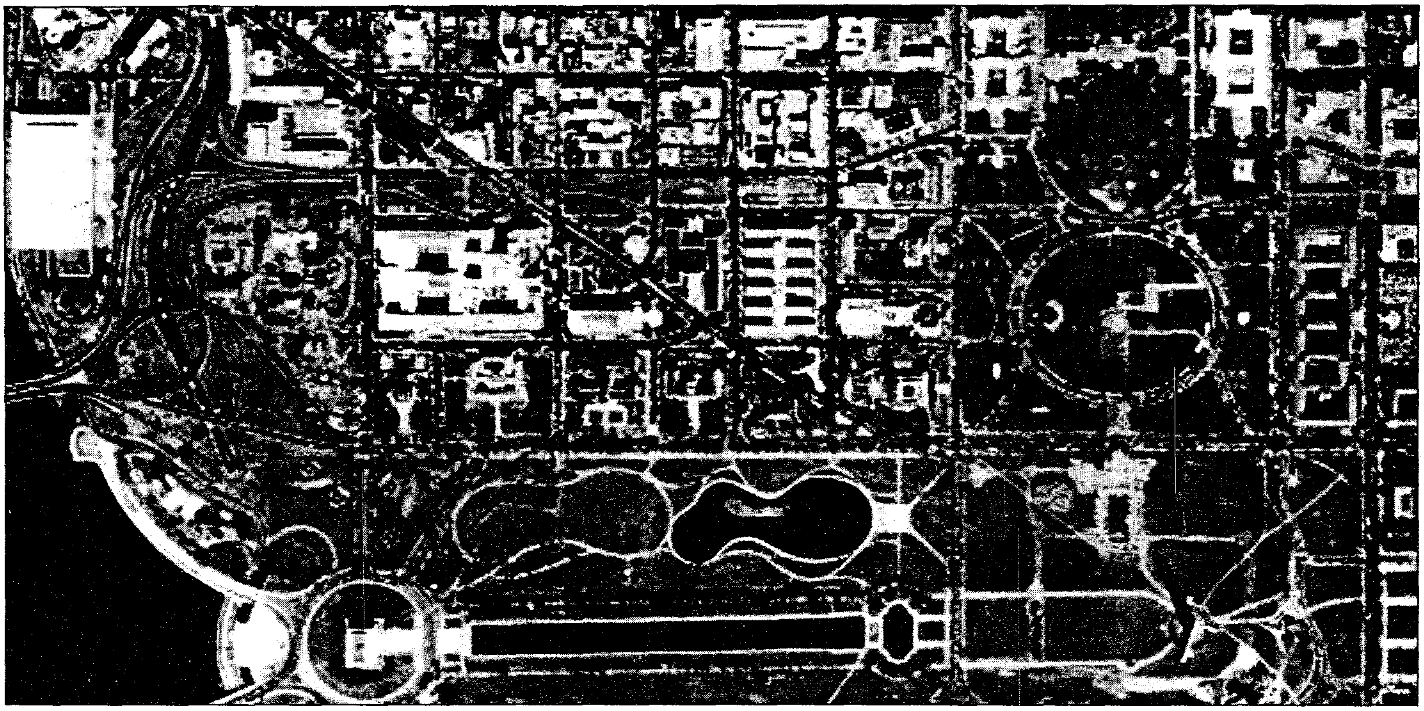


Image from part of a digital orthophoto quadrangle of Washington, D.C.

A digital orthophoto quadrangle (DOQ) is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map.

Characteristics of a USGS Digital Orthophoto Quadrangle

The standard DOQ's produced by the U.S. Geological Survey (USGS) are either gray-scale or color-infrared (CIR) images with a 1-meter ground resolution; they cover an area measuring 3.75-minutes longitude by 3.75-minutes latitude, or approximately 5 miles on each side. Each DOQ has between 50 and 300 meters of overedge image beyond the latitude and longitude corner crosses embedded in the image. This overedge facilitates tonal matching and mosaicking adjacent images.

The standard DOQ is formatted with an ASCII keyword header followed by a series of 8-bit binary image lines. CIR DOQ's are 24-bit band-interleaved-by-pixel (BIP) images. The header contains a wide range of data for identifying, displaying, and georeferencing the image.

All DOQ's are referenced to the North American Datum of 1983 (NAD 83) and cast on the Universal Transverse Mercator (UTM) projection. Primary (NAD 83) and secondary (NAD 27) datum coordinates for the upper left pixel are included in the header so that users can spatially reference other digital data to the DOQ.

The file size of a gray-scale DOQ is 40-45 megabytes, and a color-infrared DOQ can be three times this size.

Producing a Digital Orthophoto Quadrangle

To produce a DOQ requires (1) a minimum of three ground positions that can be identified on the photograph to be rectified, (2) camera calibration parameters, such as the calibrated focal length and the coordinates of the camera fiducials, (3) a digital elevation model (DEM), and (4) a digital image produced by scanning an aerial photograph with a precise, high-resolution scanner.

The digital image is rectified to generate an orthophoto by processing requirements 1 through 3 above for each image picture element (pixel), using rigorous photogrammetric equations on a computer. The finished product is a spatially accurate image with planimetric features represented in their true geographic positions.

Accuracy Requirements

The accuracy and quality of USGS DOQ's must meet National Map Accuracy Standards at 1:12,000 scale for 3.75-minute quarter quadrangles and at 1:24,000 scale for 7.5-minute quadrangles. Accuracy and quality depend on the following:

- photographs that meet National Aerial Photography Program standards, which are quarter-quadrangle centered. The photographs are exposed at a flying height of 20,000 feet above mean terrain;

- a DEM with the same area coverage as the DOQ and that is equal to or better than a level 1 USGS DEM having a root-mean-square error in elevation no greater than 7 meters;

- a highly accurate image-scanning process that uses a scanning aperture between 7.5 and 32 micrometers (µm). A 1:40,000-scale image scanned with a 25-µm aperture produces a ground sample distance of approximately 1 meter; and

- identifiable ground control positions with coordinates acquired from ground surveys or aerotriangulation.

Uses for Digital Orthophoto Quadrangles

A DOQ can be incorporated into any geographic information system (GIS) that can manipulate raster images. It can function as a cartographic base for displaying, generating, and modifying associated digital planimetric data. Other applications include vegetation and timber management, routing and habitat analysis, environmental impact assessments, emergency evacuation planning, flood analysis, soil erosion assessment, facility management, and ground-water and watershed analysis. The accuracy and extraordinary detail provided by the DOQ allow users to evaluate their data for accuracy and completeness, make real-time modifications to their data, and even generate new files.

Distribution Media

DOQ's are distributed in either native (standard) or GeoTIFF format on a variety of media, including 8-mm tape, CD-R, and FTP as uncompressed files. DOQ's covering selected counties are also available packaged as individual, JPEG-compressed files. Note that the county DOQ products contain DOQ's built to the pre-1997 (old) standard and do not contain the keyword header.

Obtaining Digital Orthophoto Quadrangles

DOQ files are available from the USGS Sales Data Base and can be ordered online through the Global Land Information System (GLIS) at edcwww.cr.usgs.gov/webglis or by contacting any Earth Science Information Center (ESIC). DOQ coverage is not available for all areas in the United States.

Additional Information

More information about DOQ's can be found at edc.usgs.gov/Webglis/glisbin/guide.pl/glis/hyper/guide/usgs_doq.

For information on other USGS products and services, call 1-888-ASK-USGS, use the ASK.USGS fax service, which is available 24 hours a day at 703-648-4888, or visit the general interest publications Web site on mapping, geography, and related topics at mapping.usgs.gov/mac/isb/pubs/pubslists/index.html.

Please visit the USGS home page at www.usgs.gov.

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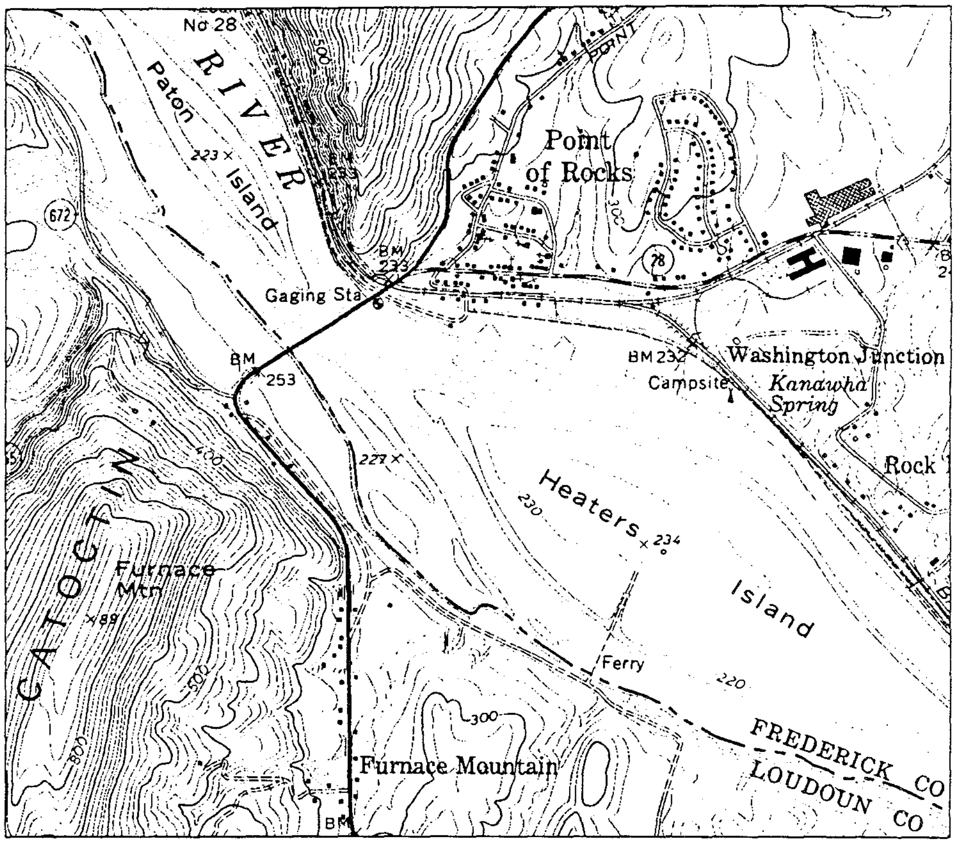
Geographic Names Information System

