EPSILON, GENERALIZATION, AND PROBABILITY IN SPATIAL DATA BASES

by

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After struggling with this degree for 7-odd years, it amazes me that it still comes down to an all-nighter. But this part should be fun, a departure from all the cut and dried stuff that follows. In no particular order:

I'd first like to thank my parents for supporting me and deciding to have me in the first place.

A gracious bow to two colleagues at Woodward-Clyde Consultants, Dennis Smith and Gary Smith, who were kind enough to listen and encourage during those nights when we closed the bar.

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EPSILON, GENERALIZATION, AND PROBABILITY IN SPATIAL DATA BASES

ABSTRACT. Cartographic generalization results in locational inaccuracies of the generalized feature. The cartographer expresses the amount of generalization and the locational inaccuracy of the feature through map design and choice of map scale. This information is often lost when the map is digitized. In the environment of geographic information systems, the locational accuracy of the data can play an important role in decision making. In this study, locational inaccuracies due to generalization are measured and applied to a hypothetical situation to demonstrate the effect generalization could have in an automated decision making environment.

INTRODUCTION

The synergy between map scale and cartographic generalization is well known. This interrelationship of scale and generalization plays a vital role in map interpretation and compilation. In compiling a map, the cartographer selects information from a variety of sources at differing scales, projections, validity, and accuracy. The visual clues inherent in the design of these maps, such as line weights, symbol size and placement, lettering sizes and fonts, all impart the degree of generalization. For instance, it should be obvious to the map interpreter that a line drawn on a map of 1:250,000 is more generalized and therefore, positionally less accurate then a line drawn on a map of 1:24,000. This knowledge would affect the final design or interpretation of the map. The choice of map symbols, the communicator of generalization, is an important one, for it imparts the degree of generalization that is warranted by the data and desired by the cartographer. If the communication is clear, then the map reader will understand the limitations of the map. This communication of generalization can work both ways, for, by using good symbolization, a cartographer can "impart an incorrect visual impression of precision and accuracy to poorly simplified or classified data" (Robinson et al., 1978, p. 153).

This study deals with cartographic line generalization in computer-assisted cartography. In computer-assisted cartography (CAC) and geographic information systems (GISs), the locational information of symbols, and by inference, the degree of generalization, is typically captured as finite points and lines. We do not digitize the symbol, we digitize a point where the symbol ought to be placed. A line representing a road, for instance, becomes a series of points, not a line of some thickness (e.g., 0.5mm). The symbols are transformed into the realm of the mathematician where lines do not have a thickness and discrete points do not have areal extent. This is one of the overwhelming attractions of CAC/GIS: that map data can be handled in the language of mathematics, not only in the language of graphics.

In the CAC/GIS environment, changing map scale can be as simple as responding to a question from an interactive program. All the forethought concerning the choice of symbols based upon the scale and resolution of the input data is all to often conveniently disregarded and, consequently, the map output belies the quality of the data. The visual clues the symbols imparted are out of sight and out of mind. Cartographers are now just beginning to realize the need for knowledge-based systems where the knowledge of cartographic conventions that the cartographer brings to the compilation and interpretation process is programmed into the system, so that symbol and scale choice follows cartographic theory and practice. It is important, then, that we understand the transformations of cartographic data that occur with scale change in a digital environment. This study is an attempt to define and measure the effects of one such transformation; that due to scale generalization.

EPSILON DISTANCE

This section discusses the idea of epsilon distance about a symbol and the effect it may have on spatial data bases. The concept of epsilon distance is traced to Perkal (Blakemore, 1984; and Chrisman, 1982), and this concept is central to the experiments performed here.

Overview

Many factors contribute to positional error on maps. Data acquisition methods, map compilation procedures, data quality and timeliness, and the experience of the cartographer are just a few of the factors contributing to the final quality and accuracy of a map. Errors can propagate from one mapping task to another, such as from photographic registration to scribing. If these errors are systematic and could be accurately measured, a composite error could be calculated that represented the deviation a particular map symbol had from true ground location. If the symbol was linear, such as a river, road, or administrative boundary, this deviation would take the form of a band of error, termed the epsilon band, about the line. This epsilon band is defined as a constant distance, or tolerance, from either side of the line and from its two end-points, and can be described as the "area occupied by rolling a ball along the line" (Chrisman, 1982, p. 160). A simple example serves to illustrate the calculation of epsilon distance. In many industry requests for digitizing services, there is usually a contract clause stating that the final product (the digitized line) cannot vary more that one-half line width from the drafted line on the manuscript. If the line was 0.5mm, this means the digitized line cannot vary by more than +/-0.25mm from the edges of the line. The digitized line will fall somewhere within a band 1.0mm (.5 + .25 + .25). This, then, is twice the epsilon distance. If the map scale of the manuscript was 1:24,000, this 1.0mm line would be 24 ground meters (78 feet).

Factors contributing to error

Many errors can occur in the map compilation process and the transformation to digital files. These may be categorized as follows:

1) resolution of the line;
2) surveying accuracy of the line;
3) errors in initial compilation;
4) errors in subsequent compilation; and
5) errors in digitizing.

Resolution of the line. In order for a line to be drawn, it must first be identified. Geographic data have varying degrees of resolution. Property boundaries, road intersections, surveying monuments, and other cadastral data can have a fine degree of resolution, but the boundary between many natural phenomena, such as vegetation cover, is just a transitional zone that cannot be identified with a high degree of precision.

Surveying accuracy of the line. Surveying instrumentation is becoming increasingly sophisticated and precise. However, as alluded to above, their use is limited to identifiable, locatable features on the ground, not to the boundary zones common to land-use and land-cover data. The benefit of high precision of location has to be weighed against the cost of such endeavors, especially where the gain in precision can be lost to drafting and compilation errors.

Errors in initial compilation. While the fields of photogrammetry and remote sensing are rapidly advancing and our planimetric accuracy is increasing, the information gathered must still be placed on paper or plastic drafting materials by a draftsman. Human errors occur in this transfer, particularly in line tracing and registration of images. These errors are generally within a drafted line width since, in order for the eye to recognize error, there has to be a gap between lines (or other symbols) that can only occur when the lines are more than a line width apart (Chrisman, 1982, p. 162). It is also recognized that the medium on which the map is drafted can introduce errors, as in the case of paper stretch.

Errors in subsequent compilation. Maps go through many generations of reinterpretation for the purpose of compiling a new map for a specific purpose. In this sense, the new map is a 'value-added' product. Each new compilation is subject to tracing, registration, and generalization error. Errors introduced at one phase of the re-compilation carry over to the next generation of compilation.

Errors in digitizing. Errors occurring in digitizing are well documented. Perhaps the most thorough treatments to date are by Traylor (1979) and Jenks (1981). Semi-automated digitizing, where the human guides the cursor (as opposed to scanning devices), is essentially a retracing of the line, except that the feed-back loop of seeing the line disappear beneath the ink of a pen is absent. Traylor found that there is a definite correlation between digitizer error and direction of cursor movement, and that there is a tendency to 'overshoot' or 'undercut' curves in a line depending on direction of cursor travel.

Recent studies

Chrisman (1982) has studied systematic errors contributing to an epsilon band on the USGS GIRAS digital land use/land cover series. After examining the various processes used in producing these files, he calculated an epsilon band width of 15.2 meters. Testing a 100,000 hectare data base of Pittsburg, Pennsylvania, with an epsilon of 20 meters, which Chrisman considered conservative, about 7 percent of the total area fell within the epsilon band. The area in the epsilon band represents a possible change of the area falling within each land use/land cover class. Chrisman was able to calculate minimum and maximum areas for each class based upon the area displaced by the epsilon band. His recommendations were to include this information as part of the dataset.

Blakemore (1984) performed a similar study with administrative units in Great Britain. In this study, point-in-polygon checks were performed (figure 1a) to determine if a point fell within an epsilon value of 0.7071km based upon 1km resolution of the sample data points. He categorized a point falling within an epsilon band as being possibly in, possibly out, and ambiguously defined if it fell exactly on the digitized line. His results were not encouraging as approximately 40 percent of the sample points tested fell within the epsilon band and could not be assigned to a definite polygon. This was largely due to the wide epsilon band and data collection methods.

OBJECTIVES AND RESEARCH DESIGN

This study was prompted by a major concern of the author: that in the environment of GIS, maps compiled at different scales are often digitized and merged with map files of another scale, and analyses are performed as if the files were all of one scale and of all the same quality. This merging is typically known as overlay, or polygon overlay for lines that bound areas. The results of a polygon overlay could be polygons bounded by lines with different epsilons, as shown in figure 1b. This technique of spatial correlation (the polygon overlay) can often yield significant statistics to a researcher, and is such a valuable utility of a GIS that it often forms the major design criteria of GIS software and data bases.

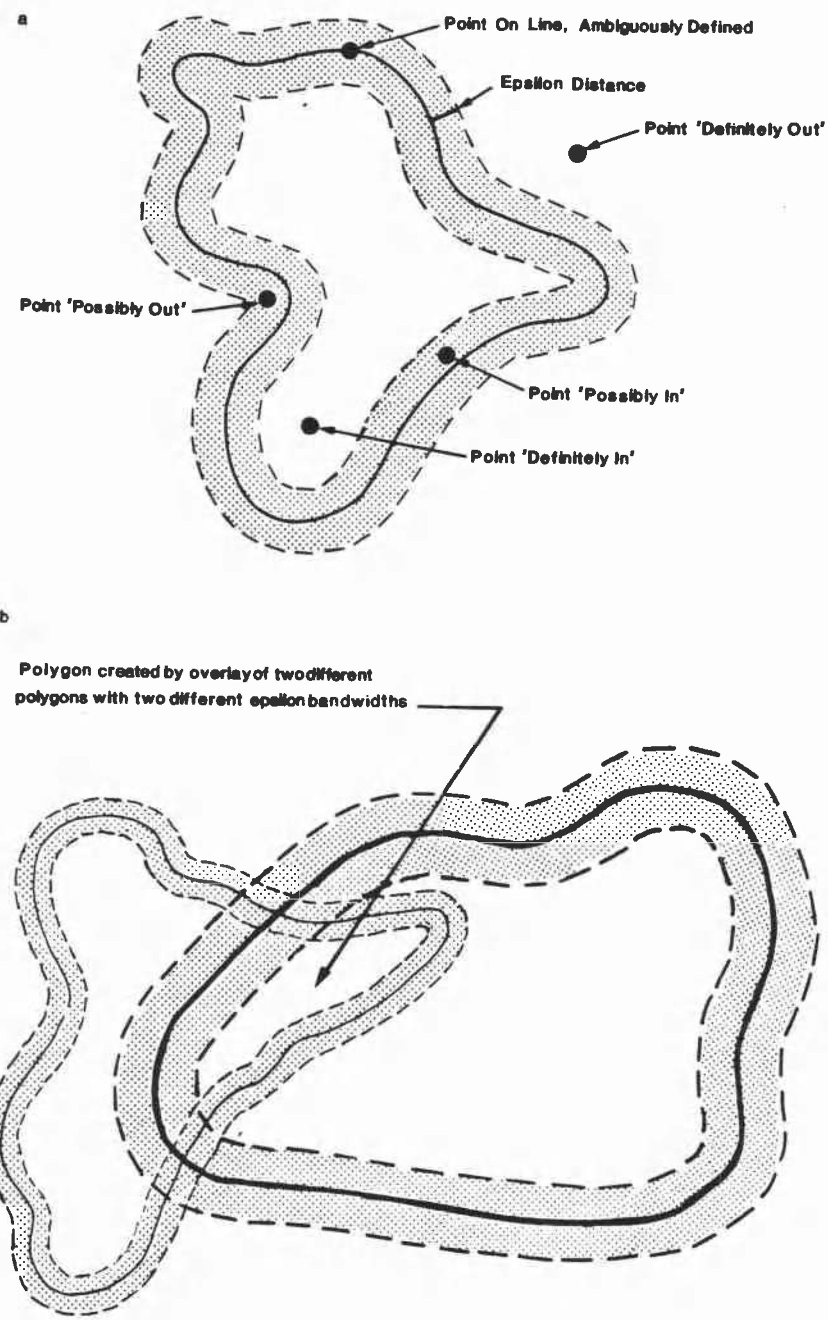


Figure 1. The shaded area about the polygon line in the top figure (a) represents epsilon, an error tolerance about the line due to various map compilation procedures. The labeled points are as defined by Blakemore (1984). The bottom figure (b) shows two polygons with two different epsilon bands intersecting to form a third polygon. This third polygon might be a 'sliver' polygon -- a small polygon that may or may not be significant to the cartographer. This sliver polygon may very well enclose nothing but epsilon error.

The application of this technique without any regard for the inaccuracies of the data sets should make cartographers wince, for, as shown in figure 1b, the polygon resulting from an overlay could be completely filled with the epsilons of its neighbors, resulting in an area that has very low probability of actually existing due to locational inaccuracies. These polygons are known as 'sliver' polygons in CAC/GIS jargon. They have been viewed mainly as a computational problem since they decrease algorithm efficiency and unnecessarily increase the size of our data bases.

The objectives of this study are to measure the locational error due to generalization, construct a statistical model of this error based on probability, and finally, examine hypothetical sliver polygons for their probability of existing, in the sense of enclosing an area of some attribute. In short, this analysis is an attempt to resolve the question of when a sliver polygon is not a sliver polygon based upon a probability model of generalization.

MEASURING GENERALIZATION

Overview

Generalization can be measured by calculating the deviation of a line from its true ground position. True ground position is rarely known, except for benchmarks. A surrogate for ground-truth would be a very accurate larger scale map, relative to a generalized smaller scale map (figure 2). To carry out the task of measuring generalization error, identical stream reaches depicted on the four

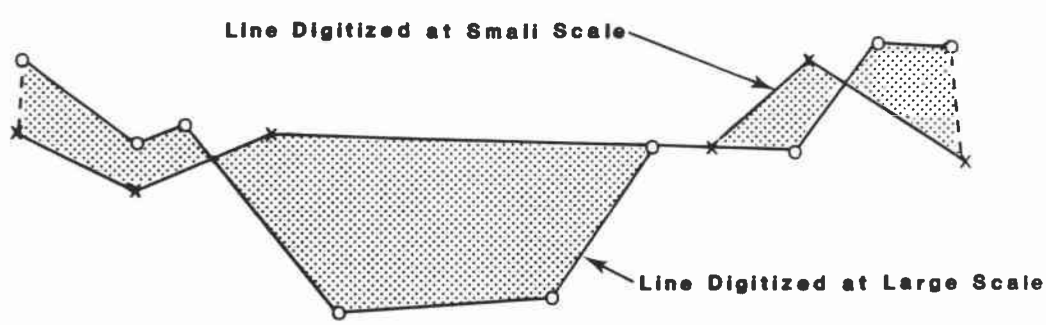


Figure 2. Two lines, each representing the same thing, but drawn at different scales. The error in placement between the two lines could be measured by the area (shaded portion of the figure) created between the two.

standard USGS scales (1:24,000, 1:62,500, 1:100,000, and 1:250,000) were used to measure the amount of deviation among the four representatives of the stream reach.

Data collection

Streams were chosen for analysis for a variety of reasons. They are a natural feature, as opposed cultural, and one assumption is that a large number of GIS data bases are of the land-management type comprised mainly of natural features. Streams are often used as state, county, province, and other administrative boundaries. As a land/water interface, streams are often used as a reference point for data collection. Because streams are sinuous with many kinks and bends, compared to roads and some other linear symbols, they are subject to a higher degree of generalization. Since the data were to be digitized, other linear features, such as roads or administrative boundaries, could not be used since they are often drawn with dashed or broken lines, hardly conducive to accurate digitizing.

Collection of stream reaches turned out to be a more difficult task than originally anticipated. The reaches had to be represented at all of the four scales as a single line and isolated from other features that might warrant positional shifts between features as scale became smaller. The maps also had to be temporally consistent so that stream courses did not change, and, of course, could not be so dated that nonphotogrammetric techniques were used in compilation. There had to be some common registration points, such as a grid line or another stream intersection, for all scales.

As it turned out, one of the best areas for finding such streams was close to home in the Oregon Coast Range. This region is tectonically stable with deeply incised streams whose courses are unlikely to change during the century of USGS map construction. This range has a consistently wet climate so the stream flow is likewise consistent (Rosenfeld, pc). These factors combined to provide a large number of permanent streams.

Out of the entire mapped Coast Range, a surprisingly low total of eight stream reaches, approximately 1500 meters long each, were found suitable for examination. More could probably be found through more intensive effort. These eight reaches are shown in figures 3a and 3b.

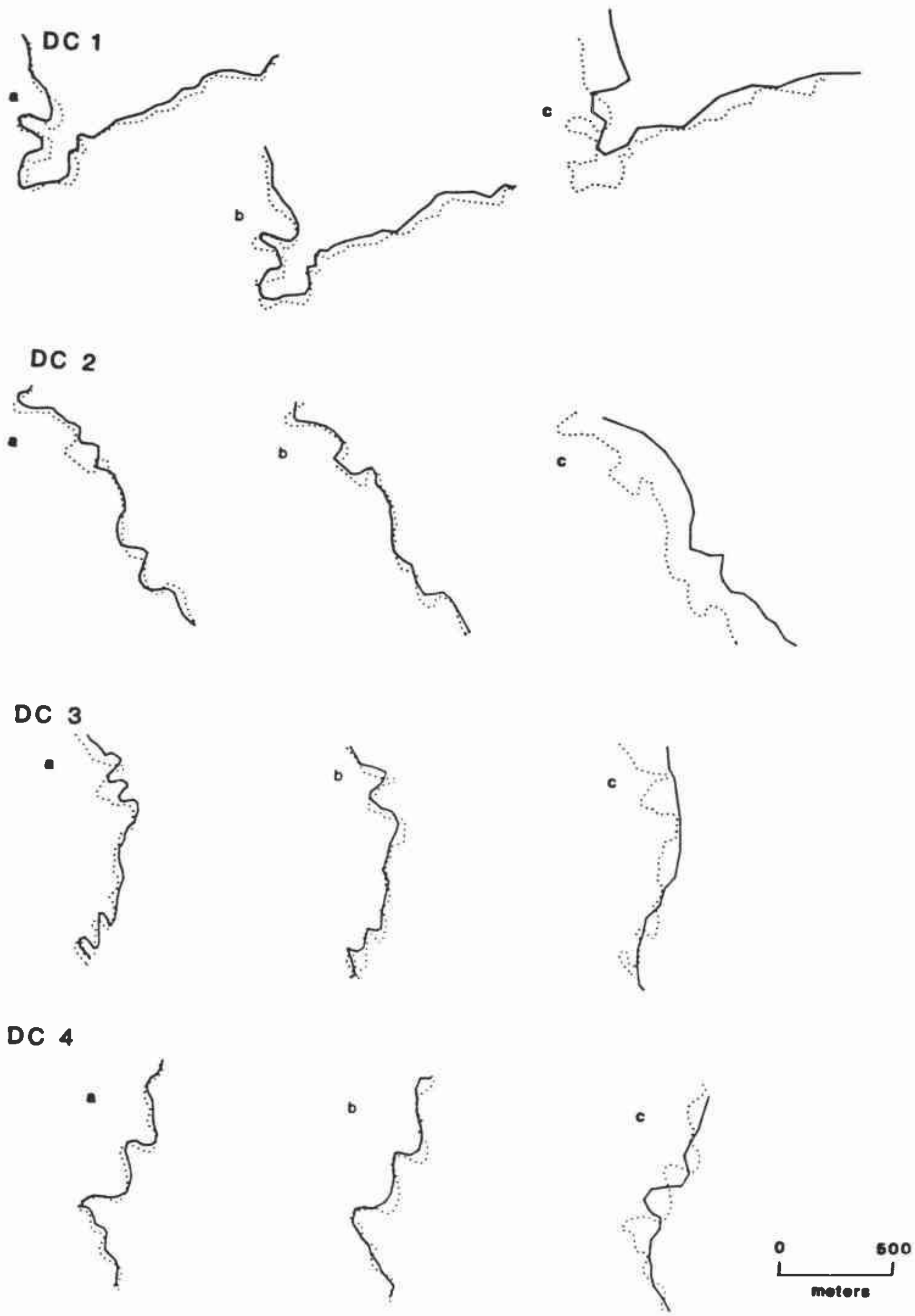


Figure 3a. Stream reaches digitized for analysis. The dotted line represents the reach at 1:24,000 (the base line) and the solid lines represent the reach at one of the three compare scales: 1:62,500 (a), 1:100,000 (b), and 1:250,000 (c). Line DC2a was not used in the analysis because it is a probable temporal change and line DC3a was not used because it failed to overlay properly.

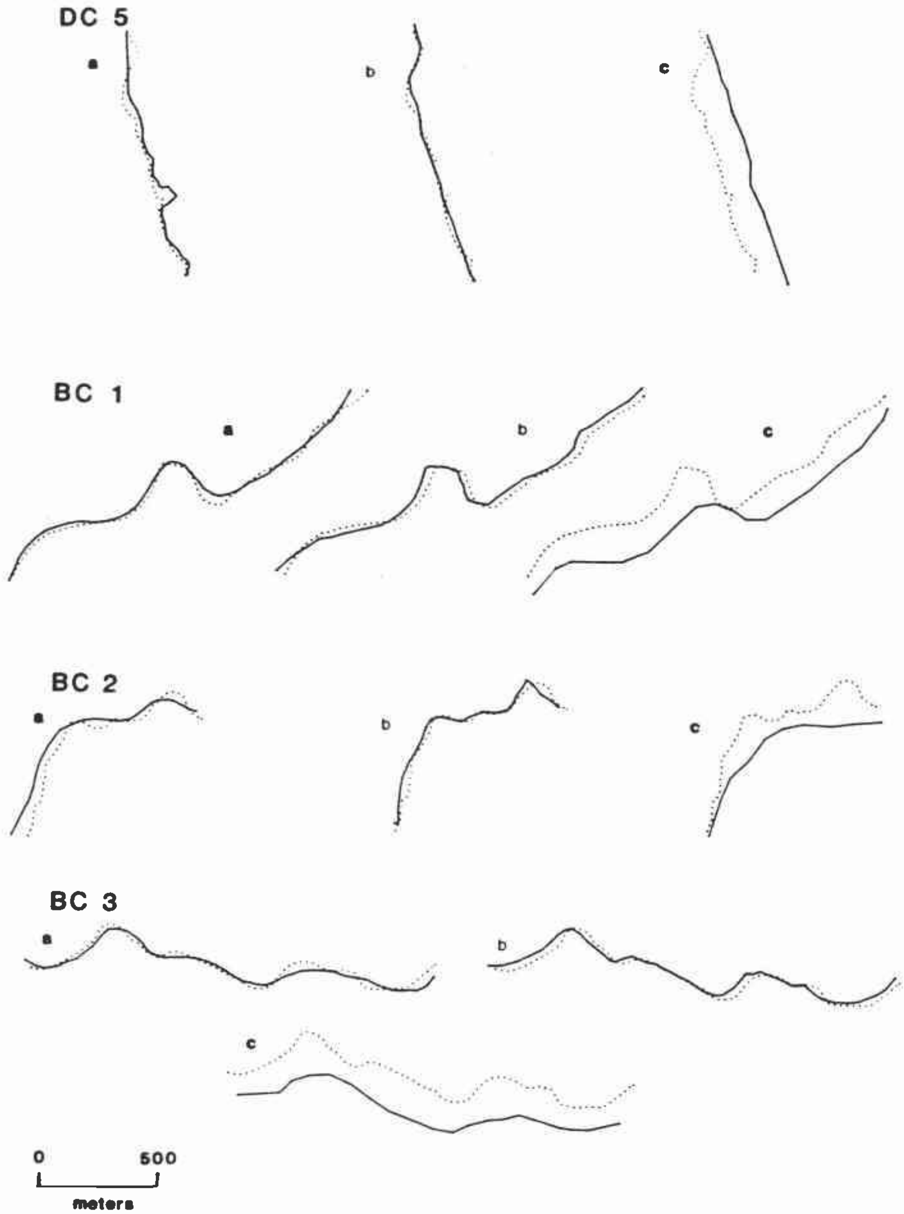


Figure 3b. Stream reaches digitized for analysis, continued.