The Geographic Names Information System (GNIS), developed by the U.S. Geological Survey (USGS) in cooperation with the U.S. Board on Geographic Names, contains information about the proper names for places, features, and areas in the Nation. This information is available for the 50 States, the District of Columbia, and the territories and outlying areas of the United States, as well as for Antarctica. The GNIS consists of four separate data bases: the National Geographic Names Data Base (NGNDB), the Antarctica Geographic Names Data Base (AGNDB), the Geographic Cell Names Data Base (GCNDB - formerly the Topographic Map Names Data Base, TMNDB), and the Reference Data Base (RDB).



Section from a 7.5-minute topographic map of Point of Rocks, Md.-Va.

The NGNDB contains records on almost 2 million geographic names in the United States - from populated places, schools, reservoirs, and parks to streams, valleys, springs, ridges, and every feature type except roads and highways. Entries include information such as the federally recognized name for the feature; former names, as well as variant spellings of the official name; the status of the names as determined by the U.S. Board on Geographic Names; the county or counties in which each named feature is located; the geographic coordinates (in degrees, minutes, and seconds, as well as decimal degrees) that locate the approximate center of an areal feature or the mouth and source of a linear feature such as a stream; and the name(s) of the USGS cell(s) (topographic map(s)) on which the feature may appear. Elevation, extent, and historical information are available for some features. Abibliographic code referring to the source of information for feature names in the data base is also available. Data from the NGNDB are used in emergency preparedness, mapmaking, local and regional planning, service delivery routing, marketing, site selection, environmental analysis, and genealogical research, as well as in other applications. Data from the NGNDB can also be incorporated into other data bases.

Data for each State or territory are compiled in two phases. The first phase, which is complete for States and areas under U.S. jurisdiction, entailed the collection of most feature names printed on the 1:24,000-scale topographic maps published by the USGS and the U.S. Forest Service, as well as on the charts of the Office of Coast Survey. The second phase is a long-term project to gather additional names information from State and local materials and from a wide variety of historical documents. This project is being accomplished on a State-by-State basis.

The Antarctica Geographic Names Data Base (AGNDB) contains names approved by the United States Board on Geographic Names for features in Antarctica and the area extending northward to the Antarctic Convergence. Included in this geographic area are the off-lying South Shetland Islands, South Orkney Islands, South Sandwich Islands, South Georgia, Bouvetøya, Heard Island, and Balleny Islands. Much of the interior of Antarctica is a featureless ice plateau that is nearly devoid of toponyms. All of the names are for natural features, such as mountains, glaciers, peninsulas, capes, bays, islands, and subglacial entities. The names of scientific stations have not been included at this time, but they may appear in the texts of some entries.

The GCNDB contains the official name for each U.S. Geological Survey cell (map series). These map series are as follows:

- 7.5 x 7.5 minutes
- 15 x 15 minutes
- 30 minutes x 1 degree
- 7.5 x 15 minutes
- 30 x 30 minutes
- 2 degrees x 1 degree
- 1 degree x 2 degrees

The RDB is designed for use as a research and reference tool as well as being a repository of reference information for the GNIS. The information in the RDB contains the complete annotated bibliographies of all source material used in the compiling of the NGNDB.

Responses to special requests for GNIS digital reports are available on diskette and cartridge and through file transfer protocol (FTP). Standard State and territory digital gazetteers are also now available for downloading at the GNIS Web site by anonymous FTP. Standard digital reports are in ASCII character code and are fixed-field-length format with a record length of 240. The standard State and territory format includes feature name, feature type, county, primary geographic coordinates (center or mouth), source geographic coordinates (linear features), elevation (if available), and cell (topographic map) name. Special topical files are also available at this site and include Populated Places (a listing of all populated place records in the NGNDB for the United States), Concise (major features), and Historical (features that no longer exist).

GNIS on CD-ROM

The GNIS CD-ROM contains four data bases:

1. The National Geographic Names Data Base (NGNDB) contains almost 2 million entries for areas in and under the jurisdiction of the United States.

2. The Antarctica Geographic Names Data Base (AGNDB) contains names approved by the U.S. Board on Geographic Names for features in Antarctica and the area extending northward to the Antarctic Convergence.

3. The Geographic Cell Names Data Base contains current cell names and historical cell names, which are bases for most USGS topographic maps.

4. The Reference Data Base (RDB) is a collection of bibliographic codes and annotated bibliographies of all sources used in compiling information for the NGNDB.

Each record in the NGNDB, AGNDB, and GCNDB can contain various location and description fields. All can be displayed, and most can be searched. Not all fields, however, contain data. The RDB contains two fields, bibliography and bibliographic code.

The following fields in the NGNDB can be searched: State, feature name, feature type, county name, cell (topographic map) name, variant name, national forest name, geographic coordinates, source coordinates, elevation, bibliographic reference code, and population (for incorporated entities). The display-only fields are State/county Federal Information Processing Standards (FIPS) code, history, description, status, decision list, and record entry date. The following fields in the AGNDB can be searched: feature name, feature type, elevation (meters), geographic coordinates, variant name, and description (includes history and name origin). The following fields in the GCNDB can be searched: State, cell (topographic map) name, reference coordinate, map scale, map reference code, county name, and history. One field is for display only and represents the percentage of the map in the county. Data contained in this field, however, have not been verified and should be used with caution and only as a general reference.

The CD-ROM contains software for searching, sorting, displaying, printing, and exporting the data, as well as relevant help screens. The software must be installed onto a hard disk before the data can be used. The CD-ROM, accompanied by a users manual titled "GNIS Digital Gazetteer," can be purchased for $57, plus a $3.50 handling charge per order mailed.

Each CD-ROM requires an IBM PC-XT-AT or compatible microcomputer with 512 K of memory and a DOS operating system version 3.0 or greater, 20 Mb of available hard-drive space, and a CD-ROM reader with software drivers that read ISO-9660 formatted CD-ROM's.

Information

For more information on the GNIS or on individual State and territory data base file status, contact:

GNIS Manager
U.S. Geological Survey
523 National Center
Reston, VA 20192
Phone: 703-648-4544
Fax: 703-648-4165
E-mail: gnis_manager@usgs.gov

The address for the GNIS home page is http://mapping.usgs.gov/www/gnis/.

For ordering information for the GNIS CD-ROM and other GNIS products, contact any Earth Science Information Center (ESIC) or telephone 1-800-USA-MAPS.

For information on other USGS products and services, call 1-800-USA-MAPS, use the EARTHFAX fax-on-demand system, which is available 24 hours a day at 703-648-4888, or visit the general interest publications website at http://mapping.usgs.gov/www/products/mappubs.html.

Please visit the USGS home page at http://www.usgs.gov/.

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Historical Mapping

Historical Maps

Maps become out of date over time. Maps that are out of date, however, can be useful to historians, attorneys, environmentalists, genealogists, and others interested in researching the background of a particular area. Local historians can compare a series of maps of the same area compiled over a long period of time to learn how the area developed. A succession of such maps can provide a vivid picture of how a place changed over time.

Researching Historical Maps

Because different types of historical maps are stored in different collections, they can be difficult to research. However, with a little perseverance, you can find a map that will suit your needs. There are many sources to investigate, ranging from local libraries and historical societies, to State and Federal Government agencies.

The best place to begin research is at a local public or college library. As a first step, you may want to consider locating some of the following books, all of which are good sources of information for the maphunter:

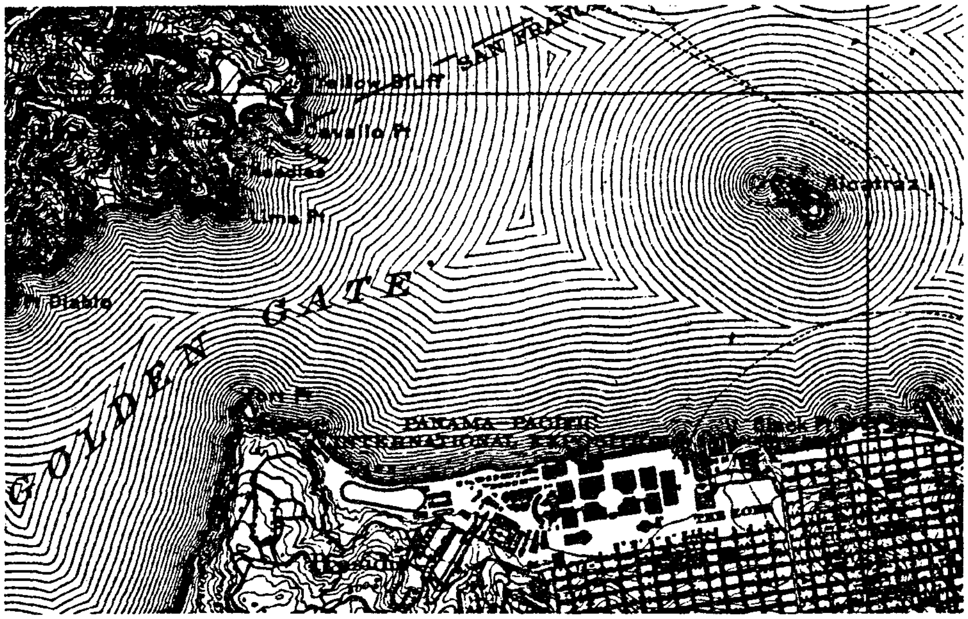
Map Collections in the United States and Canada: A Directory (compiled by David K. Carrington and Richard W. Stephenson)

Antique Map Reproductions: A Directory of Publishers & Distributors of Antique Map, Atlas & Globe Facsimilies & Reproductions (edited by Gregory C. McIntosh)

Guide to U.S. Map Resources (edited by David A. Cobb)

The National Archives

The National Archives and Records Administration (NARA), the official repository of the permanently valuable records made or accumulated by the U.S. Government, is responsible for preserving those records and making them available to the public, government officials, and scholars. Among the records in the Cartographic and Architectural Branch of the NARA, are more than 2 million maps produced by the Federal Government since 1774.