The end-points of the eight stream reaches, each represented at the four scales, were carefully registered to each other using a Zoom Transfer Scope, and then digitized using a semi-automated free-moving cursor digitizing tablet (.001 inch resolution) in point mode. The data were transformed to UTM meters using an affine transformation.

Measurement

A program was written to take each stream reach and overlay it with the 1:24,000 representation. When overlain, the stream reaches produced polygons where the compare line (the stream reach at small scale) deviated from the base line (the 1:24,000 reach). The resultant polygon verticies were calculated and written to a computer file for further analysis. The end-points of the base and compare lines of each reach were closed to form polygons as if the reaches continued on indefinitely.

The captured polygons represented the amount of deviation between the base (1:24,000) line and the compare line (1:62,500, 1:100,000, or 1:250,000). At this juncture, a decision had to be made about how best to measure the deviation the polygons represented. A simple approach would be to calculate, by coordinate method, the area of each of these polygons (figure 2) and divide this area by the length of the base or compare line. This would yield an average deviation, but it is a gross measure, for it tells us nothing about the distribution of the error. The approach taken was to sample deviations at 10 meter intervals. Another program, conceptually similar to a polygon shading routine, was written to calculate these deviations.

In this program, each individual polygon was first rotated so that the two intersections of the base and compare line were vertical and orthogonal with the y-axis. Transects were calculated at 10 meter intervals and the difference between the intersection of the transect with the base and compare line was calculated (figure 4). These differences were summed, divided by the total number of transects, and then multiplied by area to attain an area weighted average. The weighted average was necessary to give importance to large versus small polygons. A second pass was made to calculate the deviation each transect had from the unweighted mean to yield the variance of each sample. The variance was also weighted by area. The weighted means and variances were used to calculate

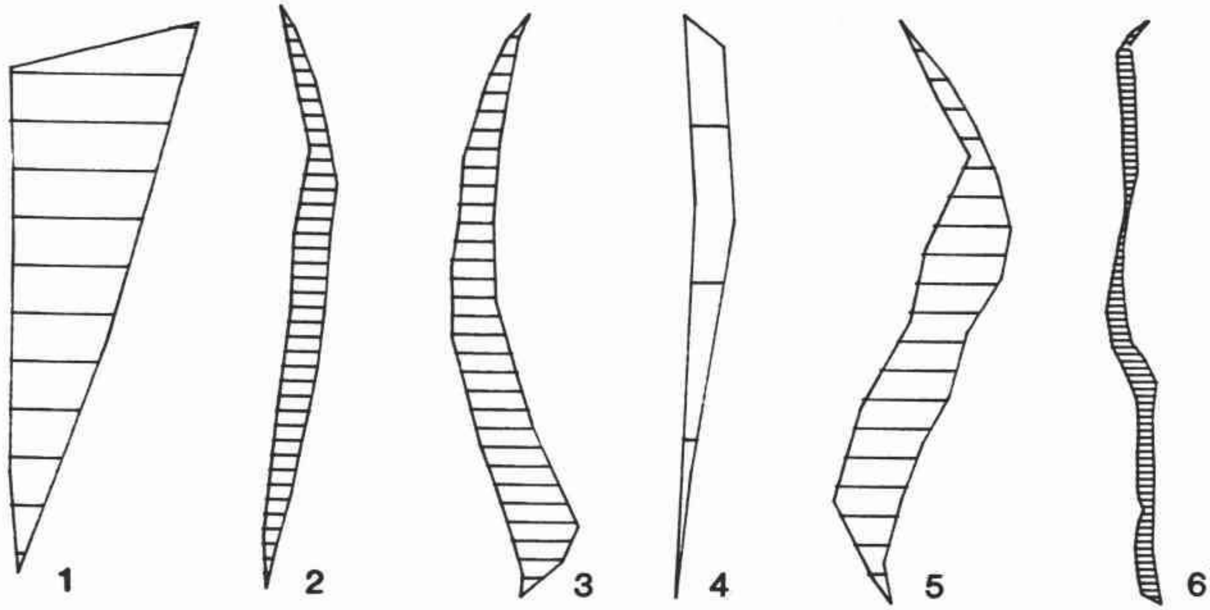


Figure 4. How error was calculated. These polygons are from the overlay shown on line BC1b in figure 3a. Each polygon is rotated so that the intersections of the base and compare line are vertical. The transects (shade lines) are 10 meters apart. The length of each transect for each polygon was used to obtain an average length and variance.

weighted standard deviations for each stream reach. The statistics from this analysis are presented in table 1.

In all cases, the absolute value of the transect distance was used. The compare line could deviate to the left or right of the base line, yielding positive or negative averages. It was assumed that overall, the sum of these positive and negative deviations would be zero.

Error distribution about a cartographic line

The result of this analysis shows that there is a bi-modal distribution of location error due to generalization and, in part, digitizing error (figure 5). The two modes of the distribution (the weighted averages) are placed on either side of the mathematical center of the line. This center-line falls in the 'saddle' between the two modes. If the error were a single-mode distribution, the result of the overlay of the base and compare line would most often yield parallel lines, where the lines were exactly or nearly coincident. The results do not bear this out, for there were no parallel lines. The polygons were mainly long 'cigar' shapes (see figure 4), where most of the transect samples were some distance away from the base line.

TABLE 1. Results of error analysis

ID	CI_b	1:62,500 mean	SD	E_{lw}	CI	1:100,000 mean	SD	E_{lw}	CI	1:250,000 mean	SD	E_{lw}	CI
DC1	2.50	31.27	15.73	.50	2.14	33.19	24.09	.33	2.14^H	89.77	107.87	.36	1.81
DC2	1.48	(Historical change)				22.22	17.16	.22	1.22	146.65	217.28	.59	1.13
DC3	1.75	(Overlay failed)				27.04	17.02	.27	1.37	72.50	126.48	.29	1.06
DC4	1.53	18.15	12.46	.29	1.40^H	30.32	13.45	.30	1.34	64.20	42.98	.26	1.23^L
DC5	1.13	22.12	52.88	.35	1.14^L	13.73	5.94	.14	1.04^L	107.97	202.97	.43	1.01
BC1	1.18	17.87	14.78	.29	1.15	22.73	22.30	.23	1.16	111.62	234.36	.45	1.09
BC2	1.38	35.51	22.23	.57	1.19	15.94	23.94	.16	1.37	86.28	261.17	.35	1.13
BC3	1.17	19.51	13.08	.31	1.11	20.71	9.46	.21	1.15	129.05	262.66	.52	1.07^H

CI = Mueller's (1968) Channel Index. Channel Index is simply the length of the stream divided by the 'crow fly' distance from its two endpoints and is used to judge stream sinuosity. CI_b is the Channel Index of the 1:24,000 stream reach.

E_{lw} = the width of the epsilon band as it would appear on the map, in millimeters. Values should be doubled to get actual line width.

SD = Standard Deviation

H = Highest standard deviation found in group.

L = Lowest standard deviation found in group.

The most plausible explanation for this twin-peaked curve is the undercut and overshoot tendencies that Traylor (1979) observed in digitizing, where one mode represents an undercut and the other an overshoot. It seems likely that the same undercut and overshoot would occur in manual map production processes and would be a natural consequence of generalization, so that the line placed on a map is rarely on the actual true location, but some mean (or epsilon) distance away. This has the disturbing consequence that the center of a drafted line is rarely on the true location, but some distance away (figure 6). For digitized lines, which have no thickness (i.e., a mathematical line), the true location of the line is most likely to be some mean distance away from the digitized line, or at the edges of the epsilon band. As to be expected, generalization only increases this distance. In generalizing, the cartographer attempts to systematically smooth the line while retaining the character of the line, intentionally straightening out corners, which is just a radical form of undercutting (for an example of this, see line DC5a in figure 3).

The area under a bi-modal curve is the same as a single-mode curve. Equidistant between the two modes falls the digitized line, and the probability that the line is in its true ground location at this point is 0.5. At the modes, the probability that the mode represents true location is either 0.75 or 0.25. If we wanted the mode with the highest probability, which one would we choose? The question could be answered if we could assume that everyone undercut convex curves and overshot concave ones, but this would be dependent on tracing or digitizing direction; clockwise or counter-clockwise. Since this information is not readily available, to say the least, the question cannot be answered so we end up choosing the saddle, a 0.5 probability, the same as if we assumed that the distribution of error was a single-mode curve. However, the model is not without its utility, for it allows and easier prediction of probability, as demonstrated in the next section.

One might expect that sinuous lines would have a higher error variance compared against straight lines. The data did not seem to validate this assumption (see measure of Channel Index in table 1) because, in generalizing relatively straight lines, once the line is missed, there is less of an opportunity to 'get back on track' as there is with more sinuous lines (see, for example, lines DC1c and DC5c in figure 3).

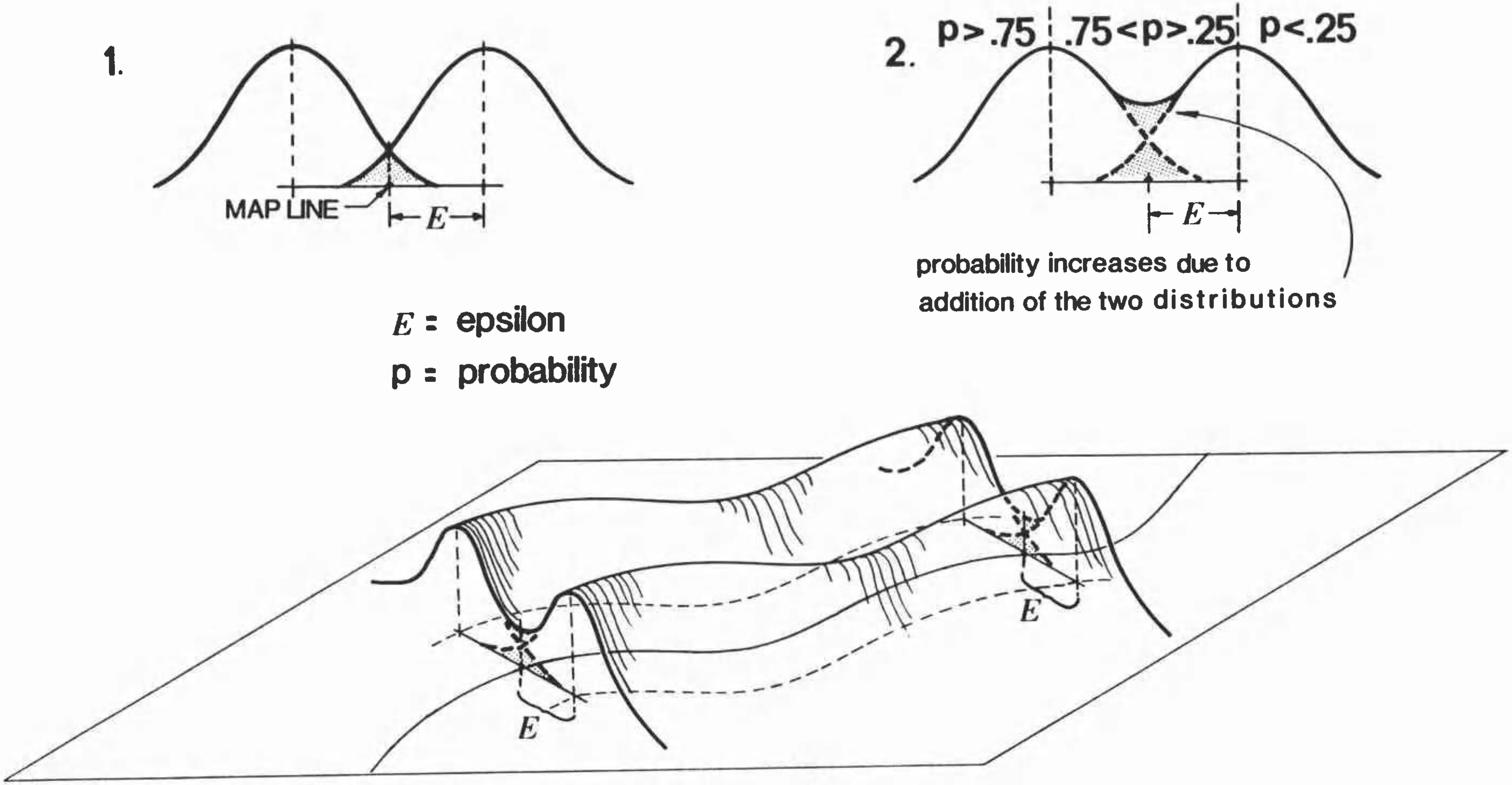


Figure 5. Bi-modal distribution of error about a cartographic line. The distribution of error due to tracing or generalization is bi-modal, most likely due to 'overshoot' and 'undercut' when tracing a line. The result is that the true ground location of the line is more likely to be to at the peaks of the distribution and not the saddle, where the line has been placed on the map. Distribution 2 shows how the area under the curve (the probability) is calcuated.

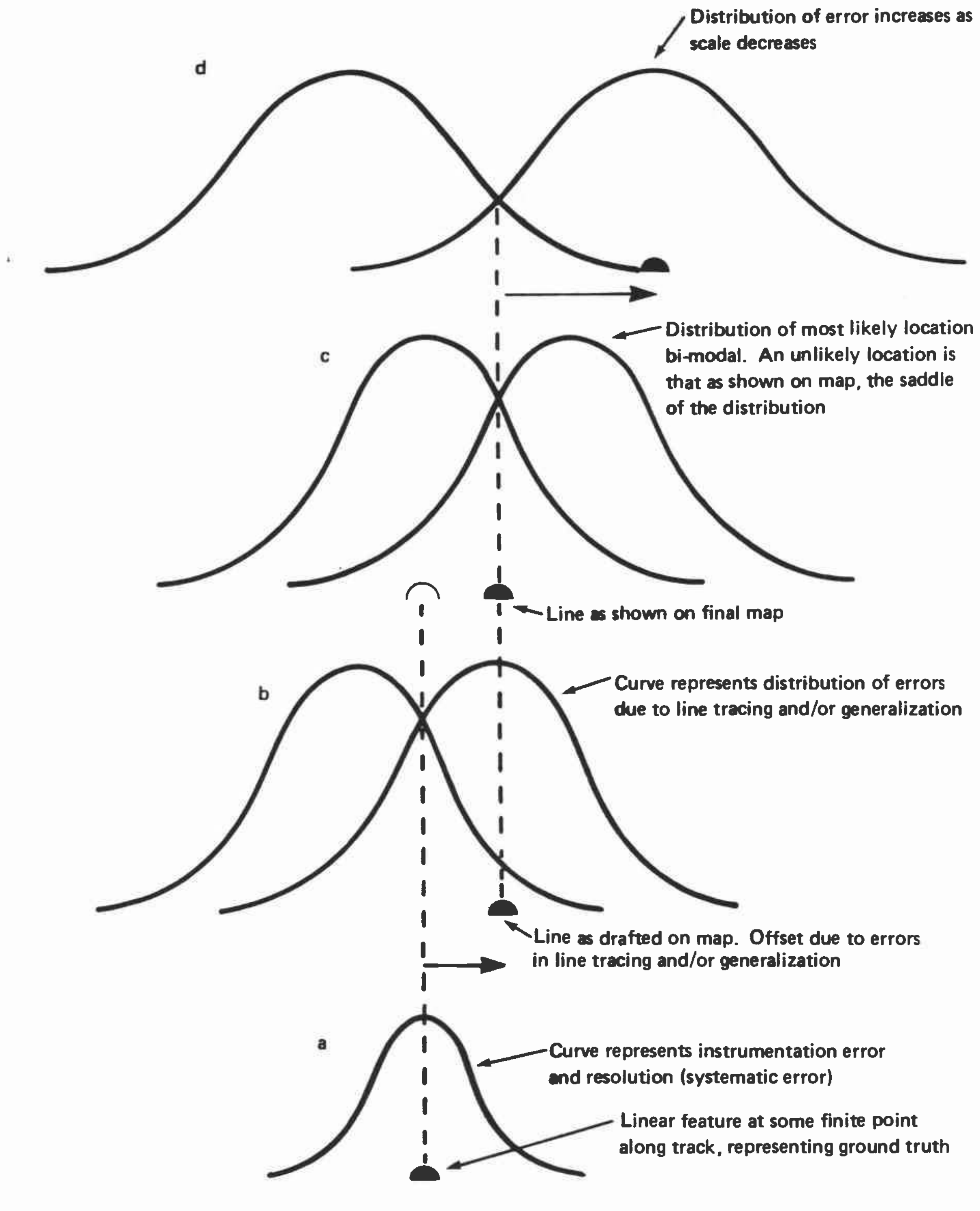


Figure 6. How the bi-modal distribution of cartographic error is created. The bottom curve (a) represents the error distribution that might be associated with instrumentation error. The second curve (b) shows how the line would be traced, where the cartographer or digitizer operator unconsciously places the line to the left or right, or, if generalizing, consciously places the line to the left or right to smooth the line while retaining its character. The third curve (c) represents the distribution of error as it appears on the final product. It is likely that the true ground location is away from the drafted or digitized line. The final distribution shows how scale generalization affects the distribution.

Throughout the analysis, the 1:24,000 map was assumed to be ground-truth when in fact it is not. Every map is a generalization of reality, but one has to start somewhere. In practical terms, the 1:24,000 map series is usually the largest scale available for any particular area. In this analysis, the assumption was that the error distribution about the 1:24,000 line was a single-mode distribution, where the actual location is distributed evenly about a mean of zero, and the standard deviation would be based upon the National Map Accuracy Standards (90 percent of the points within 0.02 inches of true ground location).

Summary

Thirty-two different stream reaches, eight apiece from the standard USGS topographic series maps, were digitized to measure positional error due to generalization. While all due care was taken in digitization of the reaches, errors were bound to occur. How much of the observed error was attributable to digitizing versus generalization is unknown, but it is felt that the majority was due to generalization. The procedures followed are typical of most short-lived, specific purpose data base construction methods (as opposed to more concerted long-term efforts, such as the Digital Line Graphs).

The sample size is too small to make any global assumptions about generalization errors, but the statistics were sufficient to perform the next part of the analysis. Much more experimentation with a higher degree of control is needed before there can be any global solution to the question of generalization error.

CALCULATING PROBABILITY

The statistics from table 1 were used to construct hypothetical sliver polygons. The highest and lowest standard deviations (SDs) from each of the compare line map scales were discarded and the remaining means and SDs were averaged by scale (table 2). For the 1:24,000 series, a mean of zero was used and a standard deviation of 7.41 meters was calculated based on the National Map Accuracy Standards that 90 percent of the well-defined points fall within 0.002 inches (0.508mm) of their true ground position.

TABLE 2. Statistics used in probability analysis.

Scale	Mean	SD
1:24,000	0.00	7.41
1:62,500	26.04	16.46
1:100,000	23.16	17.22
1:250,000	102.13	191.67

Method

A program was written that constructed square polygons of varying areas. The mean and SD of each side of the square could be specified, as well as a start length (in meters) for each side of the square. Figure 7 shows two such polygons. The solid exterior line of the polygons in this figure represent a digitized boundary while the dotted interior lines represent the mean (epsilon) distance from the boundary based on table 2. These hypothetical polygons represent sliver polygons resulting from a polygon overlay.

Once the means and SDs were input, 300 random points, a sufficiently large sample, were placed inside the boundaries of the square and the Z-score of each of these points from each of the four sides were calculated. If we consider that the sides of the square represent boundary lines, then probabilities can be calculated (from the individual Z-scores) that represent the likelihood that the point is actually the attribute on that side of the boundary line. The total probability that the point is actually the attribute bound by the four sides is some function of the four separate probabilities. Three measures could be used here. One is the average of the four probabilities. A second is that the total probability is that of the side of the square that is closest to the point (minimum distance to mean). The third measure is that of the side of the square that is closest in terms of standard deviation units (minimum Z-score). Each measure has its advantages and disadvantages. The average probability for a point right next to a line with a high epsilon would be offset by the higher probabilitiy it attained from the line directly opposite, which could have a low epsilon. The minimum distance to mean assumes a distance-decay function where the closest line exerts the most influence. The minimum Z-score assumes that the total probability is a function of the most inaccurate line (the line with the highest SD) that is closest to the point. As would be expected, the average probability was much higher in all cases. For squares

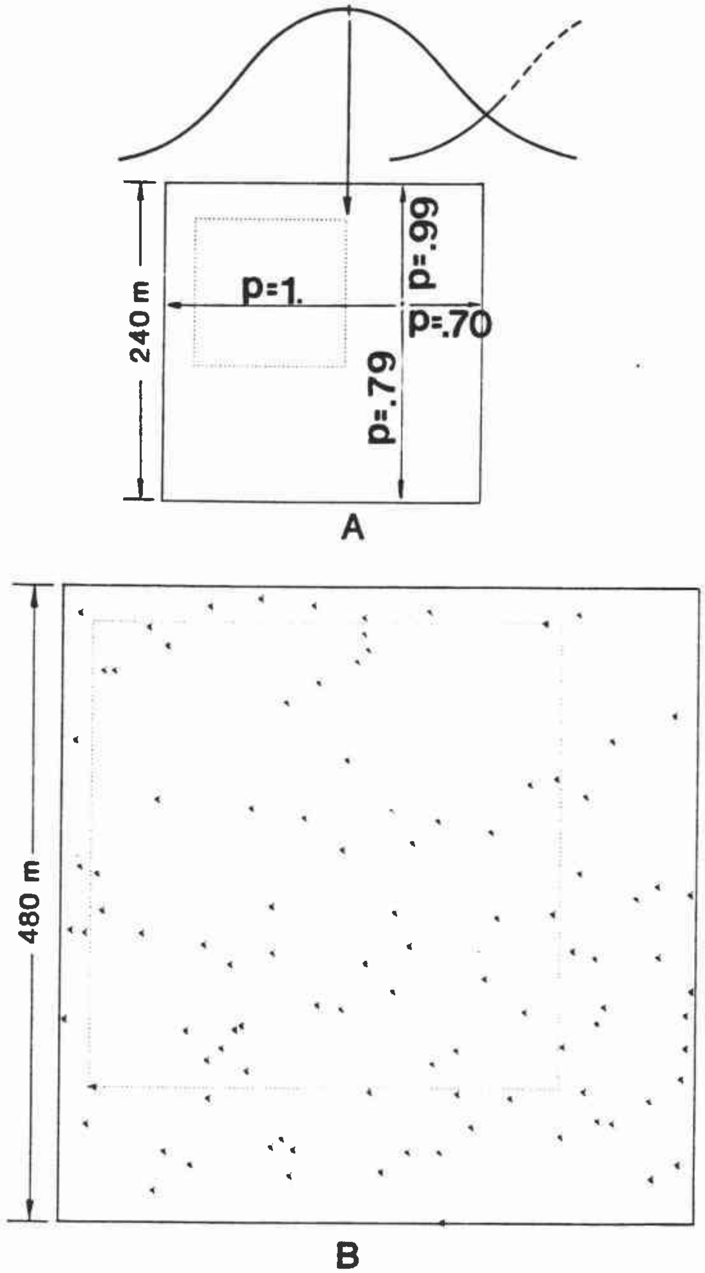


Figure 7. Hypothetical polygons constructed from a polygon overlay process using maps at three different scales. Polygon A shows how probability is calculated. A random point is generated that falls within the area bounded by the solid line, which represents the polygon boundaries. The line on the left is a 1:100,000 line, the top line is 1:62,500, and the bottom and right lines are 1:250,000. The dotted lines represent the weighted means from Table 2. The curve at the top shows the bi-modal distribution. The point's probability of being the attribute associated with the line on the right can be calculated by determining its distance from the mean and dividing by the standard deviation of that line. The probability of the point being the attribute associated with the entire square is some function of the probabilities associated with all 4 lines.

with all the same mean and standard deviation, the minimum distance to mean and minimum Z-score were identical. For squares made of sides of different scales, the minimum distance was a percentage point or two higher than the minimum Z-score until around 0.80 to 0.85 confidence, when they became nearly identical.

The program would iterate by doubling the lengths of the sides of the squares until all three measures of probability exceeded 0.99. At the end of each iteration, the average, minimum distance, and Z-score measures were output. A sample output is shown in figure 8.

The minimum Z-score probabilities were graphed against the area of the square, as shown in figure 9. Squares made up of lines of all the same scale are shown, as well as a few selected combinations that might result from a polygon overlay. There were many possible combinations of lines and only a few were tested. The initial chosen side length of the square was twice the value of the highest epsilon so that the epsilons would not overlap. These graphs can be read by selecting the confidence desired from the y-axis and reading the minimum area required to meet this confidence from the x-axis. The area was transformed to log (base 10) simply because the wide range of area values made it impossible to graph if the values were not transformed.

Analysis

If we could assume for a moment that the generalization error calculated here was an accurate measure of all generalization error, regardless of what features were generalized, then the cartographer has an extremely valuable set of information from which to make decisions about the design of a map. One general rule of thumb is that any polygon with an area equal to epsilon squared is the minimum area to be mapped; anything less would imply that the polygon boundary lines would cross each other. For example, on a 1:100,000 map, an square of $536m^2$ (epsilon squared) is but 0.23mm (0.009in) on a side, and this would be the minimum mappable areal unit. For a 1:250,000 map, the area would be $10{,}430m^2$, or 0.41mm (0.016in) on a side. Beyond this, the probability curve in the top of figure 9 could be used to determine minimal areas to be mapped. Here, for example, if we wanted to have a 99 percent confidence that an area contained 'a thing' or attribute, then the minimal mapping unit would be about $11km^2$ on a

ANALYSIS OF AREAL PROBABILITY

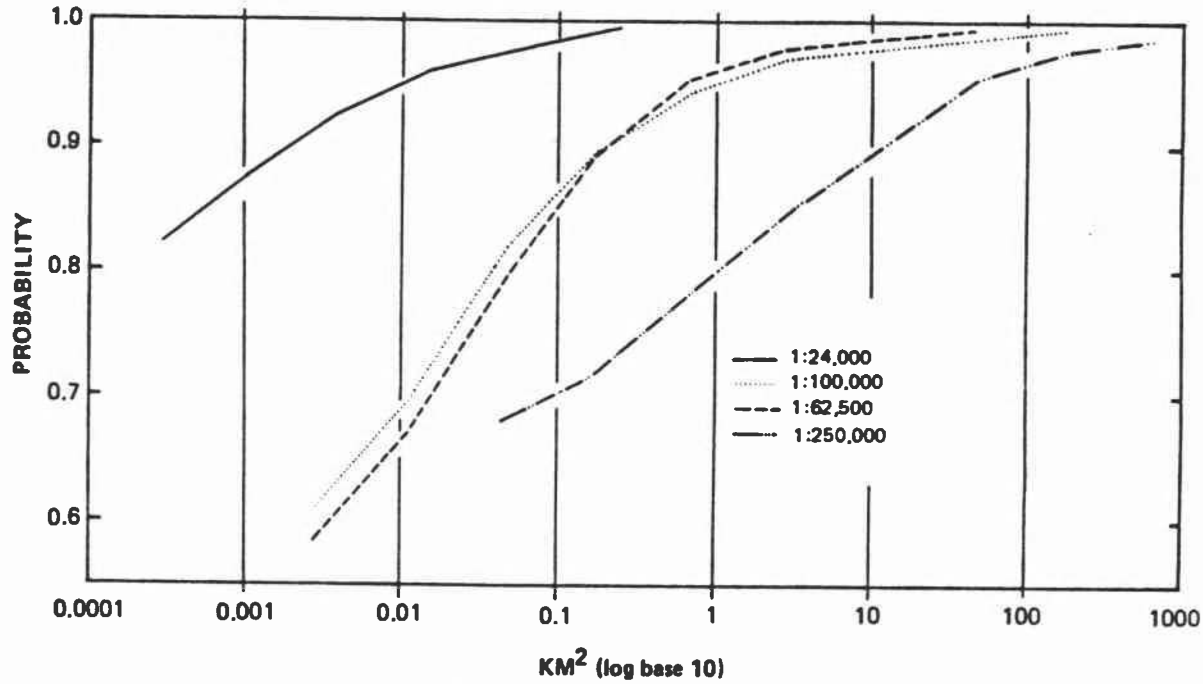
LINE (T,B,L,R)	MEAN	SD	SCALE
T	26.04	16.46	62500
B	102.13	191.67	250000
L	23.16	17.22	100000
R	102.13	191.67	250000

This is a systematic random sample...

Start length = 205.0 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	205.0	0.042	84.40	69.82	68.47
2	410.0	0.168	89.95	76.32	74.66
3	820.0	0.672	94.66	84.30	83.38
4	1640.0	2.690	97.30	91.03	90.61
5	3280.0	10.758	98.65	95.16	95.08
6	6560.0	43.034	99.33	97.59	97.51
7	13120.0	172.134	99.65	98.70	98.69
8	26240.0	688.538	99.83	99.34	99.34

Figure 8. Sample output from the probability analysis.



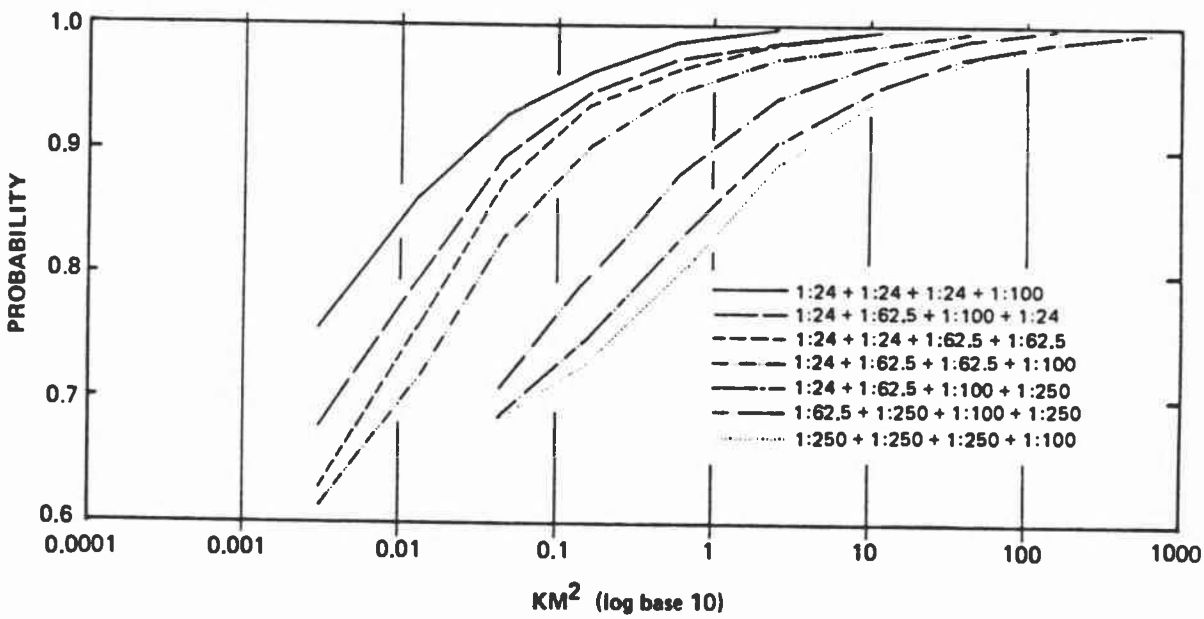


Figure 9. Graphs of probability versus area of hypothetical polygons. In the top graph, the squares were made of lines of all the same scale. In the bottom graph, the squares were made of lines of different scales. This information would be valuable to a GIS user to eliminate sliver polygons or to place some confidence in the results of a polygon overlay process.

1:62,500 map (a square about 53mm or 2in on a side). If more data were available, we could build a regression equation that would predict scale versus confidence versus minimal mapping area, and use this to determine optimum scale. In an automated environment, one novel approach might be to always output a map with lines having thicknesses scaled to epsilon, so that the map reader receives a visual clue regarding line accuracy.

The graph at the bottom of figure 9, showing squares made of polygons of different scales, contains no real surprises. Generally, the combination of scales averages out so that the probability curve falls somewhere between the largest and smallest scale. No attempt was made to mathematically determine the relationship between the confidence interval and scales used, although such a determination could undoubtably be done.

There are some obvious problems with the data and the analysis. First and foremost is the fact that a very limited data set was used to calculated generalization error. Secondly, there is an assumption made that a linear feature, such as a stream, will form a polygon boundary. One rarely draws polygons made of nothing but stream segments. It should also be noted that the attribute of a polygon and the purpose of the map have much to do with the confidence one places with the data. For instance, a polygon of some forest type may just be the demarcation of an area of homogeneous heterogeneity, where the boundary is a transistional zone whose width is far greater then an epsilon band resulting from generalization error.

CONCLUSION

As cartographers enter the structured, logical world of map automation, their assumptions about the accuracy of a map should likewise become structured and logical. Cartographic convention must be transformed from an intuitive graphic language to a structured mathematical language if we are to commit ourselves to automated methods. Nowhere is this more evident then in the interplay of map scale and generalization, where the cartographer feels his/her way through the nuances of map design to present a map that communicates the limitations of the data. This study is one attempt to quantify this process. No claim is made towards a solution, for the study is limited. Rather, it is hoped that the methods and analysis presented here will lay some groundwork for further study. It has been shown that a map symbols can be viewed as a surface of probability and as such, cartographic convention can be programmed into our systems so that informed decisions can be made.

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APPENDICIES

APPENDIX A – Programs

APPENDIX B – Reports from PASTA OVERLAY and TRANSECT

APPENDIX C – Reports from program BOX

APPENDIX D – Maps and stream reaches used in analysis

APPENDIX A
Programs

All programs were written on a Tektronics 4051 in BASIC. This machine is a real beauty, except that it is limited to 32K memory which limited the analysis somewhat. As it turned out, I was limited to lines of less than 100 points. The memory limitation also has the unfortunate side effect of limiting the number of REMARKS, so the some of the programs, especially TRANSECT, are poorly documented. I went through and briefly annotated some sections by hand.

A total of 5 main programs were used. They are as follows:

1) DIGITIZE
2) PASTA OVERLAY
3) TRANSECT
4) BOX
5) PLOTLINES

DIGITIZE is used to digitize the lines. It is a slight modification of A. Jon Kimerling's basic digitizing program. The program first asks for a line description which becomes a file header to the digitized line. CAUTION: this program will 'mark' a file of 5000 bytes on the tape. 'Marking' a file requires that the file be the last file on tape. If you mark a file in the middle of the tape, all files after that are lost.

PASTA OVERLAY is the program that creates the polygons. It asks for a base line file number and a compare line file number. It requests the scale of each line as terminal input. A POLYGON file number is also requested. CAUTION: like DIGITIZE, PASTA OVERLAY will mark a file (of 10,000 bytes). The two lines will be drawn to the screen. When a polygon is calculated, it is traced on the screen. PASTA OVERLAY takes a while to run.

TRANSECT calculates the deviations, variences, standard deviations, and a whole host of other statistics, and outputs a report.

BOX constructs the hypothetical polygons from terminal input and calculates probabilities. It is fairly straight-forward.

PLOTLINE simply plots the lines as shown in figures 3a and 3b in the main text. It is included here as an example of how to drive the HP plotter.

DIGITIZE

```
10 PAGE
20 REM*****
30 REM*  Program to digitize lines for analysis.  Modification
40 REM*   of AJ Kimerling's original digitize program.  Uses
50 REM*   an affine transformation..
60 REM*****
70 CALL 'RATE',1200,5,0
80 INIT
90 DIM X4(100),Y4(100)
100 PRINT 'LGTCO Digitizer to x,y,z coordinate program'
110 PRINT 'JInitialize Digitizer for Coordinate calculation.'
120 PRINT 'Type 'R' when ready... ';
130 INPUT Q$
140 E2=47400
150 PRINT 'JRewind and eject Program Tape,insert Data Tape'
160 PRINT 'Type 'R' when ready... ';
170 INPUT Q$
180 PRINT 'JEnter Data File number... ';
190 INPUT I9
200 FIND I9
210 MARK 1,5120
220 FIND I9
230 PRINT 'JEnter line description:'
240 INPUT A$
250 PRINT @33:A$
260 PRINT 'JEnter the minimum and maximum Eastings:'
270 INPUT C0,C1
280 PRINT 'JEnter the minimum and maximum Northings:'
290 INPUT D0,D1
300 PRINT 'JEnter the interval between grid ticks: ';
310 INPUT T0
320 PAGE
330 PRINT 'JDigitize 3 control points '
340 INPUT @40:X1,Y1
350 INPUT @40:X2,Y2
360 INPUT @40:X3,Y3
370 PRINT X1;Y1;X2;Y2;X3;Y3
380 PRINT 'Correct? (Y or N)...G';
390 INPUT Q$
400 IF Q$='N' THEN 330
410 PRINT 'Enter 3 grid coordinates corresponding with those digitized '
420 PRINT 'G'
430 INPUT M1,N1,M2,N2,M3,N3
440 PRINT 'G'
450 PRINT 'Correct? (Y or N)... ';
460 PRINT 'G'
470 INPUT Q$
480 IF Q$='N' THEN 410
490 D=X1*Y2+Y1*X3+X2*Y3-Y2*X3-X2*Y1-X1*Y3
500 A1=(M1*Y2+Y1*M3+M2*Y3-Y2*M3-Y1*M2-M1*Y3)/D
```

DIGITIZE (cont.)

```
510 A2=(X1*M2+M1*X3+X2*M3-M2*X3-M1*X2-X1*M3)/D
520 A3=(X1*Y2*M3+Y1*M2*X3+M1*X2*Y3-M1*Y2*X3-Y1*X2*M3-X1*M2*Y3)/D
530 B1=(N1*Y2+Y1*N3+N2*Y3-Y2*N3-Y1*N2-N1*Y3)/D
540 B2=(X1*N2+N1*X3+X2*N3-N2*X3-N1*X2-X1*N3)/D
550 B3=(X1*Y2*N3+Y1*N2*X3+N1*X2*Y3-N1*Y2*X3-Y1*X2*N3-X1*N2*Y3)/D
560 Z0=-1
570 PRINT 'Digitize the start point three times'
580 X8=0
590 Y8=0
600 FOR I=1 TO 3
610 INPUT @40:X,Y
620 X8=X8+X
630 Y8=Y8+Y
640 PRINT 'G'
650 NEXT I
660 X8=X8/3
670 Y8=Y8/3
680 PRINT 'Now digitize the end point three times'
690 X9=0
700 Y9=0
710 FOR I=1 TO 3
720 INPUT @40:X,Y
730 X9=X9+X
740 Y9=Y9+Y
750 PRINT 'G'
760 NEXT I
770 X9=X9/3
780 Y9=Y9/3
790 X4(1)=A1*X8+A2*Y8+A3
800 Y4(1)=B1*X8+B2*Y8+B3
810 I=1
820 PRINT 'JDigitize the line  - when done digitize the END LINE dot'
830 PRINT 'Maximum of 100  points per line'
840 PRINT 'No.        E          N'
850 PRINT @32,26:2
860 PRINT X4(1),Y4(I)
870 INPUT @40:X,Y
880 PRINT X4(I),Y4(I)
890 PRINT 'GK'
900 IF I=100 THEN 1390
910 IF X>E2 THEN 980
920 I=I+1
930 X4(I)=A1*X+A2*Y+A3
940 Y4(I)=B1*X+B2*Y+B3
950 IF I<>50 THEN 870
960 PRINT '50 pointsGGG'
970 GO TO 870
980 PRINT 'JLine is digitized!G'
990 PRINT @32,26:0
1000 PRINT 'JDo you want to see a display of this line?(Y or N)...G';
```

DIGITIZE (cont.)

```
1010 INPUT Q$
1020 IF Q$='N' THEN 1170
1030 PAGE
1040 WINDOW C0,C1,D0,D1
1050 S=(D1-D0)/(C1-C0)
1060 IF S<1 THEN 1090
1070 VIEWPORT 0,100/S,0,100
1080 GO TO 1100
1090 VIEWPORT 0,100,0,100*S
1100 AXIS T0,T0
1110 MOVE X4(1),Y4(1)
1120 FOR J=2 TO I
1130 DRAW X4(J),Y4(J)
1140 NEXT J
1150 PRINT '^When through viewing,enter `R`...G';
1160 INPUT Q$
1170 I=I+1
1180 IF I<100 THEN 1200
1190 I=100
1200 X4(I)=A1*X9+A2*Y9+A3
1210 Y4(I)=B1*X9+B2*Y9+B3
1220 FOR J=1 TO I
1230 PRINT @33:X4(J),Y4(J)
1240 NEXT J
1250 CLOSE
1260 PRINT 'Number of points= ';I
1270 PRINT 'JDigitize another?(Y or N):';
1280 INPUT Q$
1290 IF Q$='N' THEN 1430
1300 PRINT 'Enter file number:';
1310 INPUT I9
1320 FIND I9
1330 MARK 1,5120
1340 FIND I9
1350 PRINT 'Enter description:'
1360 INPUT A$
1370 PRINT @33:A$
1380 GO TO 570
1390 FOR I=1 TO 10
1400 HOME
1410 PRINT 'Give up! Too many coordinates!GGGG'
1420 NEXT I
1430 END
```

END OF DIGITIZE PROGRAM

PASTA OVERLAY

```
20 PAGE
30 X=100
40 Y=X*2
50 DIM L1(2,X),L2(2,X),A(2,Y+5),M1(X-1),M2(X-1)
60 DIM T1(X),T2(X)
70 P1=1
80 P2=1
90 X=1
100 Y=2
110 D1=0
120 D2=0
130 B=0
140 B1=0
150 B2=0
160 N1=1
170 N2=1
180 R=7
190 P9=0
200 PRINT "*****************************************************"
210 PRINT "*                                                   *"
220 PRINT "*               PASTA OVERLAY PROGRAM               *"
230 PRINT "*                        by                         *"
240 PRINT "*                 Dale M. Honeycutt                 *"
250 PRINT "*                                                   *"
260 PRINT "*****************************************************"
270 PRINT " "
280 PRINT " "
290 PRINT "EJECT THIS PROGRAM TAPE, INSERT DATA TAPE, HIT RETURN";
300 INPUT A$
310 PRINT " "
320 PRINT "Enter experiment number:";
330 INPUT E
340 PRINT "Enter file number of base line: ";
350 INPUT I
360 FIND I
370 INPUT @33:A$
380 PRINT "Description is:"
390 PRINT A$
400 PRINT "Enter scale of line:";
410 INPUT S8
420 PRINT "MAKE SURE PRINTER IS HOOKED UP, THEN HIT RETURN";
430 INPUT B$
440 CALL "RATE",600,5,0
450 D$=CHR(15)
460 PRINT @40:D$
470 PRINT @40:"J"
480 PRINT @40:"J"
490 PRINT @40: USING 500:
500 IMAGE15X"-- R E P O R T   O F   L I N E   O V E R L A Y --J"
```