Section from a 1:62,000-scale map of San Francisco, Calif., June 1915 edition, reprinted in 1929.

NARA's holdings relate primarily to official functions of the Federal Government, and records are arranged by the Federal offices that created or accumulated them. Maps that predate the Federal Government and 19th-century maps of areas outside the United States are rare among the Cartographic and Architectural Branch holdings.

The following publications, which can be viewed online, may prove useful in conducting historical map research through NARA:

General Information Leaflet No. 26
Cartographic and Architectural Records
http://www.nara.gov/publications/leaflets/gil26.html

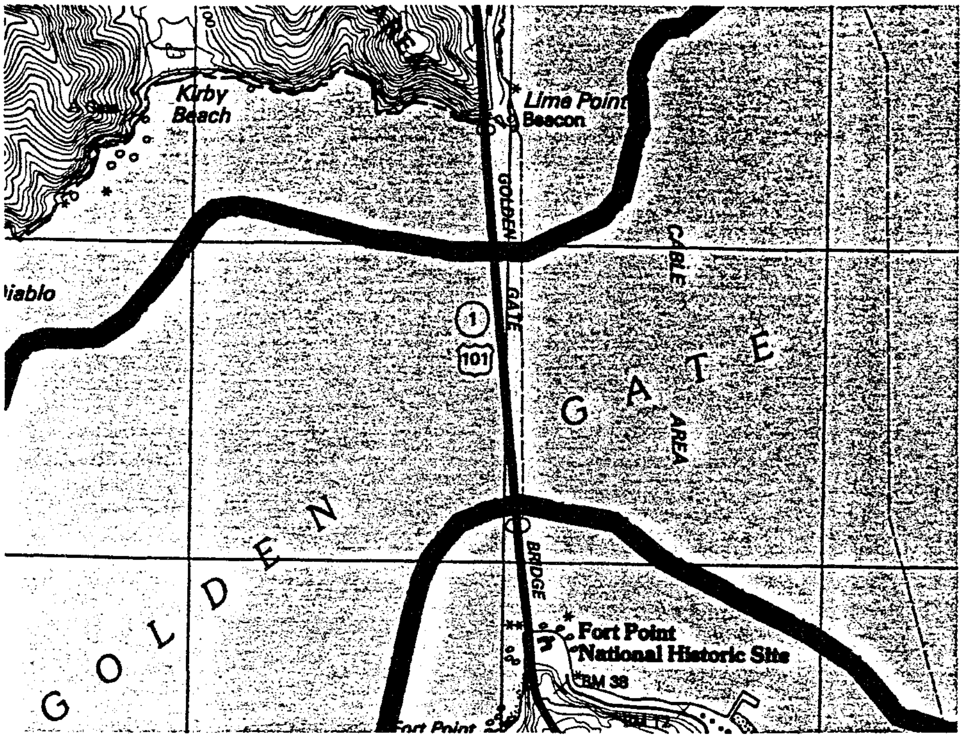
Special List No. 29
List of Selected Maps of States and Territories
http://www.nara.gov/publications/leaflets/sl29/sl29home.html

To request a search of the maps and charts, researchers need to provide NARA with with a subject, geographic area, and time period. Requests should be addressed to:

Cartographic and Architectural Branch
National Archives
8601 Adelphi Road
College Park, MD 20740-6001
Telephone: 301-713-7040

The Library of Congress

The Library of Congress serves as the research arm of Congress and is recognized as the national library of the United States. It is the world's largest library and a great resource to scholars and researchers.



Section from a 7.5-minute topographic map of San Francisco North, Calif., edited in 1996.

In the Geography and Map Division Reading Room of the Library of Congress, researchers can find the largest and most comprehensive cartographic collection in the world, including more than 4.5 million maps and 60,000 atlases, as well as a large number of cartographic materials in other formats.

The following publication, which can be viewed online, is useful for conducting historical map research through the Library of Congress:

Library of Congress Geography and Maps: An Illustrated Guide
http://lcweb.loc.gov/rr/geomap/guide

The Geography and Map Division will provide a reasonable amount of basic information about materials in its collection and will serve as the library of last resort for research questions when local resources have been exhausted. Requests should be directed to:

The Geography and Map Division
Library of Congress
James Madison Memorial Bldg.
101 Independence Ave., S.E.
Washington, DC 20540-4650
E-mail: maps@loc.gov
http://lcweb.loc.gov/rr/geogmap/

U.S. Geological Survey

The U.S. Geological Survey (USGS), established in 1879, has a large number of historical topographic maps dating back to 1879. Recognizing the value of the information contained in older maps, the USGS preserves out-of-print maps on microfilm. In this way, the USGS can limit its vast inventory to the most current maps and still provide copies of older maps.

These out-of-print maps are available for purchase as black-and-white photographic paper reproductions. Although more expensive, the precision of the photographic enlargement procedure results in higher quality prints than electrostatic paper reproductions. However, the sharpness of the reproduction depends on the condition of the original map. Also, because photographic paper is sensitive to light and will eventually fade, such reproductions should not be subjected to bright light for extended periods of time.

Ordering Instructions

If your are interested in obtaining a reproduction of a particular map from the USGS, you can send a research inquiry to:

ESIC-Reston
507 National Center
Reston, VA 20192
Telephone: 703-648-6045
Fax: 703-648-5548

Your letter of inquiry should give as much information as possible, including the State, county, and town or township; year of interest or range of years; as well as the type of information you are seeking on the map; for example, streams and rivers, railroad lines, roads, or cultural features. A researcher will then be able to determine if any maps in the USGS historical collections will suit your needs.

The reproductions are approximately 24 by 30 inches.

Refer to the **USGS Maps Price List** (stock number 76-0001) for the most recent prices.

Additional Information

For information on other USGS products and services, call 1-888-ASK-USGS, use the ASK.USGS fax service, which is available 24 hours a day at 703-648-4888, or visit the general interest publications Web site on mapping, geography, and related topics at http://mapping.usgs.gov/www/products/mappubs.html.

Please visit the USGS home page at http://www.usgs.gov/.

Appendix H

Aerial Photography Information

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How To Obtain Aerial Photographs

The U.S. Geological Survey (USGS) maintains an informational data base of aerial photographic coverage of the United States and its territories that dates back to the 1940's.

This information describes photographic projects from the USGS, other Federal, State, and local government agencies, and commercial firms.

In this part of the original 9 x 9 inch photograph, at a scale of 1:40,000, 1 inch on the photograph represents 3,333 feet on the ground. The original photograph is from NAPPW Roll 6860, Frame 59.

In this 2X (18 x 18 inch) enlargement of the same photograph, at a scale of 1:20,000, 1 inch on the photograph represents 1,666 feet on the ground.

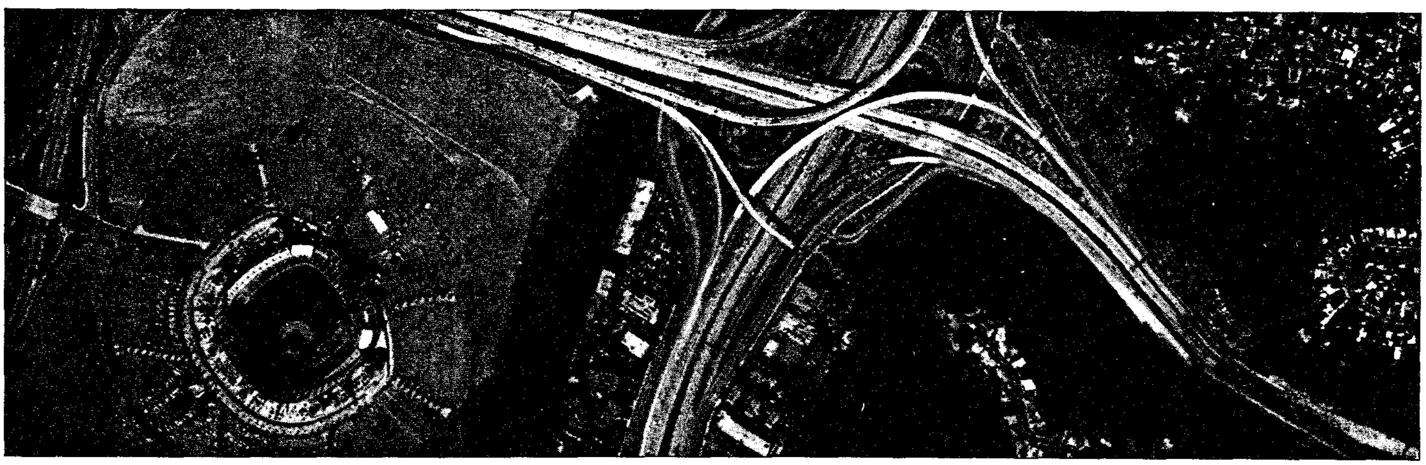
The pictures on this page show a part of a standard 9- by 9-inch photograph and the results obtained by enlarging the original photograph two and four times. Compare the size of the Qualcomm Stadium, Jack Murphy Field, in San Diego, Calif, and the adjacent parking lot and freeways shown at the different scales.