PASTA OVERLAY (cont.)

```
510 PRINT @40:'J'
520 PRINT @40: USING 530:E
530 IMAGE10X,'This is experiment number ',3D,'J'
540 PRINT @40: USING 550:I
550 IMAGE10X,'Base line file number: ',3D,'J'
560 ON EOF (0) THEN 600
570 INPUT @33:L1(X,N1),L1(Y,N1)
580 N1=N1+1
590 GO TO 560
600 PRINT @40: USING 620:L1(X,1),S8
610 N1=N1-1
620 IMAGE10X,'Start X-pt: ',10D,3X,'Scale:  1:',7D ,'J'
630 PRINT @40: USING 640:L1(Y,1),N1
640 IMAGE10X,'Start Y-pt: ',10D,3X,'Number of points: ',4D,'J'
650 PRINT @40: USING 660:L1(X,N1)
660 IMAGE10X,'End X-pt: ',2X,10D,'J'
670 PRINT @40: USING 680:L1(Y,N1)
680 IMAGE10X,'End Y-pt:',3X,10D,'J'
690 PRINT @40: USING 700:
700 IMAGE10X,'DescriptionJ'
710 PRINT @40: USING 720:A$
720 IMAGE10X,78A,'J'
730 PRINT @40:'J'
740 PRINT @40:'J'
750 PRINT 'Enter compare line file number: ';
760 INPUT I
770 FIND I
780 INPUT @33:B$
790 PRINT 'Description is:'
800 PRINT B$
810 PRINT 'Enter scale of this line:';
820 INPUT S9
830 PRINT @40: USING 840:I
840 IMAGE10X,'Compare line file number',3D,'J'
850 ON EOF (0) THEN 890
860 INPUT @33:L2(X,N2),L2(Y,N2)
870 N2=N2+1
880 GO TO 850
890 PRINT @40: USING 620:L2(X,1),S9
900 N2=N2-1
910 PRINT @40: USING 640:L2(Y,1),N2
920 PRINT @40: USING 660:L2(X,N2)
930 PRINT @40: USING 680:L2(Y,N2)
940 PRINT @40: USING 700:
950 PRINT @40: USING 720:B$
960 PRINT @40:'J'
970 PRINT @40:'J'
980 PRINT ' '
990 PRINT 'Enter file to write polygons to:';
1000 INPUT F
```

PASTA OVERLAY (cont.)

```
1010 FIND R
1020 MARK 1,10240
1030 FIND R
1040 PRINT @33:E
1050 PRINT @33:A$
1060 PRINT @33:S8
1070 PRINT @33:B$
1080 PRINT @33:S9
1090 REM****************************************
1100 REM*  Now calculate slopes for line segments, line distances
1110 REM*   and min/max's.  Output to report.
1120 REM****************************************
1130 Z1=L1(X,1)
1140 Z2=L1(X,1)
1150 Z3=L1(Y,1)
1160 Z4=L1(Y,1)
1170 FOR I=1 TO N1-1
1180 IF L1(X,I)<>L1(X,I+1) THEN 1200
1190 L1(X,I+1)=L1(X,I+1)+1.0E-3
1200 Z=L1(X,I+1)-L1(X,I)
1210 U=L1(Y,I+1)-L1(Y,I)
1220 D1=D1+SQR(ABS(U^2+Z^2))
1230 IF Z<>0 THEN 1260
1240 PRINT 'VERTICAL LINE SEGMENT ON BASE LINE, SEGMENT# ',I,'G'
1250 STOP
1260 M1(I)=U/Z
1270 Z1=Z1 MIN L1(X,I)
1280 Z2=Z2 MAX L1(X,I)
1290 Z3=Z3 MIN L1(Y,I)
1300 Z4=Z4 MAX L1(Y,I)
1310 NEXT I
1320 Z1=Z1 MIN L1(X,N1)
1330 Z2=Z2 MAX L1(X,N1)
1340 Z3=Z3 MIN L1(Y,N1)
1350 Z4=Z4 MAX L1(Y,N1)
1360 PRINT @40: USING 1370:D1
1370 IMAGE10X,'Base line distance:   ',10D,'J'
1380 Z5=L2(X,1)
1390 Z6=L2(X,1)
1400 Z7=L2(Y,1)
1410 Z8=L2(Y,1)
1420 FOR I=1 TO N2-1
1430 IF L2(X,I)<>L2(X,I+1) THEN 1450
1440 L2(X,I+1)=L2(X,I+1)+1.0E-3
1450 Z=L2(X,I+1)-L2(X,I)
1460 U=L2(Y,I+1)-L2(Y,I)
1470 D2=D2+SQR(ABS(U^2+Z^2))
1480 IF Z<>0 THEN 1510
1490 PRINT 'VERTICAL LINE SEGMENT ON COMPARE LINE, SEGMENT# ',I,'G'
1500 STOP
```

PASTA OVERLAY (cont.)

```
1510 M2(I)=U/Z
1520 Z1=Z1 MIN L2(X,I)
1530 Z2=Z2 MAX L2(X,I)
1540 Z3=Z3 MIN L2(Y,I)
1550 Z4=Z4 MAX L2(Y,I)
1560 NEXT I
1570 Z1=Z1 MIN L2(X,N2)
1580 Z2=Z2 MAX L2(X,N2)
1590 Z3=Z3 MIN L2(Y,N2)
1600 Z4=Z4 MAX L2(Y,N2)
1610 PRINT @40: USING 1620:D2
1620 IMAGE10X,'Compare line distance: ',10D,'J'
1630 Z=L1(X,1)-L1(X,N1)
1640 U=L1(Y,1)-L1(Y,N1)
1650 D3=SQR(Z^2+U^2)
1660 PRINT @40: USING 1670:D1/D3
1670 IMAGE'J',10x,'Channel Index for base line: ',3d.2d,'J'
1680 Z=L2(X,1)-L2(X,N2)
1690 U=L2(Y,1)-L2(Y,N2)
1700 D3=SQR(Z^2+U^2)
1710 PRINT @40: USING 1720:D2/D3
1720 IMAGE10x,'Channel index for compare line: ',3d.2d,'J'
1730 PRINT @33:D1
1740 PRINT @33:D2
1750 REM****************************
1760 REM*  Now we'll draw lines to screen.  First calculate min/max.
1770 REM****************************
1780 Z1=Z1 MIN Z5
1790 Z2=Z2 MAX Z6
1800 Z3=Z3 MIN Z7
1810 Z4=Z4 MAX Z8
1820 IF Z2-Z1>Z4-Z3 THEN 1860
1830 G1=90
1840 G=(Z2-Z1)/(Z4-Z3)*90
1850 GO TO 1880
1860 G=90
1870 G1=(Z4-Z3)/(Z2-Z1)*90
1880 WINDOW Z1,Z2,Z3,Z4
1890 VIEWPORT 5,G+5,5,G1+5
1900 PAGE
1910 MOVE L1(X,1),L1(Y,1)
1920 FOR I=1 TO N1
1930 DRAW L1(X,I),L1(Y,I)
1940 NEXT I
1950 MOVE L2(X,1),L2(Y,1)
1960 FOR I=1 TO N2
1970 DRAW L2(X,I),L2(Y,I)
1980 NEXT I
1990 HOME
2000 PRINT A$
```

PASTA OVERLAY (cont.)

```
2010 PRINT B$
2020 PRINT "Experiment number: ";E
2030 REM*****************************
2040 REM*  Now for the guts of the overlay routine!
2050 REM**********************************
2060 P1=1
2070 P2=1
2080 I1=L1(X,1)
2090 I2=L1(Y,1)
2100 P4=1
2110 FOR I=1 TO N1
2120 T1(I)=0
2130 NEXT I
2140 FOR I=1 TO N2
2150 T2(I)=0
2160 NEXT I
2170 REM*****************************
2180 REM*  TOP OF SEGMENT INTERSECTION LOOP
2190 REM*****************************
2200 REM**** KEEP THIS REMARK, IT'S A 'GOTO' LABEL!
2210 REM*  Calculate equation constants, solve by Cramer's rule.
2220 REM****
2230 C1=M1(P1)*L1(X,P1)-L1(Y,P1)
2240 A1=M1(P1)
2250 C2=M2(P2)*L2(X,P2)-L2(Y,P2)
2260 A2=M2(P2)
2270 D=-A1+A2
2280 REM****
2290 REM* Parallel lines if determinate=0 (D)
2300 REM****
2310 IF D<>0 THEN 2410
2320 REM****
2330 REM*  Here for parallel lines.  If C1<>C2, then they have nothing
2340 REM*   in common.
2350 REM****
2360 IF C1<>C2 THEN 2850
2370 GO TO 4490
2380 REM****
2390 REM*  Find intersection.
2400 REM****
2410 Y1=(A1*C2-A2*C1)/D
2420 X1=(-C1+C2)/D
2430 REM****
2440 REM*  Does X1&Y1 fall within both MBR's?
2450 REM****
2460 F=0
2470 F1=0
2480 Z5=L1(X,P1) MIN L1(X,P1+1)
2490 Z6=L1(X,P1) MAX L1(X,P1+1)
2500 IF X1<Z5 OR X1>Z6 THEN 2550
```

PASTA OVERLAY (cont.)

```
2510 REM****
2520 REM*  X' IN
2530 REM****
2540 F=1
2550 Z5=L1(Y,P1) MIN L1(Y,P1+1)
2560 Z6=L1(Y,P1) MAX L1(Y,P1+1)
2570 IF Y1<Z5 OR Y1>Z6 THEN 2650
2580 REM****
2590 REM*  Y' IN
2600 REM****
2610 F=F+1
2620 IF F<2 THEN 2640
2630 F1=1
2640 F=0
2650 Z5=L2(X,P2) MIN L2(X,P2+1)
2660 Z6=L2(X,P2) MAX L2(X,P2+1)
2670 IF X1<Z5 OR X1>Z6 THEN 2720
2680 REM****
2690 REM*  X'' IN
2700 REM****
2710 F=1
2720 Z5=L2(Y,P2) MIN L2(Y,P2+1)
2730 Z6=L2(Y,P2) MAX L2(Y,P2+1)
2740 IF Y1<Z5 AND Y1>Z6 THEN 2790
2750 REM****
2760 REM*  Y'' IN
2770 REM****
2780 F=F+1
2790 IF F<2 THEN 2810
2800 F1=F1+1
2810 IF F1=2 THEN 3010
2820 REM****
2830 REM*  No intersection, increment pointers to L2
2840 REM****
2850 P2=P2+1
2860 IF P2<N2 THEN 2200
2870 REM****
2880 REM*  At end of compare line, increment base, set compare back.
2890 REM****
2900 P1=P1+1
2910 IF P1=N1 THEN 2940
2920 P2=1
2930 GO TO 2200
2940 X1=L1(X,N1)
2950 Y1=L1(Y,N1)
2960 B=1
2970 REM******************************
2980 REM*  Here we have intersection.  Update 'T' arrays.  They
2990 REM*  are valuable.  They tell us what nodes are free.
3000 REM******************************
```

PASTA OVERLAY (cont.)

```
3010 T1(P1)=T1(P1)+1
3020 T2(P2)=T2(P2)+1
3030 REM******************************
3040 REM*  If T1 or T2 under current segment equal to one,
3050 REM*   then we have to account for nodes.  If T1 or T2
3060 REM*   have something greater than one, than there are
3070 REM*   no nodes to account for on this segment.  To account
3080 REM*   for nodes, we work backwards through the 'T' arrays.
3090 REM*   If T()=0, then stuff that node in.  If T()>0, then
3100 REM*   stuff last intersection in and stop looping.
3110 REM******************************
3120 P3=1
3130 IF P1=1 AND P2=1 THEN 4220
3140 REM****
3150 REM*  Put last intersection in.
3160 REM****
3170 A(X,P3)=I1
3180 A(Y,P3)=I2
3190 P3=2
3200 REM****
3210 REM*  Has L1 segment been intersected more than once?
3220 REM*   If so, no nodes on this segment.
3230 REM****
3240 IF T1(P1)>1 THEN 3480
3250 REM****
3260 REM*  No -- we have nodes in L1
3270 REM****
3280 K=P1
3290 K=K-1
3300 REM****
3310 REM*  If K=1, we're back at first segment. Start stuffing
3320 REM*   nodes into area array (A).
3330 REM****
3340 IF K=0 THEN 3420
3350 REM****
3360 REM*  If segment not intersected, then decrement
3370 REM****
3380 IF T1(K)=0 THEN 3290
3390 REM****
3400 REM*  Segment intersected, increment K to point to end node
3410 REM****
3420 K=K+1
3430 FOR I=K TO P1
3440 A(X,P3)=L1(X,I)
3450 A(Y,P3)=L1(Y,I)
3460 P3=P3+1
3470 NEXT I
3480 A(X,P3)=X1
3490 A(Y,P3)=Y1
3500 REM****
```

PASTA OVERLAY (cont.)

```
3510 REM*  Save pointer to intersection.  We write this to tape.
3520 REM****
3530 P9=P3
3540 P3=P3+1
3550 REM****
3560 REM*  Now put in line 2 nodes.  Same logic as before - has
3570 REM*   current segment been intersected more than once?
3580 REM*   If so than no free nodes on segment.
3590 REM****
3600 IF T2(P2)>1 THEN 3830
3610 K=P2
3620 K=K-1
3630 REM****
3640 REM*  If K=1, we're back to first segment.
3650 REM****
3660 IF K=0 THEN 3740
3670 REM****
3680 REM*  If segment not intersected, go back and decrement
3690 REM****
3700 IF T2(K)=0 THEN 3620
3710 REM****
3720 REM*  Segment intersected, increment K to point to end-node
3730 REM****
3740 K=K+1
3750 FOR I=P2 TO K STEP -1
3760 A(X,P3)=L2(X,I)
3770 A(Y,P3)=L2(Y,I)
3780 P3=P3+1
3790 NEXT I
3800 REM****
3810 REM*  Make first and last node equal
3820 REM****
3830 A(X,P3)=A(X,1)
3840 A(Y,P3)=A(Y,1)
3850 REM*****************************
3860 REM*  Output section.  Output to tape number of points in this
3870 REM*   polygon and the pointer to the intersection point (P9).
3880 REM*   Write area array, too, since we might want it.  Check
3890 REM*   first if B1 or B2 equal to 1, which means we have a
3900 REM*   polygon that has all four points the same, the result
3910 REM*   of parallel lines.
3920 REM*****************************
3930 REM* KEEP THIS, IT'S A LABEL
3940 MOVE A(X,1),A(Y,1)
3950 IF B1=1 OR B2=1 THEN 4020
3960 PRINT @33:P3,P9
3970 FOR I=1 TO P3
3980 PRINT @33:A(X,I),A(Y,I)
3990 DRAW A(X,I),A(Y,I)
4000 NEXT I
```

PASTA OVERLAY (cont.)

```
4010 P4=P4+1
4020 B2=0
4030 IF B=1 THEN 4380
4040 REM*************************
4050 REM*  Clean up section to increment pointers (P1 AND P2).
4060 REM*   If P2>=N2, than increment P1 by one and set P2 back
4070 REM*   to 1.  Also check if this was a special parallel line
4080 REM*   case (I1 and I2 are set to something different).
4090 REM*************************
4100 IF B1=1 THEN 4910
4110 I1=X1
4120 I2=Y1
4130 P2=P2+1
4140 IF P2<N2 THEN 2200
4150 P1=P1+1
4160 IF P1=N1 THEN 2940
4170 P2=1
4180 GO TO 2200
4190 REM*******************
4200 REM* Special case for the very first two segments intersecting.
4210 REM********************
4220 A(X,1)=L1(X,1)
4230 A(Y,1)=L1(Y,1)
4240 A(X,2)=X1
4250 A(Y,2)=Y1
4260 A(X,3)=L2(X,1)
4270 A(Y,3)=L2(Y,1)
4280 A(X,4)=A(X,1)
4290 A(Y,4)=A(Y,1)
4300 P3=4
4310 P9=2
4320 I1=X1
4330 I2=Y1
4340 GO TO 3930
4350 REM***********************
4360 REM*  Here for program end.  Fire up variance program?
4370 REM************************
4380 HOME
4390 CLOSE
4400 FOR I=1 TO 3
4410 HOME
4420 PRINT " ALL DONE!GGGG"
4430 NEXT I
4440 END
4450 REM*********************
4460 REM*  Special section for parallel lines that have chance
4470 REM*   of sharing points.
4480 REM*********************
4490 IF P2=N2 OR P1=N1 THEN 2850
4500 DIM S3(4)
```

PASTA OVERLAY (cont.)

```
4510 S3(1)=L1(X,P1)
4520 S3(2)=L1(X,P1+1)
4530 S3(3)=L2(X,P2)
4540 S3(4)=L2(X,P2+1)
4550 DIM Q(4)
4560 FOR I=1 TO 4
4570 Q(I)=0
4580 NEXT I
4590 IF S3(1)>S3(3) MAX S3(4) OR S3(1)<S3(3) MIN S3(4) THEN 4610
4600 Q(1)=1
4610 IF S3(2)>S3(3) MAX S3(4) OR S3(2)<S3(3) MIN S3(4) THEN 4630
4620 Q(2)=1
4630 IF S3(3)>S3(1) MAX S3(2) OR S3(3)<S3(1) MIN S3(2) THEN 4650
4640 Q(3)=1
4650 IF S3(4)>S3(1) MAX S3(2) OR S3(4)<S3(1) MIN S3(2) THEN 4710
4660 Q(4)=1
4670 REM****
4680 REM*  If none of the Q'S are set to 1, then we have
4690 REM*   'NON-INTERSECTING' parallel lines.
4700 REM****
4710 K9=0
4720 K9=K9+1
4730 IF Q(K9)=1 THEN 4790
4740 IF K9=4 THEN 2850
4750 GO TO 4720
4760 REM****
4770 REM*  We have 'INTERSECTING' parallel lines.
4780 REM****
4790 REM*  KEEP THIS- IT'S A LABEL
4800 B1=1
4810 X1=S3(K9)
4820 IF K9<3 THEN 4850
4830 Y1=L2(Y,K9-3+P2)
4840 GO TO 3010
4850 Y1=L1(Y,P1+K9-1)
4860 GO TO 3010
4870 REM****
4880 REM*  Entry point from clean-up section... it knows that
4890 REM*   it has a different I1 and I2.
4900 REM****
4910 B1=0
4920 B2=1
4930 K9=K9+1
4940 IF Q(K9)=1 THEN 4980
4950 IF K9<5 THEN 4930
4960 PRINT "OUT OF RANGE ON K9"
4970 STOP
4980 I1=S3(K9)
4990 IF K9<3 THEN 5020
5000 I2=L2(Y,K9-3+P2)
```

PASTA OVERLAY (cont.)

```
5010 GO TO 4130
5020 I2=L1(Y,K9-1+P1)
5030 GO TO 4130
```

END OF PASTA OVERLAY

TRANSECT

```
10 FUZZ 8,1.0E-12
20 CALL 'RATE',600,5,0
30 C$=CHR(15)
40 PRINT @40:C$
50 REM*  This program takes the output polygons from PASTA OVERLAY
60 REM*   and calculates mean error and variance by a transect
70 REM*   method.
80 PAGE
90 PRINT 'JJTRANSECT, by Dale M. HoneycuttJJ'
100 X=100
110 Y=X*2
120 DIM B(2,X),C(2,X),W1(2,Y),W2(2,Y),S9(24),M1(X-1),M2(X-1),E9(2,X)
130 FOR I=1 TO 24
140 S9(I)=0
150 NEXT I
160 PRINT 'SET UP PRINTER, HIT RETURN'
170 INPUT A$
180 FOR I=1 TO 3
190 PRINT @40:'J'
200 NEXT I
210 PRINT @40: USING 220:
220 IMAGE20X,'-- S T A T I S T I C S --J'
230 PRINT @40:'J'
240 IMAGE16X,'#     TOTAL      AREA      AREAJ'
250 IMAGE14X,'TRAN- TRANSECT  TRANS.   COORD.     WEIGHTEDJ'
260 IMAGE11X,'#  SECTS  LENGTH   METHOD   METHOD     AVERAGE  VARIANCEJ'
270 IMAGE10X,'--- ----- -------- -------- --------    -------- --------J'
280 PRINT @40:'J'
290 X=1
300 Y=2
310 PRINT 'Enter polygon file number:';
320 INPUT R
330 FIND R
340 PRINT ' '
350 PRINT 'Input distance to test variance:G';
360 INPUT S
370 INPUT @33:S9(23)
380 INPUT @33:A$
390 INPUT @33:S9(21)
400 PRINT 'JExperiment number:',S9(21)
410 PRINT 'JBase line description & scale:'
420 PRINT A$
430 PRINT S9(21)
440 INPUT @33:B$
450 INPUT @33:S9(22)
460 PRINT 'JCompare line description & scale:'
470 PRINT B$
480 PRINT S9(22)
490 PRINT 'JHit carriage return to continueG';
500 INPUT C$
```

TRANSECT (cont.)

```
510 INPUT @33:S9(15)
520 INPUT @33:S9(16)
530 PRINT @40: USING 540:S9(23),R
540 IMAGE10X,'Experiment number: ',3D,1X,'Polygon file number: ',2D,'JJ'
550 PRINT @40:'               Base line description:J'
560 PRINT @40: USING 590:A$
570 PRINT @40:'J              Compare line descriptionJ'
580 PRINT @40: USING 590:B$
590 IMAGE10X,72A,'J'
600 PRINT @40:'JJ'
610 PRINT @40: USING 240:
620 PRINT @40: USING 250:
630 PRINT @40: USING 260:
640 PRINT @40: USING 270:
650 DELETE C$
660 ON EOF (0) THEN 4570
670 INPUT @33:I1,Z
680 PAGE
690 FOR I=1 TO I1
700 INPUT @33:W1(X,I),W1(Y,I)
710 NEXT I
720 FOR I=2 TO I1-1
730 S9(1)=S9(1)+W1(Y,I)*(W1(X,I-1)-W1(X,I+1))
740 NEXT I
750 S9(1)=S9(1)+W1(Y,1)*(W1(X,I1)-W1(X,2))
760 S9(1)=S9(1)+W1(Y,I1)*(W1(X,I1-1)-W1(X,1))
770 S9(1)=S9(1)/2
780 Z5=1.0E+20
790 Z6=1.0E+20
800 FOR I=1 TO Z
810 Z5=Z5 MIN W1(X,I)
820 Z6=Z6 MIN W1(Y,I)
830 B(X,I)=W1(X,I)
840 B(Y,I)=W1(Y,I)
850 NEXT I
860 K=1
870 N1=Z
880 N2=I1-Z+1
890 FOR I=Z TO I1
900 Z5=Z5 MIN W1(X,I)
910 Z6=Z6 MIN W1(Y,I)
920 C(X,K)=W1(X,I)
930 C(Y,K)=W1(Y,I)
940 K=K+1
950 NEXT I
960 REM*  Rotate so principle axis is vertical.
970 SET DEGREES
980 Z1=1.0E+20
990 Z2=-1.0E+20
1000 Z3=Z1
```