USGS Earth Science Information Center (ESIC) representatives will assist you in locating and ordering photographs. Please submit the completed checklist and a marked map showing your area of interest to any ESIC.

Information

For information on these and other USGS products and services, call 1-888-ASK-USGS, use the Ask-USGS fax-on-demand system, which is available 24 hours a day at 703-648-4888, or visit the general interest publications Web site on mapping, geography, and related topics at http://mapping.usgs.gov/www/products/mappubs.html.

Please visit the USGS home page at http://www.usgs.gov/.



In this 4X (36 x 36 inch) enlargement of the same photograph, at a scale of 1:10,000, 1 inch on the photograph represents 833 feet on the ground.

Checklist for Obtaining Aerial Photographs

1. If you know the project, roll, and frame number of the photographs you want, contact your nearest ESIC for ordering assistance.

2. If you do not know the precise aerial photograph you need, complete this form and return it with your ***marked map showing your area of interest,*** to any ESIC. A researcher will provide information about available photographs that match your requirements. Please include your daytime telephone number. If you have any questions, call 1-888-ASK-USGS.

Name (first, middle initial, last) _______ Date _______

Company or agency _______ Telephone number (day) _______

Address _______ FAX number _______

City, State, and ZIP code _______ E-mail address _______

Specific area to be shown (enclose a **detailed marked map**)

State: _______ County: _______ Town: _______

USGS quadrangle map name (if known): _______

Township, range, and section (if known): _______

Latitude and longitude (if known): _______

Specific feature (crossroads, neighborhood, or farm) you want to see: _______

Please describe your intended use (to assist the researcher):

Film type

- ☐ Black and white
- ☐ Color infrared
- ☐ Color (limited availability)
- ☐ No preference

Most aerial photographs on record were taken with black-and-white film. Color-infrared photographs are available for the entire country.

For detailed information about color infrared, refer to the publication "Understanding Color-Infrared Photographs" available free from any ESIC.

Date of photograph

- ☐ Most recent
- ☐ Oldest

Specific year or range of years: _______

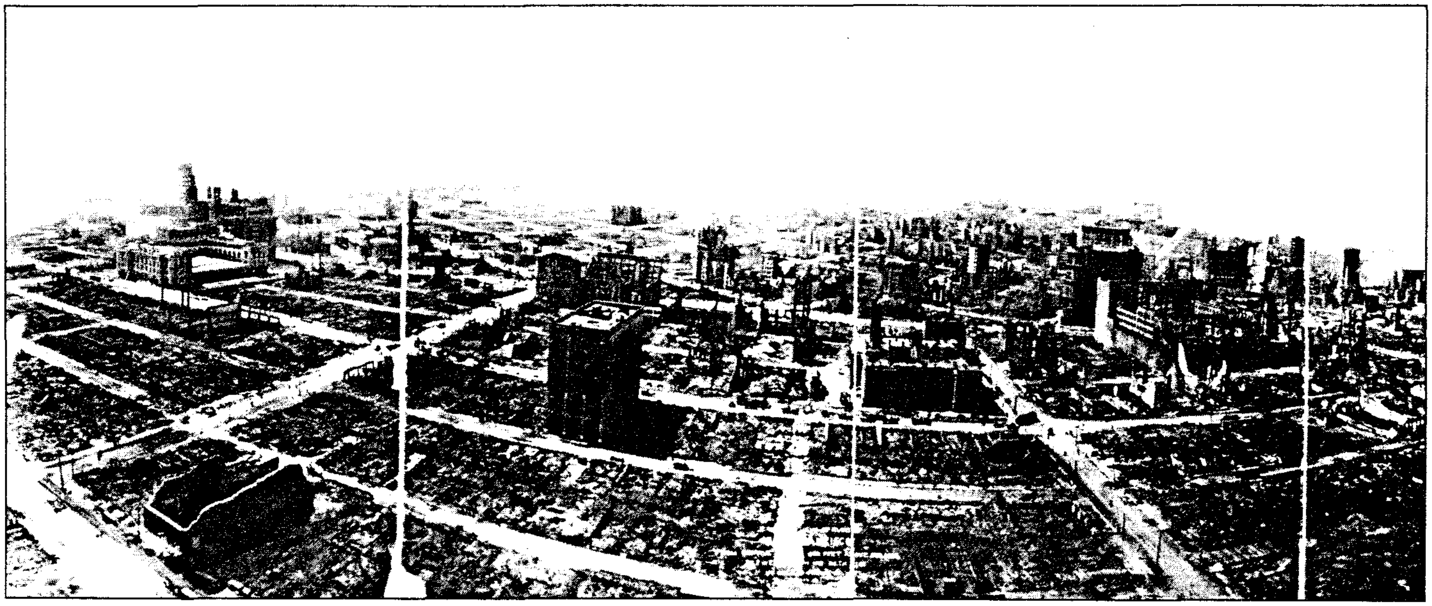
Season of year, if you have a preference: _______

Comments:

U.S. Department of the Interior
U.S. Geological Survey

Looking for an Old Aerial Photograph

Fact Sheet



San Francisco, California, May 5, 1906—Library of Congress

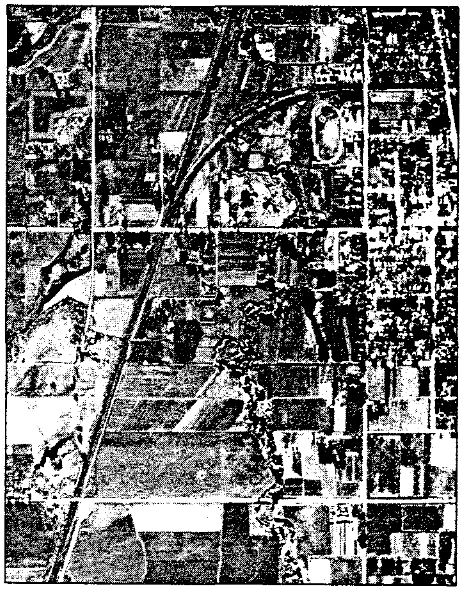
Attempts to photograph the surface of the Earth date from the 1800's, when photographers attached cameras to balloons, kites, and even pigeons. Today, aerial photographs and satellite images are commonplace.

The rate of acquiring aerial photographs and satellite images has increased rapidly in recent years. Views of the Earth obtained from aircraft or satellites have become valuable tools to Government resource planners and managers, land-use experts, environmentalists, engineers, scientists, and a wide variety of other users.

Many people want historical aerial photographs for business or personal reasons. They may want to locate the boundaries of an old farm or a piece of family property. Or they may want a photograph as a record of changes in their neighborhood, or as a gift.

The U.S. Geological Survey (USGS) maintains the Earth Science Information Centers (ESIC's) to sell aerial photographs, remotely sensed images from satellites, a wide array of digital geographic and cartographic data, as well as the Bureau's well-known maps. Declassified photographs from early spy satellites were recently added to the ESIC offerings of historical images. Using the Aerial Photography Summary Record System database, ESIC researchers can help customers find imagery in the collections of other Federal agencies and, in some cases, those of private companies that specialize in esoteric products.

Plattsburgh, New York, 1940—U.S. Geological Survey, aerial mapping photograph



Jefferson County, Colorado, 1937—National Archives, Cartographic and Architectural Branch, aerial mapping photograph

U.S. Geological Survey

At the EROS Data Center, near Sioux Falls, S. Dak., the USGS maintains the National Land Remote Sensing Data Archive, including, beside 49 million satellite images, some 8 million aerial photographs of the United States. Some of them date to the 1940's. More recent products are standardized under the National Aerial Photography Program in which the entire country has been photographed every five to seven years since 1980.

Products can be researched and ordered by contacting:

USGS EROS Data Center
Customer services
Sioux Falls, SD 57198

Phone: 605-594-6151
E-mail: custserv@edcmail.cr.usgs.gov

National Archives and Records Administration

Most aerial mapping photographs of the United States taken for Federal agencies before 1941 have been assembled at the Cartographic and Architectural Branch (CAB) of the National Archives. These photographs date from the mid-1930's and cover approximately 80 percent of the land area of the conterminous 48 United States. The CAB also maintains a collection of American military photographs of the United States from the 1940's-1960's and some German military photographs of Eastern Europe and Russia flown during World War II.

The Still Picture Branch (SPB) of the National Archives has a large collection of photographs taken from the air. These date from the early 20th century to the present. Both the CAB and the SPB maintain search rooms where visitors can search the files for the photographs they want. For mail inquiries, be specific in describing area locations and time eras. Also, include your name, address, and daytime telephone number in each inquiry. The National Archives office will return a research report and a price list for prints. The SPB will also send electrostatic copies of appropriate photographs.