CALCULATE AREA BY COORDINATE METHOD

GET MIN/MAX

TRANSECT (cont.)

```
1010 Z4=Z2
1020 IF B(X,1)<>B(X,N1) THEN 1040
1030 B(X,1)=B(X,1)+1.0E-4
1040 J=-ATN((B(Y,N1)-B(Y,1))/(B(X,N1)-B(X,1)))
1050 J=90-J
1060 PRINT USING 1070:J
1070 IMAGE'Rotating by ',3D.1D, ' degrees'
1080 C1=COS(J)
1090 S1=SIN(J)
1100 FOR I=1 TO N1
1110 Z7=(B(X,I)-Z5)*C1+(B(Y,I)-Z6)*S1
1120 B(Y,I)=(B(X,I)-Z5)*-S1+(B(Y,I)-Z6)*C1
1130 B(X,I)=Z7
1140 Z1=Z1 MIN B(X,I)
1150 Z2=Z2 MAX B(X,I)
1160 Z3=Z3 MIN B(Y,I)
1170 Z4=Z4 MAX B(Y,I)
1180 NEXT I
1190 FOR I=1 TO N2
1200 Z7=(C(X,I)-Z5)*C1+(C(Y,I)-Z6)*S1
1210 C(Y,I)=(C(X,I)-Z5)*-S1+(C(Y,I)-Z6)*C1
1220 C(X,I)=Z7
1230 Z2=Z2 MAX C(X,I)
1240 Z3=Z3 MIN C(Y,I)
1250 Z4=Z4 MAX C(Y,I)
1260 Z1=Z1 MIN C(X,I)
1270 NEXT I
1280 IF Z1>0 AND Z3>0 THEN 1440
1290 Z5=ABS(Z1)
1300 Z6=ABS(Z3)
1310 FOR I=1 TO N1
1320 B(X,I)=B(X,I)+Z5
1330 B(Y,I)=B(Y,I)+Z6
1340 NEXT I
1350 FOR I=1 TO N2
1360 C(X,I)=C(X,I)+Z5
1370 C(Y,I)=C(Y,I)+Z6
1380 NEXT I
1390 Z2=Z2+Z5
1400 Z1=Z1+Z5
1410 Z4=Z4+Z6
1420 Z3=Z3+Z6
1430 REM*  Delete duplicate points that sometimes show up.
1440 IF B(X,1)<>B(X,2) THEN 1510
1450 IF B(Y,1)<>B(Y,2) THEN 1510
1460 FOR I=1 TO N1-1
1470 B(X,I)=B(X,I+1)
1480 B(Y,I)=B(Y,I+1)
1490 NEXT I
1500 N1=N1-1
```

TRANSECT (cont.)

```
1510 IF C(X,N2-1)<>C(X,N2) THEN 1550
1520 IF C(Y,N2-1)<>C(Y,N2) THEN 1550
1530 N2=N2-1
1540 REM*  Determine slopes.
1550 FOR I=1 TO N1-1
1560 IF B(X,I)<>B(X,I+1) THEN 1580
1570 B(X,I+1)=B(X,I+1)+1.0E-3
1580 E1=B(X,I+1)-B(X,I)
1590 E2=B(Y,I+1)-B(Y,I)
1600 IF E1<>0 THEN 1630
1610 PRINT 'VERTICAL LINE SEGMENT ON BASE LINE, SEGMENT# ',I,'G'
1620 STOP
1630 M1(I)=E2/E1
1640 S9(17)=SQR(E1^2+E2^2)
1650 S9(19)=S9(17)+S9(19)
1660 NEXT I
1670 FOR I=1 TO N2-1
1680 IF C(X,I)<>C(X,I+1) THEN 1700
1690 C(X,I+1)=C(X,I+1)+1.0E-3
1700 E1=C(X,I+1)-C(X,I)
1710 E2=C(Y,I+1)-C(Y,I)
1720 IF E1<>0 THEN 1750
1730 PRINT 'VERTICAL LINE SEGMENT ON COMPARE LINE, SEGMENT# ',I,'G'
1740 STOP
1750 M2(I)=E2/E1
1760 S9(18)=SQR(E1^2+E2^2)
1770 S9(20)=S9(20)+S9(18)
1780 NEXT I
1790 REM*  Draw lines to screen.
1800 G1=90
1810 G=(Z2-Z1)/(Z4-Z3)*90
1820 WINDOW Z1,Z2+1.0E-3,Z3,Z4+1.0E-3
1830 VIEWPORT 5,G+5,5,G1+5
1840 PAGE
1850 MOVE B(X,1),B(Y,1)
1860 FOR I=1 TO N1
1870 DRAW B(X,I),B(Y,I)
1880 NEXT I
1890 MOVE C(X,1),C(Y,1)
1900 FOR I=1 TO N2
1910 DRAW C(X,I),C(Y,I)
1920 NEXT I
1930 REM*  Segment intersection loop.
1940 HOME
1950 PRINT 'S (step)= ',S
1960 PRINT ' '
1970 K=1
1980 P=1
1990 P1=1
2000 S1=Z3
```

↓ INTERSECT BASE LINE

TRANSECT (cont.)

```
2010 C1=M1(P1)*B(X,P1)-B(Y,P1)
2020 A1=M1(P1)
2030 H=0
2040 IF A1<>0 THEN 2160
2050 IF C1<>-S1 THEN 2340
2060 W1(X,P)=B(X,P1)
2070 W1(Y,P)=S1
2080 P=P+1
2090 IF P1=N1+1 THEN 2410
2100 W1(X,P)=B(X,P1+1)
2110 W1(Y,P)=S1
2120 H=1
2130 P=P+1
2140 GO TO 2340
2150 REM*  Find intersection & draw...
2160 X1=(-C1-S1)/-A1
2170 X8=B(X,P1) MIN B(X,P1+1)
2180 X9=B(X,P1) MAX B(X,P1+1)
2190 IF X1<X8 OR X1>X9 THEN 2340
2200 W1(X,P)=X1
2210 W1(Y,P)=S1
2220 MOVE W1(X,P),W1(Y,P)
2230 DRAW Z2,W1(Y,P)
2240 DRAW Z1,W1(Y,P)
2250 H=1
2260 P=P+1
2270 S1=S1+S
2280 IF S1<=Z4 THEN 2040
2290 P1=P1+1
2300 IF P1=N1 THEN 2410
2310 S1=Z3
2320 GO TO 2010
2330 REM*  Here for no intersection.  Step the Y increment
2340 S1=S1+S
2350 IF S1<=Z4 AND H=0 THEN 2040
2360 P1=P1+1
2370 IF P1=N1 THEN 2410
2380 S1=Z3
2390 GO TO 2010
2400 REM****
```

↓ INTERSECT COMPARE LINE

```
2410 T1=P-1
2420 P=1
2430 P1=1
2440 S1=Z3
2450 C1=M2(P1)*C(X,P1)-C(Y,P1)
2460 A1=M2(P1)
2470 H=0
2480 IF A1<>0 THEN 2600
2490 IF C1<>-S1 THEN 2780
2500 W2(X,P)=C(X,P1)
```

TRANSECT (cont.)

```
2510 W2(Y,P)=S1
2520 P=P+1
2530 IF P1=N2+1 THEN 2850
2540 W2(X,P)=C(X,P1+1)
2550 W2(Y,P)=S1
2560 H=1
2570 P=P+1
2580 GO TO 2780
2590 REM*  Find intersection
2600 X1=(-C1-S1)/-A1
2610 X8=C(X,P1) MIN C(X,P1+1)
2620 X9=C(X,P1) MAX C(X,P1+1)
2630 IF X1<X8 OR X1>X9 THEN 2780
2640 W2(X,P)=X1
2650 W2(Y,P)=S1
2660 MOVE W2(X,P),W2(Y,P)
2670 DRAW Z2,W2(Y,P)
2680 DRAW Z1,W2(Y,P)
2690 H=1
2700 P=P+1
2710 S1=S1+S
2720 IF S1<=Z4 THEN 2480
2730 P1=P1+1
2740 IF P1=N2 THEN 2850
2750 S1=Z3
2760 GO TO 2450
2770 REM*  No intersection
2780 S1=S1+S
2790 IF S1<=Z4 AND H=0 THEN 2480
2800 P1=P1+1
2810 IF P1=N2 THEN 2850
2820 S1=Z3
2830 GO TO 2450
2840 REM*  Now sort this garbage.
2850 T2=P-1
2860 HOME
2870 PRINT ' '
2880 PRINT 'Sorting...'
2890 FOR I=1 TO N1
2900 E9(X,I)=B(X,I)
2910 E9(Y,I)=B(Y,I)
2920 NEXT I
2930 X1=1
2940 X2=2
2950 K=(Z4-Z3)/S
2960 K=K+1
2970 K=INT(K)
2980 FOR I=1 TO K+3
2990 B(X1,I)=-1
3000 B(X2,I)=-1
```

SORT INTERSECTIONS IN ASCENDING ORDER. THE POINTER TO THE ARRAY TO CONTAIN INTERSECTIONS (ARRAY B) CAN BE CALCULATED FROM THE Y-COORDINATE

TRANSECT (cont.)

```
3010 NEXT I
3020 REM*  Fill array with intersections, sorting on the fly.
3030 IF T1<1 THEN 3080
3040 FOR I=1 TO T1
3050 J=INT((W1(Y,I)-Z3)/S+1.00001)
3060 B(X1,J)=W1(X,I)
3070 NEXT I
3080 IF T2<1 THEN 3140
3090 FOR I=1 TO T2
3100 J=INT((W2(Y,I)-Z3)/S+1.00001)
3110 B(X2,J)=W2(X,I)
```

CALCULATE POINTER TO ARRAY

```
3120 NEXT I
3130 REM*     Avert your eyes.  This gets ugly...
3140 G=1
3150 FOR I=G TO K
3160 IF B(X1,I)=-1 THEN 3190
3170 NEXT I
3180 GO TO 3350
```

CHECK IF NO INTERSECTION FOR THIS Y-COORDINATE ON BASE LINE

```
3190 L=I
3200 H=0
3210 Z5=(I-1)*S+Z3
3220 FOR I=1 TO T2
3230 IF W2(Y,I)<>Z5 THEN 3270
3240 IF W2(X,I)=B(X2,L) THEN 3270
3250 B(X1,L)=W2(X,I)
3260 H=1
3270 NEXT I
3280 IF H=1 THEN 3330
3290 FOR I=1 TO T2
3300 IF W2(Y,I)<>Z5 THEN 3320
```

IF NO INTERSECTION, SET IT TO ~~THE~~ ONE OF THE COMPARE LINE INTERSECTION THAT ISN'T EQUAL TO ITSELF

```
3310 B(X1,L)=W2(X,I)
3320 NEXT I
3330 G=L+1
3340 IF G<K THEN 3150
3350 G=1
3360 FOR I=G TO K
3370 IF B(X2,I)=-1 THEN 3400
3380 NEXT I
3390 GO TO 3580
3400 L=I
3410 H=0
```

DO THE SAME CHECK FOR THE COMPARE LINE

```
3420 Z5=(I-1)*S+Z3
3430 FOR I=1 TO T1
3440 IF W1(Y,I)<>Z5 THEN 3480
3450 IF W1(X,I)=B(X1,L) THEN 3480
3460 B(X2,L)=W1(X,I)
3470 H=1
3480 NEXT I
3490 IF H=1 THEN 3540
3500 FOR I=1 TO T1
```

TRANSECT (cont.)

```
3510 IF W1(Y,I)<>Z5 THEN 3530
3520 B(X2,L)=W1(X,I)
3530 NEXT I
3540 G=L+1
3550 IF G<K THEN 3360
3560 GO TO 3580
3570 REM****************
3580 PAGE
3590 HOME
3600 PRINT A$
3610 PRINT B$
3620 PRINT 'Transect length: ';S;' meters'
3630 PRINT 'Polygon number: ';S9(2)+1
3640 MOVE E9(X,1),E9(Y,1)
3650 FOR I=2 TO N1
3660 DRAW E9(X,I),E9(Y,I)
3670 NEXT I
3680 MOVE C(X,1),C(Y,1)
3690 FOR I=2 TO N2
3700 DRAW C(X,I),C(Y,I)
3710 NEXT I
3720 REM*************
3730 REM* S9 is the statistic array, arranged as follows:
3740 REM*
3750 REM* 1: area for this polygon, coordinate method
3760 REM* 2: polygon number (later, total number of polygons)
3770 REM* 3: number of transects, this polygon
3780 REM* 4: total length of transects, this polygon
3790 REM* 5: cumulative area, by coordinate method, no sign removal
3800 REM* 6: cumulative area, by coordinate method, absolute value
3810 REM* 7: cumulative number of transects
3820 REM* 8: cumulative total length of transects, no sign removal
3830 REM* 9: cumulative total length of transects, absolute value
3840 REM 10: unweighed avg. transect distance, this polygon.
3850 REM 11: maximum distance found, all transects
3860 REM 12: Sum of the weighted averages (see #24)
3870 REM 13: Variance (X minus unweighted avg squared)/N transects - 1
3880 REM 14: Sum of the variances times area (weighted variance).
3890 REM 15: Total length of base line from PASTA overlay routine
3900 REM 16: Total length of compare line, from PASTA overlay
3910 REM 17: Length of base line, this polygon
3920 REM 18: Length of compare line, this polygon
3930 REM 19: Total length as accumulated here of base
3940 REM 20: Total length as accumulated here of compare
3950 REM 21: Scale of base line
3960 REM 22: Scale of compare line
3970 REM 23: Experiment number (entered in PASTA overlay).
3980 REM 24: Weighted average transect distance (avg. distance *
3990 REM     polygon area), this polygon.
4000 REM*
```

TRANSECT (cont.)

```
4010 REM***************
4020 IF K=0 THEN 4230
4030 FOR I=1 TO K
4040 IF B(X1,I)=-1 OR B(X2,I)=-1 THEN 4160
4050 S8=B(X1,I)-B(X2,I)
4060 IF S8=0 THEN 4160
4070 S8=ABS(S8)
4080 IF S9(1)>0 THEN 4100
4090 S8=-S8
4100 Z5=(I-1)*S+Z3
4110 MOVE B(1,I),Z5
4120 DRAW B(2,I),Z5
4130 S9(3)=S9(3)+1
4140 S9(4)=S9(4)+S8
4150 S9(11)=S9(11) MAX ABS(S8)
4160 NEXT I
4170 REM*  End of polygon, output intermediate stats, jack
4180 REM*** Weighted avg. and sum of weighted avg.
4190 IF S9(4)=0 THEN 4430
4200 S9(8)=S9(8)+S9(4)
4210 S9(9)=S9(9)+ABS(S9(4))
4220 S9(7)=S9(7)+S9(3)
4230 S9(24)=ABS(S9(1))*(ABS(S9(4))/S9(3))
4240 S9(12)=S9(12)+S9(24)
4250 S9(5)=S9(5)+S9(1)
4260 S9(2)=S9(2)+1
4270 S9(6)=S9(6)+ABS(S9(1))
4280 S7=S9(4)*S
4290 S9(10)=ABS(S9(4)/S9(3))
4300 REM*** find variance and sum weighted sum of variance
4310 IF K=0 THEN 4410
4320 FOR I=1 TO K
4330 IF B(X1,I)=-1 OR B(X2,I)=-1 THEN 4370
4340 S8=ABS(B(X1,I)-B(X2,I))
4350 IF S8=0 THEN 4370
4360 S9(13)=S9(13)+ABS(S8-S9(10))
4370 NEXT I
4380 J=S9(3)-1
4390 IF J>0 THEN 4410
4400 J=J+1
4410 S9(13)=S9(13)^2/J
4420 S9(14)=S9(14)+S9(13)*ABS(S9(1))
4430 PRINT @40: USING 4440:S9(2),S9(3),S9(4),S7,S9(1),S9(24),S9(13)
4440 IMAGE10X,3D,2X,3D,2X,5D.2D,1X,5D.2D,1X;5D.2D,1X,8D.1D,1X,5D.2D,"J"
4450 S9(24)=0
4460 S7=0
4470 S9(13)=0
4480 S9(3)=0
4490 S9(4)=0
4500 S9(10)=0
```

TRANSECT (cont.)

```
4510 S9(1)=0
4520 S9(17)=0
4530 S9(18)=0
4540 COPY
4550 GO TO 660
4560 REM*  Here for end-of-file
4570 FOR I=1 TO 3
4580 HOME
4590 PRINT 'ALL DONEG'
4600 PRINT @40:'J'
4610 NEXT I
4620 PAGE
4630 DELETE B,C
4640 PRINT 'ADJUST PAPER IN PRINTER - HERE COME FINAL STATS'
4650 PRINT '(Hit return when paper ready)GG'
4660 INPUT C$
4670 PRINT @40: USING 4680:S9(23)
4680 IMAGE10X,'FINAL STATISTICS FOR EXPERIMENT NUMBER ',3D,'JJ'
4690 PRINT @40: USING 4700:
4700 IMAGE10X,'ABS=Absolute value, unsigned values are to be assumed.J'
4710 PRINT @40: USING 4720:S9(5)
4720 IMAGE10x,'JTotal area by coordinate method (CM): ',6D.2D,'J'
4730 PRINT @40: USING 4740:S9(6)
4740 IMAGE10X,'Total area by coordinate method, ABS: ',6D.2D,'J'
4750 PRINT @40: USING 4760:S9(5)/S9(6)
4760 IMAGE10X,'Ratio of CM to ABS CM: ',2D.3D,'J'
4770 PRINT @40: USING 4780:S9(8)*S
4780 IMAGE10X,'Total area by transect method(TM): ',6D.2D,'J'
4790 PRINT @40: USING 4800:S9(9)*S
4800 IMAGE10X,'Total area by transect method, ABS: ',6D.2D,'J'
4810 PRINT @40: USING 4820:S
4820 IMAGE10X,'JWidth between transects: ',3D.1D,'J'
4830 PRINT @40: USING 4840:S9(7)
4840 IMAGE10X,'JTotal number of transects (N): ',5D,'J'
4850 PRINT @40: USING 4860:S9(8)
4860 IMAGE10X,'Total length of transects (D)eviation : ',6D.2D,'J'
4870 PRINT @40: USING 4880:S9(9)
4880 IMAGE10X,'Total length of transects (D)eviation, ABS: ',6D.2D,'J'
4890 PRINT @40: USING 4900:S9(15)
4900 IMAGE10X,'JTrue length of base line (BL): ',6D.2D,'J'
4910 PRINT @40: USING 4920:S9(16)
4920 IMAGE10X,'True length of compare line (CL): ',6D.2D,'J'
4930 PRINT @40: USING 4940:S9(21)
4940 IMAGE10X,'JScale of base line   1:',6D,'J'
4950 PRINT @40: USING 4960:S9(22)
4960 IMAGE10X,'Scale of compare line 1:',6D,'J'
4970 PRINT @40:'JJ'
4980 PRINT @40: USING 4990:S9(12)/S9(6)
4990 IMAGE10X,'Weighted avg/total area (epsilon): ',10D.2D,'J'
5000 C$=' '
```

TRANSECT (cont.)

```
5010 J=1
5020 IF INT(S9(15))=INT(S9(19)) THEN 5050
5030 C$='*'
5040 J=2
5050 IF S9(2)>1 THEN 5070
5060 J=0
5070 PRINT @40: USING 5080:SQR(S9(14)/S9(6)/(S9(2)-J)),C$
5080 IMAGE10X,'Standard deviation: ',10D.2D,1a,'J'
5090 PRINT @40: USING 5100:S9(12)/S9(6)/(S9(22)/1000)
5100 IMAGE10x,'Epsilon line width at compare line scale: ',2d.4d,'mmJ'
5110 PRINT @40: USING 5120:S9(11)
5120 IMAGE10x,'Maximum transect length found: ',5d.2d,'J'
5130 PRINT 'GGAdjust paper again, here comes statistic arrayG'
5140 INPUT C$
5150 PRINT @40: USING 5160:S9(23)
5160 IMAGE10x,'Experiment number: ',3d,'JJ'
5170 PRINT @40: USING 5180:A$
5180 IMAGE10x,72a,'J'
5190 PRINT @40: USING 5180:B$
5200 PRINT @40:'JJ'
5210 FOR I=1 TO 24
5220 PRINT @40: USING 5230:I,S9(I)
5230 IMAGE11x,2d,') ',12D.2D,'J'
5240 NEXT I
5250 END
```

END OF TRANSECT

BOX

```
10 V=1
20 R9=100
30 PAGE
40 F=2
50 S1=99
60 REM*****
70 REM*
80 REM*  BOX - Program to perform an analysis of probability
90 REM*   about square polygons made of different scale lines.
100 REM*
110 REM*****
120 DIM S(4,2),W(4),A(500),D(4),P(4),R(4),D9(500),Z9(500),R1(500)
130 DIM R2(500)
140 REM****
150 REM* S(1,1)&S(1,2) =Mean and SD of Top line
160 REM* S(2,1)&S(2,2) =same for bottom line
170 REM* S(3,1)&S(3,2) =left line
180 REM* S(4,1)&S(4,2) =right line
190 REM****
200 PRINT 'BOX - program to calculate probability of random points'
210 PRINT '      falling within a square made of sides of different'
220 PRINT '      means and deviations.'
230 PRINT '    JBy Dale M. Honeycutt'
240 PRINT 'JJ'
250 PRINT 'Enter Mean, SD, and scale for TOP line:'
260 INPUT S(1,1),S(1,2),R(1)
270 PRINT 'Enter Mean, SD and scale for BOTTOM line:'
280 INPUT S(2,1),S(2,2),R(2)
290 PRINT 'Enter Mean, SD, and scale for LEFT line:'
300 INPUT S(3,1),S(3,2),R(3)
310 PRINT 'Enter Mean, SD, and scale for RIGHT line:'
320 INPUT S(4,1),S(4,2),R(4)
330 PRINT 'JJ'
340 FOR I=1 TO 4
350 IF S(I,2)>0 THEN 380
360 PRINT 'No 0 SD's allowed!!!!!GGGG'
370 GO TO I OF 250,270,290,310
380 NEXT I
390 PAGE
400 W(1)=ASC('T')
410 W(2)=ASC('B')
420 W(3)=ASC('L')
430 W(4)=ASC('R')
440 PRINT '  MEAN      SD      SIDE   SCALEJ'
450 FOR I=1 TO 4
460 W$=CHR(W(I))
470 PRINT USING 490:S(I,1),S(I,2),W$,R(I)
480 NEXT I
490 IMAGE 4d.2d,2x,4d.2d,5x,1a,3X,6D
500 PRINT 'JJ'
```

BOX (cont.)

```
510 PRINT 'Are these correct (y/n?): ';
520 INPUT Q$
530 IF Q$='N' THEN 250
540 PRINT 'Make sure printer is hooked up, hit <return>: ';
550 INPUT Q$
560 CALL 'rate',600,5,0
570 A$=CHR(15)
580 PRINT @40:A$
590 PRINT @40:'J'
600 PRINT @40: USING 610:
610 IMAGE10x'ANALYSIS OF AREAL PROBABILITYJ'
620 PRINT @40: USING 630:
630 IMAGE10X'-----------------------------J'
640 PRINT @40: USING 650:
650 IMAGE'JJ',10x,'LINE (T,B,L,R)   MEAN      SD     SCALEJ'
660 PRINT @40: USING 670:
670 IMAGE10x,     '--------------  ------   ------   ------J'
680 FOR I=1 TO 4
690 W$=CHR(W(I))
700 PRINT @40: USING 720:W$,S(I,1),S(I,2),R(I)
710 NEXT I
720 IMAGE16x,1a,9x,3d.2d,3x,3d.2d,3X,6D,'J'
730 PRINT @40: USING 740:
740 IMAGE'JJ',10x,'This is a systematic random sample...JJ'
750 REM****
760 REM*  Calculate default length of sides based on maximum mean
770 REM*   encountered.  Make length so that it is greater than
780 REM*   twice this mean so that the sides do not coalese, or however
790 REM*   it's spelled....
800 REM****
810 PRINT 'Avgerage probability will be displayed to screen. Change'
820 PRINT 'this (y/n)?';
830 INPUT Q$
840 IF Q$='N' THEN 870
850 PRINT 'Input 2 for minimum distance or 3 for minimum z-score: ';
860 INPUT V
870 M=S(1,1)
880 FOR I=2 TO 4
890 M=M MAX S(I,1)
900 NEXT I
910 PRINT 'Maximum mean is: ';M
920 REM****
930 REM*  Take twice maximum and round up.  We want length to
940 REM*   be in steps of .5, so multiply by 10, take integer,
950 REM*   then divide by 10.
960 REM****
970 L=M*2+0.5
980 L=INT(L*10)
990 L=L/10
1000 PRINT 'Default length is: ';L;'.  Do you want to change (y/n?):';
```

BOX (cont.)

```
1010 INPUT Q$
1020 IF Q$='N' THEN 1050
1030 PRINT 'Enter new start length: ';
1040 INPUT L
1050 PRINT 'Length will be doubled for each iteration. Do you want'
1060 PRINT 'to change this factor (y/n)? ';
1070 INPUT Q$
1080 IF Q$='N' THEN 1110
1090 PRINT 'Input new factor: ';
1100 INPUT F
1110 PRINT 'Analysis will stop when all probabilities are ';S1
1120 PRINT 'or greater.  Do you want to change this (y/n): ';
1130 INPUT Q$
1140 IF Q$='N' THEN 1170
1150 PRINT 'Enter new stop for all probabilities: ';
1160 INPUT S1
1170 PRINT 'I will generate ';R9;' pts.  Change (y/n?): ';
1180 INPUT Q$
1190 IF Q$='N' THEN 1220
1200 PRINT 'Input number of pts to generate: ';
1210 INPUT R9
1220 PRINT 'JJLength is ';L
1230 PRINT 'Increment factor is ';F
1240 PRINT 'Analysis will stop when all probabilities are ';S1
1250 PRINT @40: USING 1260:L
1260 IMAGE10X,'Start length = ',3d.1d,' metersJ'
1270 PRINT @40: USING 1280:F
1280 IMAGE10x,'Increment multiplier = ',2d.1d,'J'
1290 PRINT @40: USING 1300:S1
1300 IMAGE10x,'Program will stop when all probabilities >= ',3d.2d,'J'
1310 PRINT @40: USING 1320:R9
1320 IMAGE10x,'Number of random points generated per pass = ',3d,'JJJ'
1330 PRINT @40: USING 1340:
1340 IMAGE30X,'AREA',6X,'PROBABILITIESJ'
1350 PRINT @40: USING 1360:
1360 IMAGE10X' #  LENGTHm          (km)     avg    minD    minZJ'
1370 PRINT @40: USING 1380:
1380 IMAGE10X'--- --------    ---------    -----   -----   -----J'
1390 REM****
1400 REM*  Set up constants for calculation of area under curve.
1410 REM*   This equation from 'Handbook of Mathematical Functions',
1420 REM*   National Bureau of Standards, 1968.'
1430 REM****
1440 T1=SQR(PI*2)
1450 T2=0.2316419
1460 T3=0.31938153
1470 T4=-0.356563782
1480 T5=1.781477937
1490 T6=-1.821255978
1500 T7=1.330274429
```

BOX (cont.)

```
1510 FOR I=1 TO R9
1520 R1(I)=RND(1)
1530 R2(I)=RND(-1)
1540 NEXT I
1550 REM****
1560 REM* Draw a box to screen
1570 REM****
1580 K1=0
1590 GOSUB 2520
1600 REM**** Start loop for new length
1610 K=0
1620 REM**** Loop for w/in same length (R9 times)
1630 IF K=R9 THEN 2310
1640 X1=R1(K+1)
1650 X1=L*X1
1660 IF X1>L THEN 1630
1670 Y1=R2(K+1)
1680 Y1=L*Y1
1690 IF Y1>L THEN 1670
1700 K=K+1
1710 MOVE X1,Y1
1720 DRAW X1,Y1
1730 D(1)=L-S(1,1)-Y1
1740 D(2)=Y1-S(2,1)
1750 D(3)=X1-S(3,1)
1760 D(4)=L-S(4,1)-X1
1770 D6=1
1780 D5=D(1)
1790 FOR I=2 TO 4
1800 IF D(I)>D5 THEN 1830
1810 D6=1
1820 D5=D(I)
1830 NEXT I
1840 REM****
1850 REM*  Find z-score
1860 REM****
1870 FOR I=1 TO 4
1880 D(I)=D(I)/S(I,2)
1890 NEXT I
1900 Z6=1
1910 Z5=D(1)
1920 FOR I=2 TO 4
1930 IF D(I)>Z5 THEN 1960
1940 Z6=1
1950 Z5=D(I)
1960 NEXT I
1970 REM****
1980 REM*  Calculate probability
1990 REM****
2000 FOR I=1 TO 4
```

BOX (cont.)

```
2010 IF D(I)<4 THEN 2040
2020 P(I)=1
2030 GO TO 2160
2040 N1=0
2050 IF D(I)=>0 THEN 2080
2060 D(I)=ABS(D(I))
2070 N1=1
2080 T8=1/(1+T2*D(I))
2090 T9=EXP(-(D(I)^2/2))/T1
2100 P(I)=T9*(T3*T8+T4*T8^2+T5*T8^3+T6*T8^4+T7*T8^5)
2110 P(I)=P(I)/2
2120 IF N1=0 THEN 2150
2130 P(I)=P(I)+0.5
2140 GO TO 2160
2150 P(I)=1-P(I)
2160 NEXT I
2170 REM****
2180 REM*  Calculate total probability
2190 REM****
2200 A(K)=(P(1)+P(2)+P(3)+P(4))/4
2210 D9(K)=P(D6)
2220 Z9(K)=P(Z6)
2230 GO TO V OF 2240,2260,2280
2240 PRINT USING 2300:A(K)
2250 GO TO 1630
2260 PRINT USING 2300:D9(K)
2270 GO TO 1630
2280 PRINT USING 2300:Z9(K)
2290 GO TO 1630
2300 IMAGE1d.2D
2310 E=0
2320 E1=0
2330 E2=0
2340 D0=R9/100
2350 K1=K1+1
2360 FOR I=1 TO R9
2370 E=E+A(I)
2380 E1=E1+D9(I)
2390 E2=E2+Z9(I)
2400 NEXT I
2410 E=E/D0
2420 E1=E1/D0
2430 E2=E2/D0
2440 PRINT @40: USING 2450:K1,L,(L/1000)^2,E,E1,E2
2450 IMAGE10x,2d,1x,7d.1d,3x,5d.3d,2x,3d.2d,1x,3d.2d,1x,3d.2d,'J'
2460 IF E=>S1 AND E1=>S1 AND E2=>S1 THEN 2490
2470 L=L*F
2480 GO TO 1590
2490 HOME
2500 PRINT 'ALL DONE!!!!GGGGGGGG'
```

BOX (cont.)

```
2510 END
2520 VIEWPORT 35,95,20,80
2530 PAGE
2540 WINDOW 0,L,0,L
2550 MOVE 0,0
2560 DRAW 0,L
2570 DRAW L,L
2580 DRAW L,0
2590 DRAW 0,0
2600 MOVE S(3,1),S(2,1)
2610 DRAW S(3,1),L-S(1,1)
2620 DRAW L-S(4,1),L-S(1,1)
2630 DRAW L-S(4,1),S(2,1)
2640 DRAW S(3,1),S(2,1)
2650 HOME
2660 PRINT 'Length = ';L
2670 PRINT 'Area = ';(L/1000)^2
2680 RETURN
```

END OF BOX

PLOTLINES

```
10 PRINT 'MAKE SURE PLOTTER IS HOOKED UP RIGHT, HIT RETURNGGGGG'
20 INPUT Q$
30 PAGE
40 X=1
50 Y=2
60 S1=24
70 CALL 'RATE',1200,5,0
80 DIM B(2,100),C(2,100),M(4),C1(3),P(3),B1(2,100)
90 FOR I=1 TO 3
100 P(3)=0
110 NEXT I
120 PRINT 'ENTER THE BASE LINE FILE NUMBER:';
130 INPUT B2
140 PRINT 'NOW ENTER THE 3 COMPARE FILE NUMBERS:';
150 INPUT C1(1),C1(2),C1(3)
160 PRINT 'ENTER BIT (0,1) PATTERN: ';
170 INPUT P(1),P(2),P(3)
180 PRINT 'ENTER START Y IN PLOTTER UNITS: ';
190 INPUT E
200 PRINT 'ENTER THE X STEP BETWEEN LINES: ';
210 INPUT S
220 REM*  READ BASE
230 FIND B2
240 ON EOF (0) THEN 320
250 INPUT @33:A$
260 PRINT 'DESCRIPTION IS'
270 PRINT A$
280 I=1
290 INPUT @33:B1(X,I),B1(Y,I)
300 I=I+1
310 GO TO 290
320 N1=I-1
330 REM* FIND MIN MAX
340 M(1)=B1(X,1)
350 M(3)=B1(Y,1)
360 M(2)=M(1)
370 M(4)=M(3)
380 FOR I=1 TO N1
390 M(1)=M(1) MIN B1(X,I)
400 M(2)=M(2) MAX B1(X,I)
410 M(3)=M(3) MIN B1(Y,I)
420 M(4)=M(4) MAX B1(Y,I)
430 NEXT I
440 PRINT @40:'IN;SP1;VA;EC0;'
450 FOR K1=1 TO 3
460 IF P(K1)=0 THEN 490
470 PRINT 'I'M ON FILE NUMBER ';K1;' INSERT CORRECT TAPE, HIT RETURNGG';
480 INPUT A$
490 FIND C1(K1)
500 INPUT @33:A$
```

PLOTLINES (cont.)

```
510 PRINT 'DESCRIPTION IS  '
520 PRINT A$
530 I=1
540 ON EOF (0) THEN 580
550 INPUT @33:C(X,I),C(Y,I)
560 I=I+1
570 GO TO 550
580 N2=I-1
590 FOR I=1 TO N2
600 Z1=C(X,I) MIN M(1)
610 Z2=C(X,I) MAX M(2)
620 Z3=C(Y,I) MIN M(3)
630 Z4=C(Y,I) MAX M(4)
640 NEXT I
650 REM** FIND PLOTTER UNITS
660 FOR I=1 TO N1
670 B(X,1)=B1(X,1)-Z1
680 B(Y,I)=B1(Y,I)-Z3
690 NEXT 1
700 FOR I=1 TO N2
710 C(X,1)=C(X,I)-Z1
720 C(Y,I)=C(Y,I)-Z3
730 NEXT I
740 Z2=Z2-Z1
750 Z4=Z4-Z3
760 Z1=0
770 Z3=0
780 Z6=Z2-Z1
790 Z6=Z6/S1/0.025
800 Z7=Z4-Z3
810 Z7=Z7/S1/0.025
820 A=(K1-1)*S+2000
830 Z6=INT(Z6+A+0.5)
840 Z7=INT(Z7+E+0.5)
850 PRINT 'PLOTTER UNITS FOLLOW'
860 PRINT A,E,Z6,Z7
870 PRINT @40:'IP',A,',',E,',',Z6,',',Z7,';'
880 Z1=INT(Z1+0.5)
890 Z2=INT(Z2+0.5)
900 Z3=INT(Z3+0.5)
910 Z4=INT(Z4+0.5)
920 PRINT @40:'SC',Z1,',',Z2,',',Z3,',',Z4,';'
930 D=SQR((Z6-A)^2+(Z7-E)^2)
940 F=3000/D
950 F=F*1.5
960 PRINT @40:'LT1,',F,';'
970 PRINT @40:'PU;PA',B(X,1),',',B(Y,1),';'
980 PRINT @40:'PD;'
990 FOR I=2 TO N1
1000 PRINT @40:'PA',B(X,I),',',B(Y,I),';'
```

PLOTLINES (cont.)

```
1010 NEXT I
1020 REM  PLOT COMPARE
1030 PRINT @40:"LT;"
1040 PRINT @40:"PU;PA",C(X,1),",",C(Y,1),";"
1050 PRINT @40:"PD;"
1060 FOR I=2 TO N2
1070 PRINT @40:"PA",C(X,I),",",C(Y,I),";"
1080 NEXT I
1090 PRINT @40:"PU;"
1100 NEXT K1
1110 END
1120 PRINT @32,26:0
1130 FOR I=1 TO N1
1140 PRINT B(X,I),B(Y,I)
1150 NEXT I
1160 PRINT
1170 FOR I=1 TO N2
1180 PRINT C(X,I),C(Y,I)
1190 NEXT I
```

END OF PLOTLINES

APPENDIX B

Reports from PASTA OVERLAY and TRANSECT

-- R E P O R T   O F   L I N E   O V E R L A Y --

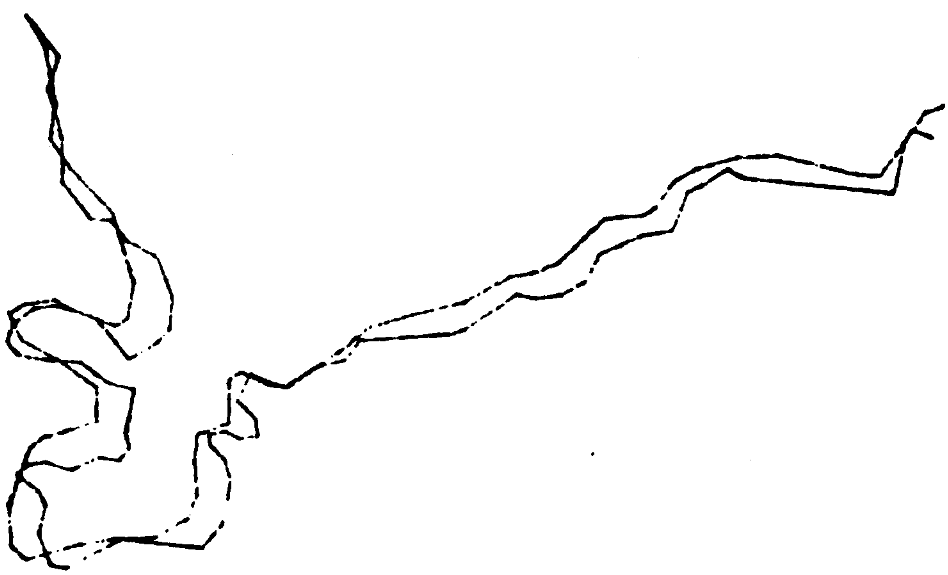
This is experiment number ~~99~~ 9
Base line file number: 12
Start X-pt: 473212 Scale: 1: 24000
Start Y-pt: 5091272 Number of points: 76
End X-pt: 474310
End Y-pt: 5091158
Description
Deep Creek from Nehalam River, 1st reach, 1:24,000

Compare line file number 13
Start X-pt: 473196 Scale: 1: 62500
Start Y-pt: 5091291 Number of points: 59
End X-pt: 474325
End Y-pt: 5091197
Description
Nehalem River and Deep Creek, 1:62,5000

Base line distance: 2758
Compare line distance: 2426

Channel Index for base line: 2.50
Channel index for compare line: 2.14

[illegible] River, 1st reach, 1:24,000
[illegible] River and [illegible] Creek, 1:62,5000
[illegible]



-- S T A T I S T I C S --

Experiment number: 8 Polygon file number: 39

Base line description:
Deep Creek from Nehalam River, 1st reach, 1:24,000

Compare line description
Nehalem River and Deep Creek, 1:62,5000

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	7	-51.56	-515.61	-526.05	3874.8	68.11
2	2	7.14	71.38	73.86	263.6	2.68
3	6	-48.35	-483.46	-490.99	3956.2	72.59
4	10	164.27	1642.73	1658.96	27252.3	339.43
5	14	-640.14	-6401.41	-6488.85	296698.4	1764.18
6	2	1.70	16.96	23.18	19.7	0.52
7	7	-57.45	-574.51	-618.00	5072.1	53.45
8	7	83.69	836.87	845.01	10102.4	135.74
9	15	-756.25	-7562.50	-7698.53	388134.4	5535.89
10	1	0.00	0.01	8.46	0.0	0.00
11	10	-317.96	-3179.63	-3300.22	104934.9	919.66
12	8	118.90	1188.99	1230.99	18295.4	264.81
12	0	0.00	0.00	-4.34	0.0	0.00
13	25	783.36	7833.56	7810.33	244730.8	4765.03
14	4	-11.23	-112.30	-104.45	293.3	0.21
15	82	2033.18	20331.83	20360.41	504834.8	5389.76
16	2	-2.99	-29.93	-38.10	57.0	0.42
17	2	45.86	458.59	620.51	14228.0	291.99

FINAL STATISTICS FOR EXPERIMENT NUMBER 8

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 13366.51
Total area by coordinate method, ABS: 51896.91
Ratio of CM to ABS CM: 0.258
Total area by transect method(TM): 13521.59
Total area by transect method, ABS: 51240.30

Width between transects: 10.0

Total number of transects (N): 204
Total length of transects (D)eviation : 1352.16
Total length of transects (D)eviation, ABS: 5124.03

True length of base line (BL): 2757.92
True length of compare line (CL): 2426.19

Scale of base line 1: 24000
Scale of compare line 1: 62500

Weighted avg/total area (epsilon): 31.27
Standard deviation: 15.73
Epsilon line width at compare line scale: 0.5003mm
Maximum transect length found: 89.62

Experiment number: 8

Deep Creek from Nehalam River, 1st reach, 1:24,000
Nehalem River and Deep Creek, 1:62,5000

1)	0.00
2)	17.00
3)	0.00
4)	0.00
5)	13366.51
6)	51896.91
7)	204.00
8)	1352.16
9)	5124.03
10)	0.00
11)	89.62
12)	1622748.05
13)	0.00
14)	205344737.77
15)	2757.92
16)	2426.19
17)	0.00
18)	0.00
19)	2757.92
20)	2493.60
21)	24000.00
22)	62500.00
23)	8.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

This is experiment number 092
Base line file number: 14

Start X-pt:	475052	Scale: 1:	24000
Start Y-pt:	5090989	Number of points:	66
End X-pt:	475805		
End Y-pt:	5090000		

Description
Deep Creek, reach #2, 1:24,000

Compare line file number 15

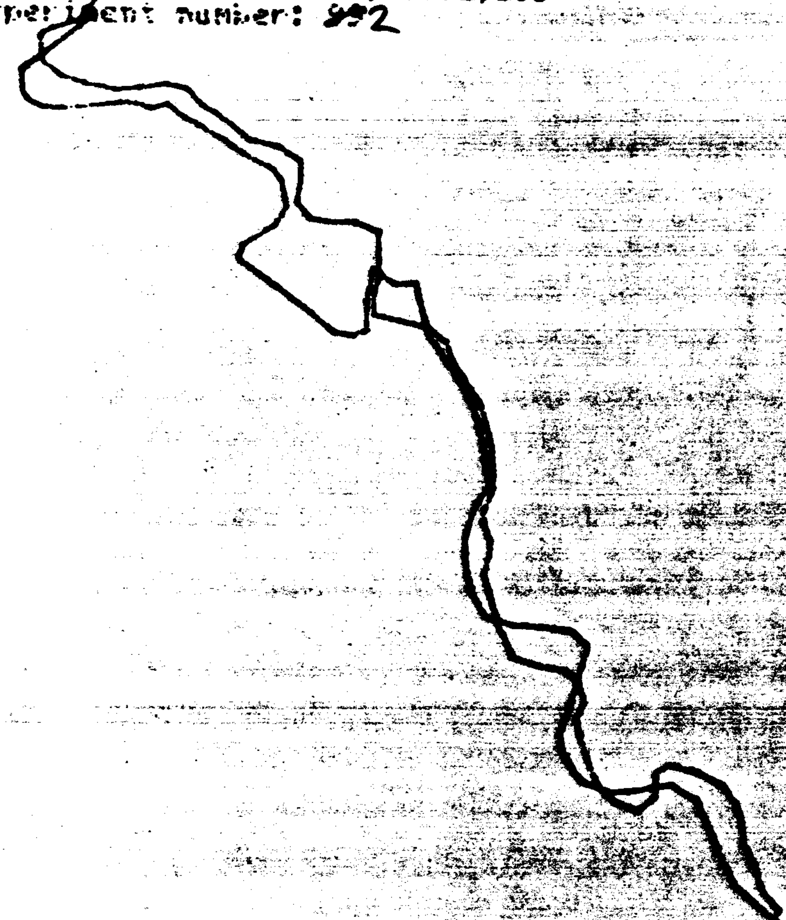
Start X-pt:	475052	Scale: 1:	62500
Start Y-pt:	5091011	Number of points:	55
End X-pt:	475812		
End Y-pt:	5089986		

Description
Deep Creek, 2nd reach, 1:62,500

Base line distance: 1837
Compare line distance: 1675

Channel Index for base line: 1.48
Channel index for compare line: 1.31

Deep Creek, reach #2, 1:24,000
Deep Creek, 2nd reach, 1:62,500
Experiment number: 2