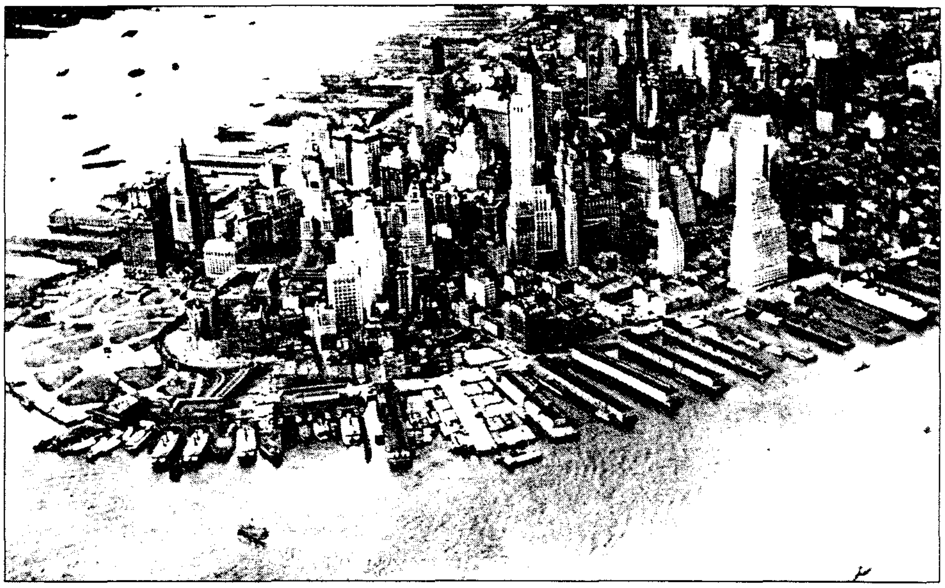
For information from the CAB and the SPB, contact:

National Archives and Records Administration
Cartographic and Architectural Branch (NNSC)
8601 Adelphi Rd.
College Park, MD 20740-6001
301-713-7040

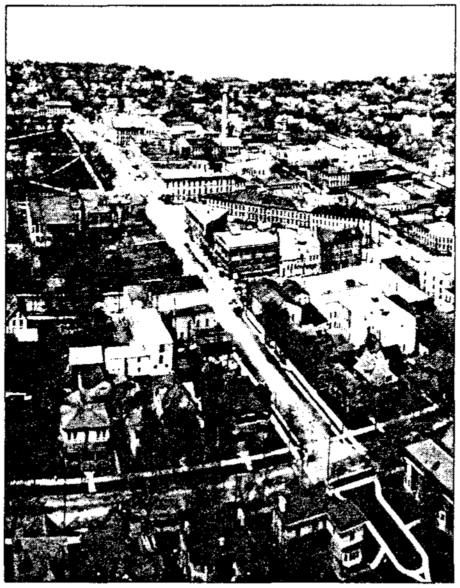
Library of Congress

The Library of Congress maintains a large collection of historical photographs, some of which are aerial photographs dating from 1900 to the 1940's. A few aerial photographs of the Connecticut countryside and Paris, France, taken from aerial balloons in the 1880's are also available, as is a series of panoramic views of U.S. cities taken between 1906-1908. The Library will perform a limited number of searches (less than 10) for a single mail inquiry, but visitors to Washington, D.C., are welcome to examine their research files. For more information contact:

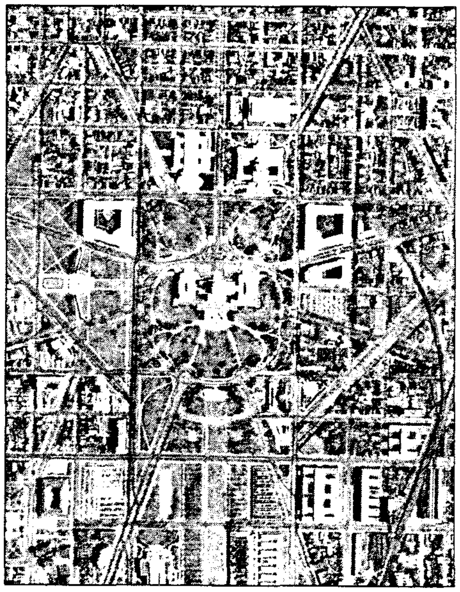
Library of Congress
Prints and Photographs Division
James Madison Memorial Building
101 Independence Avenue, S.E.
Washington, DC 20540-4840
202-707-6394



Lower Manhattan, New York, 1930's—National Archives, Still Picture Branch



Madison, Wisconsin, 1908—Library of Congress



Washington, D.C., 1949—U.S. Geological Survey, aerial mapping photograph

Information

For information on these and other USGS products and services, call 1-800-USA-MAPS, or receive information from the EARTHFAX fax-on-demand system, which is available 24 hours a day at 703-648-4888.

Please visit the USGS home page at <URL: http://www.usgs.gov/>

USGS
science for a changing world

Aerial Photography Summary Record System

Introduction

The Aerial Photography Summary Record System (APSRS) describes aerial photography projects that meet specified criteria over a given geographic area of the United States and its territories.

Aerial photographs are an important tool in cartography and a number of other professions. Land use planners, real estate developers, lawyers, environmental specialists, and many other professionals rely on detailed and timely aerial photographs.

Until 1975, there was no systematic approach to locate an aerial photograph, or series of photographs, quickly and easily. In that year, the U.S. Geological Survey (USGS) inaugurated the APSRS, which has become a standard reference for users of aerial photographs.

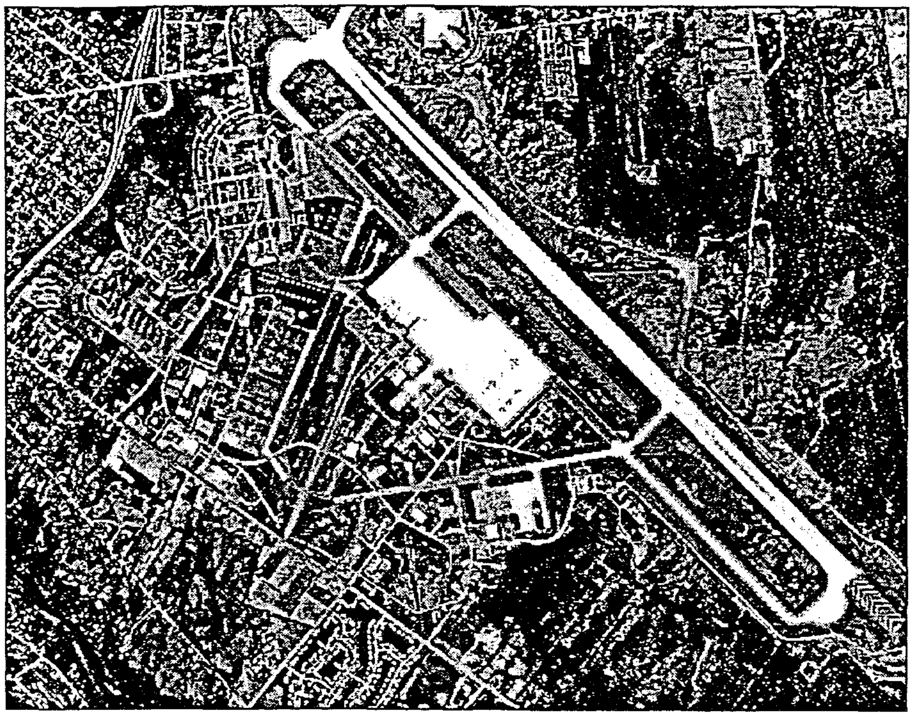
Contents

There are two data bases in the system: the APSRS data base and the contributor data base. Each record in the APSRS data base contains up to 13 descriptive fields. All fields can be displayed, and 12 of the 13 fields can be searched. Not all fields, however, contain data for every record.

Each record in the contributor data base contains the name, address, and phone number of a contributor. The contributor field and the field containing the city, State, and zip code can be searched.

The APSRS data base describes more than 600,000 aerial photography projects covering the United States and its territories. Anumber of Federal, State, and municipal agencies and commercial firms contribute to APSRS.

Each listing is a summary of aerial photography projects within a 7.5- by 7.5-minute quadrangle area, corresponding to the USGS 7.5-minute map series. Entries are sorted by project date and describe the scale, project code, file type, cloud cover, and camera focal length. The entries also give the name of the holding agency or firm.



Part of NHAP83, Roll 77, Frame 6.

Requirements

Hardware requirements include an IBM PC-XT-AT or compatible microcomputer with 512 kilobytes of memory, with DOS operating system version 3.0 or greater; one 20-megabyte hard drive; and a CD-ROM reader with software drivers that read ISO-9660 formatted CD-ROM's.

Information

The APSRS data base and contributor data base are available on CD-ROM for $57.00, plus a $5.00 handling fee. The CD-ROM contains licensed software for searching, sorting, displaying, printing, and exporting the data. The software must be installed onto a hard drive before the data can be used. The CD-ROM is accompanied by a users manual.

For information on ordering the CD-ROM, or to obtain a list of available photographs covering a specific areas, contact any Earth Science Information Center (ESIC).

The data bases are maintained by the USGS. For information about submitting projects for entry into the APSRS, contact:

U.S. Geological Survey
APSRS Data Base Manager
509 National Center
Reston, VA 20192
703-648-5903

For information on these and other USGS products and services, call 1-800-USA-MAPS, use the EARTHFAX fax-on-demand system, which is available 24 hours a day at 703-648-4888, or visit the general interest publications website at http://mapping.usgs.gov/www/products/mappubs.html.