-- S T A T I S T I C S --

Experiment number: 2 Polygon file number: 16

Base line description:
Deep Creek, reach #2, 1:24,000

Compare line description
Deep Creek, 2nd reach, 1:62,500

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	8	-92.20	-921.98	-991.25	11424.0	242.27
2	46	2187.99	21879.92	21729.00	1033540.7	43913.47
3	8	-216.94	-2169.42	-2198.90	59629.4	1763.65
4	18	136.11	1361.12	1375.58	10401.8	36.54
5	15	-268.13	-2681.31	-2717.08	48568.8	403.81
6	11	375.44	3754.42	3784.19	129158.7	2193.73
7	12	-197.33	-1973.34	-1969.48	32387.1	302.10
8	6	80.53	805.29	857.55	11509.6	284.44
9	21	-588.38	-5883.80	-5951.59	166752.2	1105.73

FINAL STATISTICS FOR EXPERIMENT NUMBER 2

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 13918.02
Total area by coordinate method, ABS: 41574.62
Ratio of CM to ABS CM: 0.335
Total area by transect method(TM): 14170.90
Total area by transect method, ABS: 41430.61

Width between transects: 10.0

Total number of transects (N): 145
Total length of transects (D)eviation : 1417.09
Total length of transects (D)eviation, ABS: 4143.06

True length of base line (BL): 1837.34
True length of compare line (CL): 1674.55

Scale of base line 1: 24000
Scale of compare line 1: 62500

Weighted avg/total area (epsilon): 36.16
Standard deviation: 54.15
Epsilon line width at compare line scale: 0.5786mm
Maximum transect length found: 118.04

Experiment number: 2

Deep Creek, reach #2, 1:24,000
Deep Creek, 2nd reach, 1:62,500

1)	0.00
2)	9.00
3)	0.00
4)	0.00
5)	13918.02
6)	41574.62
7)	145.00
8)	1417.09
9)	4143.06
10)	0.00
11)	118.04
12)	1503372.20
13)	0.00
14)	975182578.83
15)	1837.34
16)	1674.55
17)	0.00
18)	0.00
19)	1837.34
20)	1711.63
21)	24000.00
22)	62500.00
23)	2.00
24)	0.00

-- REPORT OF LINE OVERLAY --

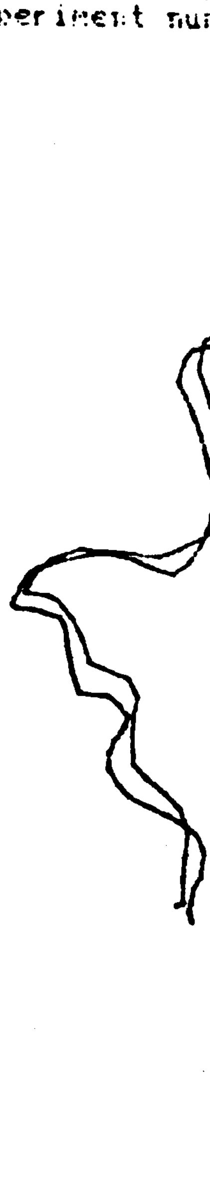
This is experiment number ~~59~~ 24
Base line file number: 18
Start X-pt: 475909 Scale: 1: 24000
Start Y-pt: 5088994 Number of points: 85
End X-pt: 475770
End Y-pt: 5087998
Description
Deep Creek, reach 4, 5089-5088, 1:24,000

Compare line file number 21
Start X-pt: 475920 Scale: 1: 62500
Start Y-pt: 5089017 Number of points: 52
End X-pt: 475752
End Y-pt: 5088017
Description
Deep Creek 4th, 5089-5088,1:62,500

Base line distance: 1542
Compare line distance: 1421

Channel Index for base line: 1.53
Channel index for compare line: 1.40

Deep Creek, reach 4, 5089-5089, 1:24,000
Deep Creek 4th, 5089-5088,1:62,500
Experiment number: 99



-- S T A T I S T I C S --

Experiment number: 3 Polygon file number: 24

Base line description:
Deep Creek, reach 4, 5089-5088, 1:24,000

Compare line description
Deep Creek 4th, 5089-5088,1:62,500

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	2	10.78	107.76	106.97	576.4	116.08
2	10	-101.59	-1015.91	-1050.10	10668.1	127.56
3	24	405.95	4059.46	4062.16	68709.1	1134.10
4	13	-300.84	-3008.42	-3077.61	71221.2	787.64
5	21	353.73	3537.30	3546.13	59731.9	872.22
6	17	-165.57	-1655.74	-1668.56	16251.1	548.30
7	32	697.69	6976.91	7022.43	153108.8	1727.42
8	11	-137.21	-1372.06	-1337.01	16676.8	326.05

FINAL STATISTICS FOR EXPERIMENT NUMBER 3

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 7604.41
Total area by coordinate method, ABS: 21870.97
Ratio of CM to ABS CM: 0.348
Total area by transect method(TM): 7629.30
Total area by transect method, ABS: 21733.55

Width between transects: 10.0

Total number of transects (N): 130
Total length of transects (D)eviation : 762.93
Total length of transects (D)eviation, ABS: 2173.36

True length of base line (BL): 1542.34
True length of compare line (CL): 1420.73

Scale of base line 1: 24000
Scale of compare line 1: 62500

Weighted avg/total area (epsilon): 18.15
Standard deviation: 12.46
Epsilon line width at compare line scale: 0.2904mm
Maximum transect length found: 42.58

Experiment number: 3

Deep Creek, reach 4, 5089-5088, 1:24,000
Deep Creek 4th, 5089-5088,1:62,500

1)	0.00
2)	8.00
3)	0.00
4)	0.00
5)	7604.41
6)	21870.97
7)	130.00
8)	762.93
9)	2173.36
10)	0.00
11)	42.58
12)	396943.46
13)	0.00
14)	23751805.61
15)	1542.34
16)	1420.73
17)	0.00
18)	0.00
19)	1542.34
20)	1471.66
21)	24000.00
22)	62500.00
23)	3.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

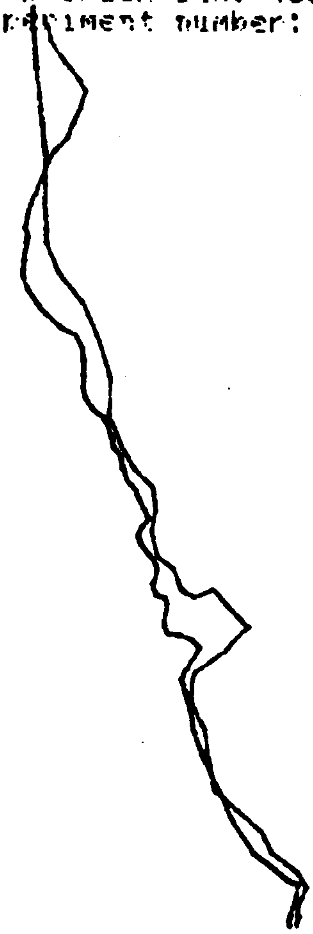
This is experiment number 9510
Base line file number: 19
Start X-pt: 475772 Scale: 1: 24000
Start Y-pt: 5087998 Number of points: 74
End X-pt: 476027
End Y-pt: 5086994
Description
Deep Creek, 5th reach, 5088 - 5087, 1:24,000

Compare line file number 22
Start X-pt: 475755 Scale: 1: 62500
Start Y-pt: 5088018 Number of points: 41
End X-pt: 476036
End Y-pt: 5087006
Description
Deep Creek 5th, 4088-4087, 1:62,500

Base line distance: 1171
Compare line distance: 1201

Channel Index for base line: 1.13
Channel index for compare line: 1.14

Deep Creek, 5th reach, 5088 - 5087, 1:24,000
Deep Creek 5th, 4088-4087, 1:62,500
Experiment number: 10



-- S T A T I S T I C S --

Experiment number: 10 Polygon file number: 41

Base line description:
Deep Creek, 5th reach, 5088 - 5087, 1:24,000

Compare line description
Deep Creek 5th, 4088-4087, 1:62,500

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	18	-481.08	-4810.84	-4812.59	128625.6	3241.04
2	69	1516.21	15162.10	15225.93	334575.4	11102.50
3	2	-2.72	-27.18	-32.31	43.9	4.43
4	16	198.74	1987.40	1997.16	24807.2	244.73

FINAL STATISTICS FOR EXPERIMENT NUMBER 10

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 12378.19
Total area by coordinate method, ABS: 22067.99
Ratio of CM to ABS CM: 0.561
Total area by transect method(TM): 12311.48
Total area by transect method, ABS: 21987.51

Width between transects: 10.0

Total number of transects (N): 105
Total length of transects (D)eviation : 1231.15
Total length of transects (D)eviation, ABS: 2198.75

True length of base line (BL): 1171.31
True length of compare line (CL): 1201.11

Scale of base line 1: 24000
Scale of compare line 1: 62500

Weighted avg/total area (epsilon): 22.12
Standard deviation: 52.88
Epsilon line width at compare line scale: 0.3539mm
Maximum transect length found: 76.21

Experiment number: 10

Deep Creek, 5th reach, 5088 - 5087, 1:24,000
Deep Creek 5th, 4088-4087, 1:62,500

1)	0.00
2)	4.00
3)	0.00
4)	0.00
5)	12378.19
6)	22067.99
7)	105.00
8)	1231.15
9)	2198.75
10)	0.00
11)	76.21
12)	488051.99
13)	0.00
14)	185132529.91
15)	1171.31
16)	1201.11
17)	0.00
18)	0.00
19)	1171.31
20)	1243.21
21)	24000.00
22)	62500.00
23)	10.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

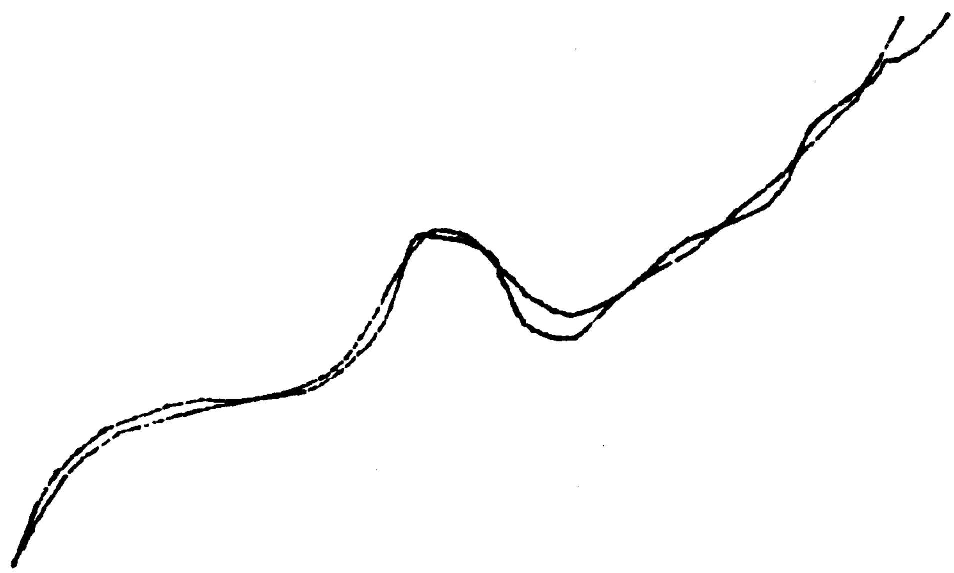
This is experiment number 20
Base line file number: 7
Start X-pt: 445149 Scale: 1: 24000
Start Y-pt: 4974148 Number of points: 75
End X-pt: 446596
End Y-pt: 4975004
Description
Boulder Creek, 1st segment, junction Siletz to 4975n, 1:24,000

Compare line file number 10
Start X-pt: 445133 Scale: 1: 62500
Start Y-pt: 4974120 Number of points: 47
End X-pt: 446525
End Y-pt: 4975001
Description
Boulder Creek, 1st reach, Siletz to 4975, 1:62500

Base line distance: 1986
Compare line distance: 1902

Channel Index for base line: 1.18
Channel index for compare line: 1.15

Boulder Creek, 1st segment, junction Siletz to 4975m, 1:24,000
Boulder Creek, 1st reach, Siletz to 4975, 1:62500
Experiment number: 20



-- S T A T I S T I C S --

Experiment number: 20 Polygon file number: 13

Base line description:
Boulder Creek, 1st segment, junction Siletz to 4975n, 1:24,000

Compare line description
Boulder Creek, 1st reach, Siletz to 4975, 1:62500

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	77	957.07	9570.70	9580.22	119077.2	1511.20
2	4	-25.70	-256.99	-266.02	1709.2	24.04
3	8	80.70	806.97	811.01	8180.8	33.88
4	4	-13.37	-133.67	-143.05	478.0	12.84
5	19	587.78	5877.84	5874.88	181745.0	1909.88
6	19	-165.14	-1651.42	-1656.88	14401.1	693.49
7	16	204.94	2049.36	2050.59	26265.0	456.08
8	15	-176.76	-1767.61	-1773.09	20894.2	203.80
9	18	420.58	4205.84	4231.01	98860.8	4243.88

FINAL STATISTICS FOR EXPERIMENT NUMBER 20

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 18708.68
Total area by coordinate method, ABS: 26386.76
Ratio of CM to ABS CM: 0.709
Total area by transect method(TM): 18701.01
Total area by transect method, ABS: 26320.40

Width between transects: 10.0

Total number of transects (N): 180
Total length of transects (D)eviation : 1870.10
Total length of transects (D)eviation, ABS: 2632.04

True length of base line (BL): 1985.91
True length of compare line (CL): 1902.35

Scale of base line 1: 24000
Scale of compare line 1: 62500

Weighted avg/total area (epsilon): 17.87
Standard deviation: 14.78
Epsilon line width at compare line scale: 0.2860mm
Maximum transect length found: 51.14

Experiment number: 20

Boulder Creek, 1st segment, junction Siletz to 4975n, 1:24,000
Boulder Creek, 1st reach, Siletz to 4975, 1:62500

1)	0.00
2)	9.00
3)	0.00
4)	0.00
5)	18708.68
6)	26386.76
7)	180.00
8)	1870.10
9)	2632.04
10)	0.00
11)	51.14
12)	471611.36
13)	0.00
14)	46135112.30
15)	1985.91
16)	1902.35
17)	0.00
18)	0.00
19)	1985.92
20)	2005.98
21)	24000.00
22)	62500.00
23)	20.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

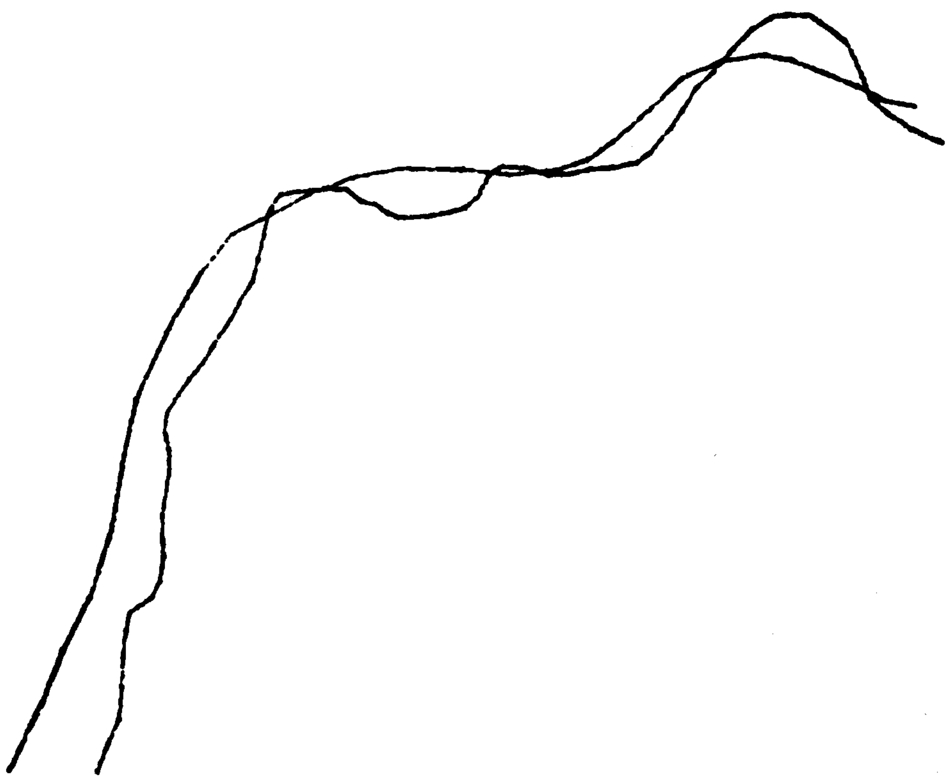
```
This is experiment number  21
Base line file number:   8
Start X-pt:      446598   Scale:  1:  24000
Start Y-pt:     4975002   Number of points:   69
End X-pt:        447299
End Y-pt:       4975536
Description
Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,


Compare line file number 11
Start X-pt:      446526   Scale:  1:  62500
Start Y-pt:     4975001   Number of points:   28
End X-pt:        447276
End Y-pt:       4975567
Description
Boulder Creek, 2nd reach, 4975n to L. Boulder junction, 1,62500


Base line distance:          1211
Compare line distance:        1114

Channel Index for base line:   1.38
Channel index for compare line:   1.19
```

Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,000
Boulder Creek, 2nd reach, 4975n to L. Boulder junction, 1,62500
Experiment number: 21



-- S T A T I S T I C S --

Experiment number: 21 Polygon file number: 14

Base line description:
Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,(

Compare line description
Boulder Creek, 2nd reach, 4975n to L. Boulder junction, 1,62500

#	# TRAN- SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	49	2067.10	20671.01	20948.58	883731.1	3954.48
2	5	-27.83	-278.26	-280.51	1561.1	36.72
3	13	363.97	3639.71	3657.92	102413.3	1479.11
4	3	-17.76	-177.62	-182.18	1078.6	3.79
5	18	279.04	2790.37	2799.48	43397.8	1083.70
6	12	-342.73	-3427.33	-3425.72	97842.2	994.90
7	8	70.36	703.63	706.59	6214.8	218.50

FINAL STATISTICS FOR EXPERIMENT NUMBER 21

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 24224.15
Total area by coordinate method, ABS: 32000.99
Ratio of CM to ABS CM: 0.757
Total area by transect method(TM): 23921.52
Total area by transect method, ABS: 31687.93

Width between transects: 10.0

Total number of transects (N): 108
Total length of transects (D)eviation : 2392.15
Total length of transects (D)eviation, ABS: 3168.79

True length of base line (BL): 1211.14
True length of compare line (CL): 1113.90

Scale of base line 1: 24000
Scale of compare line 1: 62500

Weighted avg/total area (epsilon): 35.51
Standard deviation: 22.23
Epsilon line width at compare line scale: 0.5681mm
Maximum transect length found: 65.40

Experiment number: 21

Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,0
Boulder Creek, 2nd reach, 4975n to L. Boulder junction, 1,62500

1)	0.00
2)	7.00
3)	0.00
4)	0.00
5)	24224.15
6)	32000.99
7)	108.00
8)	2392.15
9)	3168.79
10)	0.00
11)	65.40
12)	1136238.96
13)	0.00
14)	94858545.31
15)	1211.14
16)	1113.90
17)	0.00
18)	0.00
19)	1211.14
20)	1224.02
21)	24000.00
22)	62500.00
23)	21.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

This is experiment number 22
Base line file number: 9
Start X-pt: 447298 Scale: 1: 24000
Start Y-pt: 4975537 Number of points: 84
End X-pt: 449006
End Y-pt: 4975528
Description
Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,0

Compare line file number 12
Start X-pt: 447271 Scale: 1: 62500
Start Y-pt: 4975570 Number of points: 52
End X-pt: 449001
End Y-pt: 4975479
Description
Boulder Creek, 3rd reach, L. Boulder to 449e, 1:62500

Base line distance: 1999
Compare line distance: 1914

Channel Index for base line: 1.17
Channel index for compare line: 1.11

Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,000
Boulder Creek, 3rd reach, L. Boulder to 449e, 1:62500
Experiment number: 22

-- S T A T I S T I C S --

Experiment number: 22 Polygon file number: 15

Base line description:
Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,

Compare line description
Boulder Creek, 3rd reach, L. Boulder to 449e, 1:62500

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	9	89.97	899.73	958.52	9582.3	184.41
2	34	-526.77	-5267.67	-5276.57	81750.7	803.55
3	19	206.45	2064.48	2073.45	22529.4	430.36
4	13	-201.94	-2019.38	-2026.90	31485.2	589.12
5	19	146.95	1469.47	1472.44	11388.0	105.16
6	3	-4.51	-45.08	-50.82	76.4	4.47
7	13	183.89	1838.87	1842.10	26056.8	173.92
8	23	-631.06	-6310.63	-6316.57	173311.1	3192.61
9	1	0.18	1.79	3.02	0.5	0.00
10	11	-161.91	-1619.07	-1628.18	23964.9	556.69
11	13	268.06	2680.61	2687.74	55421.5	912.64
12	22	-578.07	-5780.66	-5795.62	152284.1	4513.92

FINAL STATISTICS FOR EXPERIMENT NUMBER 22

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): -12057.37
Total area by coordinate method, ABS: 30131.92
Ratio of CM to ABS CM: -0.400
Total area by transect method(TM): -12087.55
Total area by transect method, ABS: 29997.45

Width between transects: 10.0

Total number of transects (N): 180
Total length of transects (D)eviation : -1208.76
Total length of transects (D)eviation, ABS: 2999.74

True length of base line (BL): 1999.45
True length of compare line (CL): 1914.18

Scale of base line 1: 24000
Scale of compare line 1: 62500

Weighted avg/total area (epsilon): 19.51
Standard deviation: 13.08
Epsilon line width at compare line scale: 0.3121mm
Maximum transect length found: 45.66

Experiment number: 22

Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,(
Boulder Creek, 3rd reach, L. Boulder to 449e, 1:62500

1)	0.00
2)	12.00
3)	0.00
4)	0.00
5)	-12057.37
6)	30131.92
7)	180.00
8)	-1208.76
9)	2999.74
10)	0.00
11)	45.66
12)	587850.81
13)	0.00
14)	56665188.18
15)	1999.45
16)	1914.18
17)	0.00
18)	0.00
19)	1999.45
20)	2005.71
21)	24000.00
22)	62500.00
23)	22.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