Please visit the USGS home page at http://www.usgs.gov/.

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

AVAILABILITY OF AERIAL PHOTOGRAPHY

Aerial photographs can be used to assist in mapping difficult locations. The earliest comprehensive photographs of large areas were done in the 1930s by the newly formed Soil Conservation Service as they began their mandated objective. When available they may show trail traces that may not be visible in images done in later years. They have been assembled at the Cartographic and Architectural Branch of the National Archives. Dating from the mid-1930's, these aerial photographs cover approximately 80 percent of the United States. (Refer to USGS Fact Sheet "Looking for an Old Aerial Photograph.")

The USGS maintains an informational data base of aerial photographic coverage of the United States that dates back to the 1940's. (Refer to USGS Fact Sheet "How to Obtain Aerial Photographs.") In addition, BLM Filed Offices and Forest Service District Offices hold aerial photographs covering their respective districts. These are available to researchers and mappers on request.

There is a National Office for obtaining aerial photography prints, dating from 1941 to the present, of almost any location in the United States. The address is: ASCS Aerial Photography Field Office (APFO), 2222 W. 2300 S., Salt Lake City, Utah. They have on file aerial photography that was flown by the USDA Forest Service, Agricultural Stabilization and Conservation Service, and the Soil Conservation Service. The photo scales range from 1:15,840 (about 1 inch = ¼ mile) to 1:80,000 (1 inch = 1¼ miles). They also have on file some imagery from LANDSAT and Skylab missions.

More recently, digitized aerial photographs from the 1990s have become available through TerraServer. The USGS provides the TerraServer web page (serviced by Microsoft) with images and maps of the United States. The images are in the public domain, and are freely available to download, use and re-distribute at:

http://terraserver.homeadvisor.msn.com/default.asp

TerraServer uses two types of data products, Digital Orthophoto Quadrangles (DOQs) and Digital Raster Graphics (DRGs). A DOQ is a computer-generated image of an aerial photograph. It has been orthorectified—altered so that it has the geometric properties of a map. This process also enables accurate measurements of ground distance on the photos—just as you get on maps—and ensures that the photos can be used in automated mapping and geographical analysis software along with other digital cartographic data.

A DRG is a digitally scanned image of a USGS topographic map. As with the paper topographic maps, DRG's can be used for hiking, camping, hunting, or other recreational activities. The full potential of a DRG is realized when it is combined with other digital map data, such as a digital orthophoto quadrangles (DOQ) or digital elevation model (DEM). The resulting hybrid product is excellent for collecting and revising digital map data.

The standard DOQ from the USGS is a black-and-white (gray-scale) or color-infrared image covering 3.75 minutes of latitude by 3.75 minutes of longitude. Four such photos can be combined in a mosaic to cover the area represented by a standard USGS 7.5-minute, 1:24,000-scale topographic map. Using mosaics is easier because images overlap. The DOQ's are referenced to the North American Datum of 1983 and use the Universal Transverse Mercator projection. Their resolution is such that each pixel represents a square meter.

The DOQs on the Microsoft TerraServer site are 1-meter resolution images, meaning the smallest object that can be distinguished is about three feet across. That does not mean, however, that everything three feet long or more can be identified in the photo. For example, it is usually easy to identify a driveway in one of these pictures. If a car is parked in the driveway, you can easily tell what it is. But if a car is parked in the middle of a field, where you would not expect to find it, you might not be able to identify it as an automobile. The ability to identify features increases with the viewer's experience in photographic interpretation—a skill for recognizing objects in images.

DOQs are produced by a process that begins with the scanning of photos obtained almost exclusively from the National Aerial Photography Program (NAPP), an interagency effort coordinated by the USGS. Each photo covers an area a little more than five miles on a side, representing about one-fourth of a standard, 7.5-minute USGS topographic quadrangle map.

Once scanned into digital form, the images undergo a computer "orthorectification" process, making them geometrically like maps. The process of orthorectification removes distortions created by the cameras taking the photos. The perspective of a camera causes things like foreshortening where, for example, parallel lines seem to converge near the camera. It is important to remove these distortions so accurate information—such as distances—can be gleaned from the final product.

USING Terra*Server* AERIAL PHOTOTOGRAPHY

(Process developed by OCTA Southwest Chapter Mapping Group)

Although time consuming, the downloaded TerraServer images can be helpful in locating trail traces. The downloads need to be at the highest magnification available at the site, and with the UTM lines on the map. Computer speed, memory size, and monitor size will have a bearing on how effective this process will be. In addition, you should be a good map reader and have the necessary 7.5 minute USGS topographic maps on hand to continually assist in this process.

The image capture process is:

- Find the location of interest on TerraServer.
- Use the "large" image size option.
- Zoom to the largest magnification and keep the area of interest in the image center.
- Go to "image info" which gives you the UTM markings on your image.
- Do a screen capture of the map image with the UTM designations included.
- This gives you one image, continue capturing additional images as needed.

You now have a series of images saved in your computer. To keep the images in order as you proceed, you need a method to organize them by name/number.

The image enhancement process is:

- Open an image in a photo program such as PhotoShop.
- Resize the image, if necessary, to print on one page, keeping all images to the same size.
- Lighten or darken the image as needed.
- Add contrast to the image to enhance the subtle features.
- Sharpen the image for further enhancement if needed.
- Save as a different file if you feel you may want to return to your original later.

At this point, the image may be printed. Some refinement of the saved image may be necessary to get the best print. Once the best enhancement is found, usually it can be used on all images.

The printed images can be taped together in whatever way helps to show the features. One effective method is to tape several together in a strip. This may make an otherwise subtle trail trace become more apparent.

In areas where the trail has proved difficult to find on the ground, the images may assist in locating possible places to search. With the UTM lines in place on your image, the goto feature on a GPS unit can be effectively used to locate areas of interest on the ground. The map mosaics or strips can be carried into the field if kept at a reasonable size and organized for ready use.

Be aware that these image UTMs are in the 1983 datum, while the USGS topographic maps are in the 1927 datum. It may be necessary to use both of these datums as you work in the field. The GPS unit can be switched from one datum to the other with no loss of data.

Collected GPS waypoints can be plotted on these image maps in the same way plotting is done on topographic quadrangles. However, the scale will be different. A thousand meter UTM square on the topographic quad measures approximately 1.75 inches while the same thousand meter UTM square on the photo image (at the highest magnification) measures approximately 12 inches.

Appendix I

Applying National Register Criteria and Aspects Of Integrity To Emigrant Trails

APPLYING NATIONAL REGISTER CRITERIA AND ASPECTS OF INTEGRITY TO EMIGRANT TRAILS

Overview

The National Historic Preservation Act (NHPA 1966, as amended) is designed to address concerns over adverse impacts to historic and prehistoric resources resulting from federally funded activities and to ensure opportunities for public appreciation and enjoyment of the nation's heritage. It authorizes the Secretary of Interior to recognize and develop protective strategies for properties with "historic significance." The National Register of Historic Places is the official list of properties recognized as historically significant.

Under Section 106 of NHPA, Federal agencies with either direct control of historic properties, or responsibility for the expenditure of federal funds affecting historic properties, are legally obligated to evaluate the eligibility of such properties for the National Register. Furthermore, Federal agencies are legally obligated, and pending evaluation, to assure that historic properties are not impacted beyond the point at which they are no longer eligible. This means determining and establishing **eligibility** is essential for protecting and preserving historic trails.

A property's eligibility for listing on the National Register is based on the evaluation and application of specified criteria published in the National Park Service's National Register Bulletin, *How to Apply the National Register Criteria for Evaluation.* For a property to qualify for the National Register, it must meet each of two broad standards of eligibility. First, it must be **historically significant**, that is, it must be associated with an important historic context. The second broad measure of eligibility comes from a determination of the property's ability to **convey its significance**. Specifically, the ability to convey significance is defined by the property's degree of **historic integrity**.

Furthermore, as defined in the criteria for evaluation, a property must be classified as a building structure, object, site, or district in the National Register. Historic trails can be classified as either a site or district. The **district** classification may be more appropriate because a trail is a linear property that encompasses a variety of elements and features which are historically and functionally linked by a travelway.

Historic Significance

To establish **historical significance**, an emigrant trail or section of trail must meet one or more of four "criteria for evaluation." Because the National Register "criteria for evaluation" are primarily phrased in terms of and directed toward historic buildings and sites, the following is a suggested application of the four criteria to emigrant trails. (Refer to "The National Register Criteria for Evaluation" following this discussion.)

Criterion **A** — They have been associated with a significant historic event or pattern of events in American history.
Criterion **B** — They have involved the lives of people who made an important contribution to the westward overland migration.
Criterion **C** — They embody distinctive characteristics of 19th century wagon trails.
Criterion **D** — They have yielded or have the potential to yield information important to an understanding of the history of western overland migration.

Historic Integrity

In order for a property to **convey its significance** it must **possess historic integrity.** The National Register recognizes seven aspects or qualities of integrity that, in various combinations, define a property's ability to convey significance. They are integrity of location, design, setting, materials, workmanship, feeling, and association.

Generally, to retain historic integrity, a property must possess several, and usually most, of the aspects. Determining which aspects of integrity are most important to the eligibility of a particular property is dependent on the type of property and the historic context within which the property is determined to be significant.

Because the National Register "aspects of integrity" are phrased in terms of and directed towards historic buildings and sites, the following is a suggested application of the seven aspects of integrity to emigrant trails. (Refer to "How to Evaluate the Integrity of a Property" following this discussion.)

Location — Refers to the particular place where trail making occurred and the relationship between that location and the western overland migration which brought it about.
Design — Refers to the way in which diagnostic features of a trail are interconnected and organized so they are recognizable as a historic wagon trail.
Setting — Refers to the physical and visual environment of a trail in the sense of the character of the place in which the trail played its historical role, such as alpine vistas, desert panoramas, noted springs, famous passes, alkali flats, river crossings, unique rock formations, register rocks, scenic canyons and valleys, camping sites, etc.
Materials — Refers to the remaining physical elements that testify to the significance of a trail, such as ruts, swales, rock alignments, artifacts, graves, grooved and rust rocks, etc.
Workmanship — Refers to the physical evidence of craftsmanship in trail making. Although emigrant trails normally do not evidence high-style craftsmanship, they often reflect a simple and distinctive type of artisan labor in trail making.
Feeling — Refers to the trail's expression of the western overland migration, along with the presence of physical and environmental features, that taken together convey the trail's historic character.
Association — Refers to the direct link between the western overland migration and the trail. The physical features of the trail must be sufficiently intact to convey this relationship to an observer.

Making the Case for Significance and Integrity

To be eligible for listing in the National Register of Historic Places, the case has to be made for a trail's historic significance and the trail's historic integrity that conveys that significance. It is easier to make the case for significance when a trail is associated with historic trends or movements that have been widely recognized and well studied.

Mapping and inventorying a trail, along with utilizing the classification categories in the MET Manual, can aid in determining the trail's level of integrity. (Refer to "Emigrant Trail Classification Categories" in the MET Manual, pages 13-15.)

Thorough and convincing answers to the following questions can make the case for trail significance and integrity.

- What was the trail called at the time it was associated with emigrant overland travel?
- During what period of history was the trail associated with important events, activities, and persons? In what area of history is the trail significant?
- How was the trail used historically and what use does it have today?
- Who and how many used the trail historically? Did the users make any important contributions to history?
- How does the trail relate to the history of the area where it is located?
- How does the trail illustrate any themes or trends important to the history of the state in which it is located or to the nation?
- When was the trail opened and in what way did subsequent use change its physical form?
- What are the important historical and physical characteristics that made up the trail?
- What were the historical influences (such as design, materials, or workmanship) on the trail's appearance?
- What changes have been made to the trail over time and when did these changes occur? How have these changes affected its historic integrity?
- What is the current condition of the trail and its setting?
- How long is the trail, where is it located, and what is the width of the corridor in which trail associated activities and events took place?
- Does the trail contain any archeological remains? To what period, events, and activities do they relate? To what extent has their significance been evaluated?
- How have archeological sites, if any, been identified (e.g. through intensive survey)? To what extent and by what methods have subsurface deposits been located?
- What county, state, or federal agencies manage the trail? Or in the case of private property, who are the current owners?
- Which of the four National Register criteria apply to the trail? And in what way and to what extent?
- Which of the seven aspects of integrity apply to the trail? And in what way and to what extent?

After these questions have been answered satisfactorily, there is a formal documentation process (including submission of topographic maps and b&w photos) to nominate an emigrant trail or section of a trail for listing in the National Register. This process involves completion of a "Registration Form" and numerous "Continuation Sheets." Refer to the National Park Service publication, *Guidelines for Completing National Register of Historic Places Form.*

The following pages in this Appendix are taken from the National Park Service National Register Bulletin on *How to Apply the National Register Criteria for Evaluation.* They define the four criteria for evaluation and the seven aspects of integrity that have been applied to emigrant trails in the above discussions.

II. THE NATIONAL REGISTER CRITERIA FOR EVALUATION

CRITERIA FOR EVALUATION:[3]

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of persons significant in our past; or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded, or may be likely to yield, information important in prehistory or history.

CRITERIA CONSIDERATIONS:

Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties *will qualify* if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

a. A religious property deriving primary significance from architectural or artistic distinction or historical importance; or

b. A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or

c. A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his or her productive life; or

d. A cemetery which derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or

e. A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or

f. A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or

g. A property achieving significance within the past 50 years if it is of exceptional importance.

[3]The Criteria for Evaluation are found in the *Code of Federal Regulations, Title 36, Part 60,* and are reprinted here in full.

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Generally, to retain historic integrity, a property must possess several, and usually most, of the aspects. Determining which aspects of integrity are most important to the eligibility of a particular property is dependent on the type of property and the historic context within which the property is determined to be significant.

Because the National Register "aspects of integrity" are phrased in terms of and directed towards historic buildings and sites, the following is a suggested application of the seven aspects of integrity to emigrant trails. (Refer to "How to Evaluate the Integrity of a Property" following this discussion.)

Location — Refers to the particular place where trail making occurred and the relationship between that location and the western overland migration which brought it about.
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Making the Case for Significance and Integrity

To be eligible for listing in the National Register of Historic Places, the case has to be made for a trail's historic significance and the trail's historic integrity that conveys that significance. It is easier to make the case for significance when a trail is associated with historic trends or movements that have been widely recognized and well studied.

Mapping and inventorying a trail, along with utilizing the classification categories in the MET Manual, can aid in determining the trail's level of integrity. (Refer to "Emigrant Trail Classification Categories" in the MET Manual, pages 13-15.)

III. HOW TO USE THIS BULLETIN TO EVALUATE A PROPERTY

For a property to qualify for the National Register it must meet one of the National Register Criteria for Evaluation by:

- **Being associated with an important historic context** *and*
- **Retaining historic integrity of those features necessary to convey its significance.**

Information about the property based on physical examination and documentary research is necessary to evaluate a property's eligibility for the National Register. Evaluation of a property is most efficiently made when following this sequence:

1. Categorize the property (Part IV). A property must be classified as a district, site, building, structure, or object for inclusion in the National Register.
2. **Determine which prehistoric or historic context(s) the property represents** (Part V). A property must possess significance in American history, architecture, archeology, engineering, or culture when evaluated within the historic context of a relevant geographic area.
3. Determine whether the property is significant under the National Register Criteria (Part VI). This is done by identifying the links to important events or persons, design or construction features, or information potential that make the property important.
4. Determine if the property represents a type usually excluded from the National Register (Part VII). If so, determine if it meets any of the Criteria Considerations.
5. Determine whether the property retains integrity (Part VIII). Evaluate the aspects of location, design, setting, workmanship, materials, feeling, and association that the property must retain to convey its historic significance.

If, after completing these steps, the property appears to qualify for the National Register, the next step is to prepare a written nomination. (Refer to *National Register Bulletin: How to Complete the National Register Registration Form.*)

VIII. HOW TO EVALUATE THE INTEGRITY OF A PROPERTY

INTRODUCTION

Integrity is the ability of a property to convey its significance. To be listed in the National Register of Historic Places, a property must not only be shown to be significant under the National Register criteria, but it also must have integrity. The evaluation of integrity is sometimes a subjective judgment, but it must always be grounded in an understanding of a property's physical features and how they relate to its significance.

Historic properties either retain integrity (this is, convey their significance) or they do not. Within the concept of integrity, the National Register criteria recognizes seven aspects or qualities that, in various combinations, define integrity.

To retain historic integrity a property will always possess several, and usually most, of the aspects. The retention of specific aspects of integrity is paramount for a property to convey its significance. Determining *which* of these aspects are most important to a particular property requires knowing why, where, and when the property is significant. The following sections define the seven aspects and explain how they combine to produce integrity.

SEVEN ASPECTS OF INTEGRITY

- Location
- Design
- Setting
- Materials
- Workmanship
- Feeling
- Association

UNDERSTANDING THE ASPECTS OF INTEGRITY

LOCATION

Location is the place where the historic property was constructed or the place where the historic event occurred. The relationship between the property and its location is often important to understanding why the property was created or why something happened. The actual location of a historic property, complemented by its setting, is particularly important in recapturing the sense of historic events and persons. Except in rare cases, the relationship between a property and its historic associations is destroyed if the property is moved. (See Criteria Consideration B in *Part VII: How to Apply the Criteria Considerations*, for the conditions under which a moved property can be eligible.)

DESIGN

Design is the combination of elements that create the form, plan, space, structure, and style of a property. It results from conscious decisions made during the original conception and planning of a property (or its significant alteration) and applies to activities as diverse as community planning, engineering, architecture, and landscape architecture. Design includes such elements as organization of space, proportion, scale, technology, ornamentation, and materials.

A property's design reflects historic functions and technologies as well as aesthetics. It includes such considerations as the structural system; massing; arrangement of spaces; pattern of fenestration; textures and colors of surface materials; type, amount, and style of ornamental detailing; and arrangement and type of plantings in a designed landscape.

Design can also apply to districts, whether they are important primarily for historic association, architectural value, information potential, or a combination thereof. For districts significant primarily for historic association or architectural value, design concerns more than just the individual buildings or structures located within the boundaries. It also applies to the way in which buildings, sites, or structures are related: for example, spatial relationships between major features; visual rhythms in a streetscape or landscape plantings; the layout and materials of walkways and roads; and the relationship of other features, such as statues, water fountains, and archeological sites.

SETTING

Setting is the physical environment of a historic property. Whereas location refers to the specific place where a property was built or an event occurred, setting refers to the *character* of the place in which the property played its historical role. It involves *how,* not just where, the property is situated and its relationship to surrounding features and open space.

Setting often reflects the basic physical conditions under which a property was built and the functions it was intended to serve. In addition, the way in which a property is positioned in its environment can reflect the designer's concept of nature and aesthetic preferences.

The physical features that constitute the setting of a historic property can be either natural or manmade, including such elements as:

- Topographic features (a gorge or the crest of a hill);
- Vegetation;
- Simple manmade features (paths or fences); and
- Relationships between buildings and other features or open space.

These features and their relationships should be examined not only within the exact boundaries of the property, but also between the property and its *surroundings.* This is particularly important for districts.

MATERIALS

Materials are the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property. The choice and combination of materials reveal the preferences of those who created the property and indicate the availability of particular types of materials and technologies. Indigenous materials are often the focus of regional building traditions and thereby help define an area's sense of time and place.

A property must retain the key exterior materials dating from the period of its historic significance. If the property has been rehabilitated, the historic materials and significant features must have been preserved. The property must also be an actual historic resource, not a recreation; a recent structure fabricated to look historic is not eligible. Likewise, a property whose historic features and materials have been lost and then reconstructed is usually not eligible. (See Criteria Consideration E in *Part VII: How to Apply the Criteria Considerations* for the conditions under which a reconstructed property can be eligible.)

WORKMANSHIP

Workmanship is the physical evidence of the crafts of a particular culture or people during any given period in history or prehistory. It is the evidence of artisans' labor and skill in constructing or altering a building, structure, object, or site. Workmanship can apply to the property as a whole or to its individual components. It can be expressed in vernacular methods of construction and plain finishes or in highly sophisticated configurations and ornamental detailing. It can be based on common traditions or innovative period techniques.

Workmanship is important because it can furnish evidence of the technology of a craft, illustrate the aesthetic principles of a historic or prehistoric period, and reveal individual, local, regional, or national applications of both technological practices and aesthetic principles. Examples of workmanship in historic buildings include tooling, carving, painting, graining, turning, and joinery. Examples of workmanship in prehistoric contexts include Paleo-Indian clovis projectile points; Archaic period beveled adzes; Hopewellian birdstone pipes; copper earspools and worked bone pendants; and Iroquoian effigy pipes.

FEELING

Feeling is a property's expression of the aesthetic or historic sense of a particular period of time. It results from the presence of physical features that, taken together, convey the property's historic character. For example, a rural historic district retaining original design, materials, workmanship, and setting will relate the feeling of agricultural life in the 19th century. A grouping of prehistoric petroglyphs, unmarred by graffiti and intrusions and located on its original isolated bluff, can evoke a sense of tribal spiritual life.

ASSOCIATION

Association is the direct link between an important historic event or person and a historic property. A property retains association if it *is* the place where the event or activity occurred and is sufficiently intact to convey that relationship to an observer. Like feeling, association requires the presence of physical features that convey a property's historic character. For example, a Revolutionary War battlefield whose natural and manmade elements have remained intact since the 18th century will retain its quality of association with the battle.

Because feeling and association depend on individual perceptions, their retention *alone* is never sufficient to support eligibility of a property for the National Register.

ASSESSING INTEGRITY IN PROPERTIES

Integrity is based on significance: why, where, and when a property is important. Only after significance is fully established can you proceed to the issue of integrity.

The steps in assessing integrity are:

- Define the **essential physical features** that must be present for a property to represent its significance.
- Determine whether the essential physical features are visible enough to convey their significance.
- Determine whether the property needs to be compared with similar properties. And,
- Determine, based on the significance and essential physical features, which aspects of integrity are particularly vital to the property being nominated and if they are present.

Ultimately, the question of integrity is answered by whether or not the property retains the identity for which it is significant.

DEFINING THE ESSENTIAL PHYSICAL FEATURES

All properties change over time. It is not necessary for a property to retain all its historic physical features or characteristics. The property must retain, however, the essential physical features that enable it to convey its historic identity. The essential physical features are those features that define both *why* a property is significant (Applicable Criteria and Areas of Significance) and *when* it was significant (Periods of Significance). They are the features without which a property can no longer be identified as, for instance, a late 19th century dairy barn or an early 20th century commercial district.

CRITERIA A AND B

A property that is significant for its historic association is eligible if it retains the essential physical features that made up its character or appearance during the period of its association with the important event, historical pattern, or person(s). If the property is a site (such as a treaty site) where there are no material cultural remains, the setting must be intact.

Archeological sites eligible under Criteria A and B must be in overall good condition with excellent preservation of features, artifacts, and spatial relationships to the extent that these remains are able to convey important associations with events or persons.

CRITERION C

A property important for illustrating a particular architectural style or construction technique must retain most of the physical features that constitute that style or technique. A property that has lost some historic materials or details can be eligible *if* it retains the majority of the features that illustrate its style in terms of the massing, spatial relationships, proportion, pattern of windows and doors, texture of materials, and ornamentation. The property is not eligible, however, if it retains some basic features conveying massing but has lost the majority of the features that once characterized its style.

Archeological sites eligible under Criterion C must be in overall good condition with excellent preservation of features, artifacts, and spatial relationships to the extent that these remains are able to illustrate a site type, time period, method of construction, or work of a master.

CRITERION D

For properties eligible under Criterion D, including archeological sites and standing structures studied for their information potential, less attention is given to their overall condition, than it they were being considered under Criteria A, B, or C. Archeological sites, in particular, do not exist today exactly as they were formed. There are always cultural and natural processes that alter the deposited materials and their spatial relationships.

For properties eligible under Criterion D, integrity is based upon the property's potential to yield specific data that addresses important research questions, such as those identified in the historic context documentation in the Statewide Comprehensive Preservation Plan or in the research design for projects meeting the *Secretary of the Interior's Standards for Archeological Documentation.*

INTERIORS

Some historic buildings are virtually defined by their exteriors, and their contribution to the built environment can be appreciated even if their interiors are not accessible. Examples of this would include early examples of steel-framed skyscraper construction. The great advance in American technology and engineering made by these buildings can be read from the outside. The change in American popular taste during the 19th century, from the symmetry and simplicity of architectural styles based on classical precedents, to the expressions of High Victorian styles, with their combination of textures, colors, and asymmetrical forms, is readily apparent from the exteriors of these buildings.

Other buildings "are" interiors. The Cleveland Arcade, that soaring 19th century glass-covered shopping area, can only be appreciated from the inside. Other buildings in this category would be the great covered train sheds of the 19th century.

In some cases the loss of an interior will disqualify properties from listing in the National Register—a historic concert hall noted for the beauty of its auditorium and its fine acoustic qualities would be the type of property that if it were to lose its interior, it would lose its value as a historic resource. In other cases, the overarching significance of a property's exterior can overcome the adverse effect of the loss of an interior.

In borderline cases particular attention is paid to the significance of the property and the remaining historic features.

HISTORIC DISTRICTS

For a district to retain integrity as a whole, the majority of the components that make up the district's historic character must possess integrity even if they are individually undistinguished. In addition, the relationships among the district's components must be substantially unchanged since the period of significance.

When evaluating the impact of intrusions upon the district's integrity, take into consideration the relative number, size, scale, design, and location of the components that do not contribute to the significance. A district is not eligible if it contains so many alterations or new intrusions that it no longer conveys the sense of a historic environment.

A component of a district cannot contribute to the significance if:

- it has been substantially altered since the period of the district's significance *or*
- it does not share the historic associations of the district.

VISIBILITY OF PHYSICAL FEATURES

Properties eligible under Criteria A, B, and C must not only retain their essential physical features, but the features must be visible enough to convey their significance. This means that even if a property is physically intact, its integrity is questionable if its significant features are concealed under modern construction. Archeological properties are often the exception to this; by nature they usually do not require visible features to convey their significance.

XI. LIST OF NATIONAL REGISTER BULLETINS

The Basics
How to Apply National Register Criteria for Evaluation *

Guidelines for Completing National Register of Historic Places Form
Part A: How to Complete the National Register Form *
Part B: How to Complete the National Register Multiple Property Documentation Form *

Researching a Historic Property *

Property Types
Guidelines for Evaluating and Documenting Historic **Aids to Navigation** *

Guidelines for Identifying, Evaluating and Registering **America's Historic Battlefields**

Guidelines for Evaluating and Registering Historical **Archeological Sites**

Guidelines for Evaluating and Documenting Historic **Aviation Properties**

Guidelines for Evaluating and Registering **Cemeteries and Burial Places**

How to Evaluate and Nominate **Designed Historic Landscapes** *

Guidelines for Identifying, Evaluating and Registering Historic **Mining Sites**

How to Apply National Register Criteria to **Post Offices** *

Guidelines for Evaluating and Documenting **Properties Associated with Significant Persons**

Guidelines for Evaluating and Documenting **Properties That Have Achieved Significance Within the Last Fifty Years** *

Guidelines for Evaluating and Documenting **Rural Historic Landscapes** *

Guidelines for Evaluating and Documenting **Traditional Cultural Properties** *

Nominating Historic **Vessels and Shipwrecks** to the National Register of Historic Places

Technical Assistance
Defining Boundaries for National Register Properties*

Guidelines for Local Surveys: A Basis for Preservation Planning *

How to Improve the Quality of Photographs for National Register Nominations

National Register Casebook: Examples of Documentation *

Using the UTM Grid System to Record Historic Sites

To order these publications, write to: National Register of Historic Places, National Park Service, 1849 C St., NC 400, NW, Washington, D.C. 20240, or e-mail at: nr_reference@nps.gov. Publications marked with an asterisk (*) are also available in electronic form at www.cr.nps.gov/nr.

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