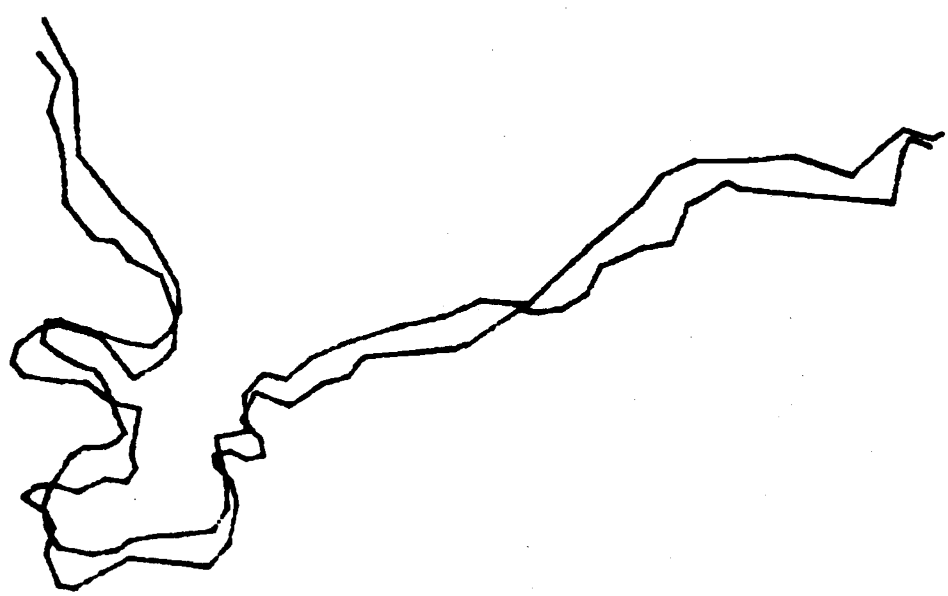
This is experiment number 99
Base line file number: 12
Start X-pt: 473212 Scale: 1: 24000
Start Y-pt: 5091272 Number of points: 76
End X-pt: 474310
End Y-pt: 5091158
Description
Deep Creek from Nehalam River, 1st reach, 1:24,000

Compare line file number 25
Start X-pt: 473217 Scale: 1: 100000
Start Y-pt: 5091314 Number of points: 66
End X-pt: 474325
End Y-pt: 5091173
Description
Deep Creek, 1st segment, 1:100,000

Base line distance: 2758
Compare line distance: 2393

Channel Index for base line: 2.50
Channel index for compare line: 2.14

Deep Creek from Nehalem River, 1st reach, 1:24,000
Deep Creek, 1st segment, 1:100,000
Experiment number: 5



-- S T A T I S T I C S --

Experiment number: 5 Polygon file number: 31

Base line description:
Deep Creek from Nehalam River, 1st reach, 1:24,000

Compare line description
Deep Creek, 1st segment, 1:100,000

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	40	1104.74	11047.41	11076.64	305920.3	5243.39
2	15	-274.23	-2742.29	-2804.20	51266.2	2163.67
3	12	368.70	3686.98	3699.96	113680.9	2211.64
4	13	-498.34	-4983.41	-4978.43	190842.9	2158.57
5	3	49.51	495.14	505.27	8339.3	44.01
6	3	-15.98	-159.85	-156.76	835.2	14.42
7	23	775.95	7759.48	8197.93	276572.7	1782.25
8	2	-12.61	-126.15	-150.22	947.5	6.24
9	4	133.70	1337.02	1430.35	47810.4	365.38
10	2	-3.50	-35.01	-43.47	76.1	12.24
11	93	3364.89	33648.89	33595.53	1215539.9	8590.69

FINAL STATISTICS FOR EXPERIMENT NUMBER 5

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 50372.60
Total area by coordinate method, ABS: 66638.77
Ratio of CM to ABS CM: 0.756
Total area by transect method(TM): 49928.22
Total area by transect method, ABS: 66021.63

Width between transects: 10.0

Total number of transects (N): 210
Total length of transects (D)eviation : 4992.82
Total length of transects (D)eviation, ABS: 6602.16

True length of base line (BL): 2757.92
True length of compare line (CL): 2392.60

Scale of base line 1: 24000
Scale of compare line 1:100000

Weighted avg/total area (epsilon): 33.19
Standard deviation: 24.09
Epsilon line width at compare line scale: 0.3319mm
Maximum transect length found: 71.12

Experiment number: 5

Deep Creek from Nehalam River, 1st reach, 1:24,000
Deep Creek, 1st segment, 1:100,000

1)	0.00
2)	11.00
3)	0.00
4)	0.00
5)	50372.60
6)	66638.77
7)	210.00
8)	4992.82
9)	6602.16
10)	0.00
11)	71.12
12)	2211831.47
13)	0.00
14)	386843886.65
15)	2757.92
16)	2392.60
17)	0.00
18)	0.00
19)	2757.92
20)	2457.37
21)	24000.00
22)	100000.00
23)	5.00
24)	0.00

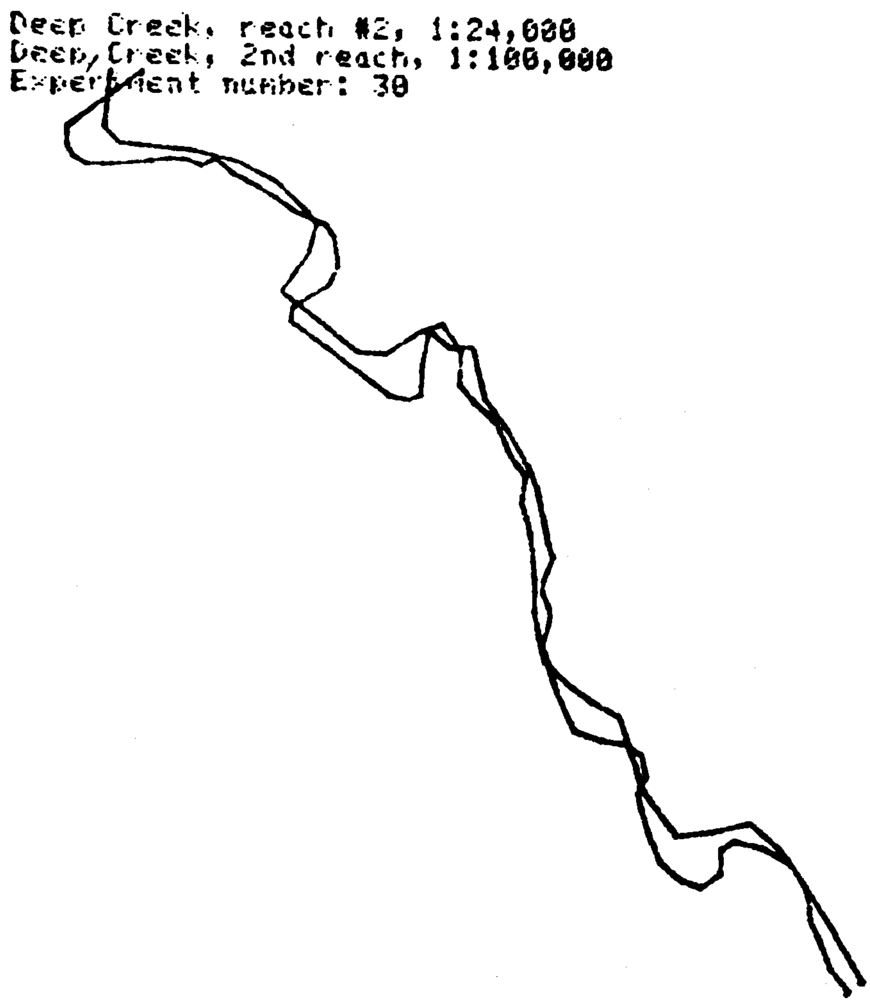
-- R E P O R T   O F   L I N E   O V E R L A Y --

This is experiment number 30
Base line file number: 14
Start X-pt: 475052 Scale: 1: 24000
Start Y-pt: 5090989 Number of points: 66
End X-pt: 475805
End Y-pt: 5090000
Description
Deep Creek, reach #2, 1:24,000

Compare line file number 26
Start X-pt: 475019 Scale: 1: 100000
Start Y-pt: 5090994 Number of points: 41
End X-pt: 475819
End Y-pt: 5090013
Description
Deep Creek, 2nd reach, 1:100,000

Base line distance: 1837
Compare line distance: 1548

Channel Index for base line: 1.48
Channel index for compare line: 1.22


Deep Creek, reach #2, 1:24,000
Deep Creek, 2nd reach, 1:100,000
Experiment number: 30

-- S T A T I S T I C S --

Experiment number: 30 Polygon file number: 47

Base line description:
Deep Creek, reach #2, 1:24,000

Compare line description
Deep Creek, 2nd reach, 1:100,000

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	4	-48.33	-483.29	-478.65	5783.2	149.24
2	27	518.07	5180.74	5281.97	101350.0	3123.58
3	9	-255.06	-2550.59	-2583.64	73220.1	758.31
4	17	481.68	4816.76	5226.83	148096.4	4359.14
5	35	-449.71	-4497.09	-4547.10	58425.0	646.45
6	12	264.74	2647.44	2657.80	58636.5	1470.08
7	4	-32.31	-323.06	-326.46	2636.6	10.68
8	18	519.65	5196.46	5419.75	156464.0	4792.85
9	2	-0.61	-6.13	-8.63	2.6	0.17
10	13	181.49	1814.94	1822.02	25437.4	560.33

FINAL STATISTICS FOR EXPERIMENT NUMBER 30

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 12463.88
Total area by coordinate method, ABS: 28352.85
Ratio of CM to ABS CM: 0.440
Total area by transect method(TM): 11796.18
Total area by transect method, ABS: 27516.51

Width between transects: 10.0

Total number of transects (N): 141
Total length of transects (D)eviation : 1179.62
Total length of transects (D)eviation, ABS: 2751.65

True length of base line (BL): 1837.34
True length of compare line (CL): 1547.71

Scale of base line 1: 24000
Scale of compare line 1:100000

Weighted avg/total area (epsilon): 22.22
Standard deviation: 17.16
Epsilon line width at compare line scale: 0.2222mm
Maximum transect length found: 77.22

Experiment number: 30

Deep Creek, reach #2, 1:24,000
Deep Creek, 2nd reach, 1:100,000

1)	0.00
2)	10.00
3)	0.00
4)	0.00
5)	12463.88
6)	28352.85
7)	141.00
8)	1179.62
9)	2751.65
10)	0.00
11)	77.22
12)	630051.78
13)	0.00
14)	75160873.43
15)	1837.34
16)	1547.71
17)	0.00
18)	0.00
19)	1837.34
20)	1600.22
21)	24000.00
22)	100000.00
23)	30.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

This is experiment number 956
Base line file number: 17

Start X-pt:	475813	Scale: 1:	24000
Start Y-pt:	5089998	Number of points:	77
End X-pt:	475914		
End Y-pt:	5088992		

Description
Deep Creek, reach 3, 5090 to 5089

Compare line file number 27

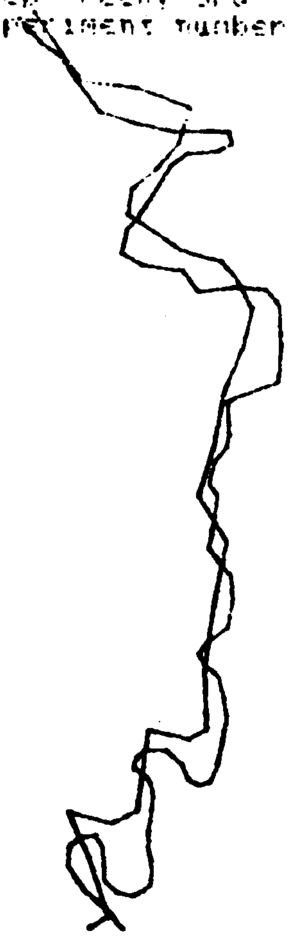
Start X-pt:	475825	Scale: 1:	100000
Start Y-pt:	5090007	Number of points:	31
End X-pt:	475877		
End Y-pt:	5088992		

Description
Deep Creek, 3rd reach, 1:100,000

Base line distance: 1771
Compare line distance: 1395

Channel Index for base line: 1.75
Channel index for compare line: 1.37

Deep Creek, reach 3. 5000 to 5039
Deep Creek, 3rd reach. 1:100,000
Experiment number: 6



-- S T A T I S T I C S --

Experiment number: 6 Polygon file number: 32

Base line description:
Deep Creek, reach 3, 5090 to 5089

Compare line description
Deep Creek, 3rd reach, 1:100,000

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	20	426.08	4260.81	4332.40	92297.5	3580.01
2	13	-259.05	-2590.47	-2589.27	51595.7	780.84
3	13	389.67	3896.67	3895.26	116758.1	547.89
4	26	-583.99	-5839.90	-5990.28	134548.7	5282.24
5	5	46.70	466.98	477.89	4463.3	156.99
6	8	-118.08	-1180.77	-1178.94	17400.7	98.28
7	3	9.81	98.07	109.47	357.9	21.36
8	11	-375.84	-3758.43	-4072.50	139147.2	3507.67
9	3	18.67	186.66	168.85	1050.6	77.41
10	10	-419.88	-4198.79	-5319.59	223358.8	5294.52
11	8	118.99	1189.88	1203.70	17903.3	311.60
12	4	-35.81	-358.08	-312.16	2794.4	425.12

FINAL STATISTICS FOR EXPERIMENT NUMBER 6

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): -9275.17
Total area by coordinate method, ABS: 29650.31
Ratio of CM to ABS CM: -0.313
Total area by transect method(TM): -7827.37
Total area by transect method, ABS: 28025.52

Width between transects: 10.0

Total number of transects (N): 124
Total length of transects (D)eviation : -782.74
Total length of transects (D)eviation, ABS: 2802.55

True length of base line (BL): 1770.76
True length of compare line (CL): 1395.08

Scale of base line 1: 24000
Scale of compare line 1:100000

Weighted avg/total area (epsilon): 27.04
Standard deviation: 17.02
Epsilon line width at compare line scale: 0.2704mm
Maximum transect length found: 102.60

Experiment number: 6

Deep Creek, reach 3, 5090 to 5089
Deep Creek, 3rd reach, 1:100,000

1)	0.00
2)	12.00
3)	0.00
4)	0.00
5)	-9275.17
6)	29650.31
7)	124.00
8)	-782.74
9)	2802.55
10)	0.00
11)	102.60
12)	801676.17
13)	0.00
14)	94471831.44
15)	1770.76
16)	1395.08
17)	0.00
18)	0.00
19)	1770.76
20)	1447.47
21)	24000.00
22)	100000.00
23)	6.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

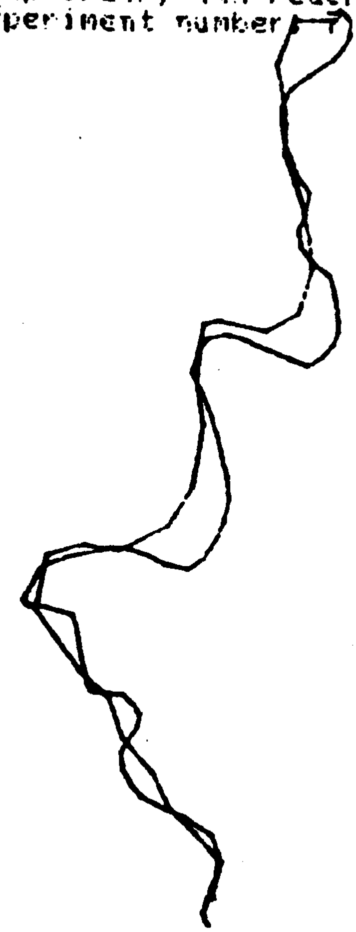
This is experiment number 957
Base line file number: 18
Start X-pt: 475909 Scale: 1: 24000
Start Y-pt: 5088994 Number of points: 85
End X-pt: 475770
End Y-pt: 5087998
Description
Deep Creek, reach 4, 5089-5088, 1:24,000

Compare line file number 28
Start X-pt: 475903 Scale: 1: 100000
Start Y-pt: 5088984 Number of points: 30
End X-pt: 475776
End Y-pt: 5088026
Description
Deep Creek, 4th reach, 1:100,000

Base line distance: 1542
Compare line distance: 1292

Channel Index for base line: 1.53
Channel index for compare line: 1.34

Deep Creek, reach 4, 5039-5088, 1:24,000
Deep Creek, 4th reach, 1:100,000
Experiment number: 7



-- S T A T I S T I C S --

Experiment number: 7 Polygon file number: 33

Base line description:
Deep Creek, reach 4, 5089-5088, 1:24,000

Compare line description
Deep Creek, 4th reach, 1:100,000

#	# TRAN- SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	11	-401.55	-4015.50	-4067.77	148492.3	2410.48
2	4	7.57	75.68	81.51	154.2	3.59
3	8	-48.04	-480.42	-488.98	2936.4	45.24
4	4	31.03	310.30	318.48	2470.6	22.65
5	15	-563.96	-5639.63	-5695.14	214123.2	3469.47
6	4	10.49	104.89	112.13	294.0	8.59
7	19	-712.95	-7129.49	-6989.60	262275.3	4646.79
8	1	1.90	19.01	26.20	49.8	0.00
9	6	-50.43	-504.35	-521.26	4381.6	11.16
10	5	37.51	375.11	359.73	2698.7	91.53
11	9	-144.72	-1447.20	-1442.04	23188.0	431.91
12	2	10.20	102.03	97.54	497.6	29.20
13	5	-100.63	-1006.26	-1015.46	20436.2	75.80
14	9	147.99	1479.93	1487.16	24454.5	490.18
15	6	-43.77	-437.74	-448.79	3274.2	44.36
16	7	28.45	284.46	292.51	1188.7	28.66

FINAL STATISTICS FOR EXPERIMENT NUMBER 7

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): -17893.77
Total area by coordinate method, ABS: 23444.31
Ratio of CM to ABS CM: -0.763
Total area by transect method(TM): -17909.18
Total area by transect method, ABS: 23411.99

Width between transects: 10.0

Total number of transects (N): 115
Total length of transects (D)eviation : -1790.92
Total length of transects (D)eviation, ABS: 2341.20

True length of base line (BL): 1542.34
True length of compare line (CL): 1292.07

Scale of base line 1: 24000
Scale of compare line 1:100000

Weighted avg/total area (epsilon): 30.32
Standard deviation: 13.45
Epsilon line width at compare line scale: 0.3032mm
Maximum transect length found: 64.06

Experiment number: 7

Deep Creek, reach 4, 5089-5088, 1:24,000
Deep Creek, 4th reach, 1:100,000

1)	0.00
2)	16.00
3)	0.00
4)	0.00
5)	-17893.77
6)	23444.31
7)	115.00
8)	-1790.92
9)	2341.20
10)	0.00
11)	64.06
12)	710915.39
13)	0.00
14)	63572868.16
15)	1542.34
16)	1292.07
17)	0.00
18)	0.00
19)	1542.34
20)	1333.29
21)	24000.00
22)	100000.00
23)	7.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

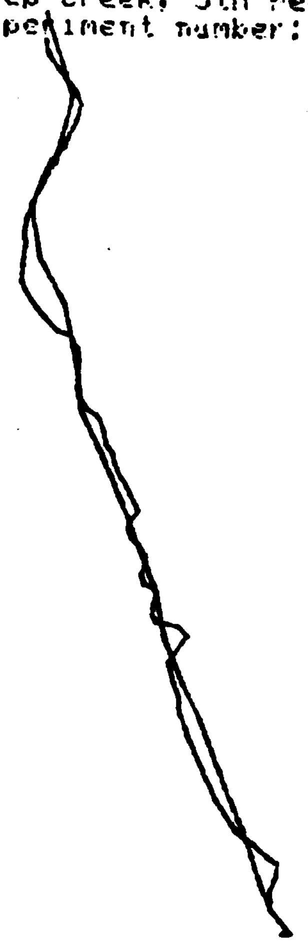
This is experiment number 11
Base line file number: 19
Start X-pt: 475772 Scale: 1: 24000
Start Y-pt: 5087998 Number of points: 74
End X-pt: 476027
End Y-pt: 5086994
Description
Deep Creek, 5th reach, 5088 - 5087, 1:24,000

Compare line file number 29
Start X-pt: 475770 Scale: 1: 100000
Start Y-pt: 5088031 Number of points: 22
End X-pt: 476039
End Y-pt: 5086956
Description
Deep Creek, 5th reach, 1:100,000

Base line distance: 1171
Compare line distance: 1155

Channel Index for base line: 1.13
Channel index for compare line: 1.04

Deep Creek, 5th reach, 5088 - 5037, 1:24,000
Deep Creek, 5th reach, 1:100,000
Experiment number: 11



-- S T A T I S T I C S --

Experiment number: 11 Polygon file number: 42

Base line description:
Deep Creek, 5th reach, 5088 - 5087, 1:24,000

Compare line description
Deep Creek, 5th reach, 1:100,000

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	6	41.14	411.44	431.12	2956.4	28.63
2	9	-76.29	-762.89	-769.73	6524.6	87.83
3	5	12.54	125.41	130.62	327.6	6.26
4	1	-0.26	-2.64	-5.62	1.5	0.00
5	15	310.37	3103.74	3103.89	64224.5	1050.69
6	5	-11.06	-110.56	-115.89	256.2	5.82
7	2	2.05	20.50	26.54	27.2	2.83
8	16	-169.23	-1692.32	-1686.21	17835.0	132.49
9	2	6.66	66.56	64.90	216.0	0.25
10	2	-4.36	-43.65	-48.01	104.8	3.50
11	7	36.23	362.26	387.52	2005.4	85.28
12	4	-59.22	-592.25	-601.96	8912.7	268.76
13	22	315.09	3150.92	3158.56	45238.2	300.76
14	12	-115.05	-1150.53	-977.09	9368.1	589.31

FINAL STATISTICS FOR EXPERIMENT NUMBER 11

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 3098.64
Total area by coordinate method, ABS: 11507.66
Ratio of CM to ABS CM: 0.269
Total area by transect method(TM): 2885.99
Total area by transect method, ABS: 11595.66

Width between transects: 10.0

Total number of transects (N): 108
Total length of transects (D)eviation : 288.60
Total length of transects (D)eviation, ABS: 1159.57

True length of base line (BL): 1171.31
True length of compare line (CL): 1155.47

Scale of base line 1: 24000
Scale of compare line 1:100000

Weighted avg/total area (epsilon): 13.73
Standard deviation: 5.94
Epsilon line width at compare line scale: 0.1373mm
maximum transect length found: 32.77

Experiment number: 11

Deep Creek, 5th reach, 5088 - 5087, 1:24,000
Deep Creek, 5th reach, 1:100,000

1)	0.00
2)	14.00
3)	0.00
4)	0.00
5)	3098.64
6)	11507.66
7)	108.00
8)	288.60
9)	1159.57
10)	0.00
11)	32.77
12)	157998.21
13)	0.00
14)	5286954.60
15)	1171.31
16)	1155.47
17)	0.00
18)	0.00
19)	1171.31
20)	1228.24
21)	24000.00
22)	100000.00
23)	11.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

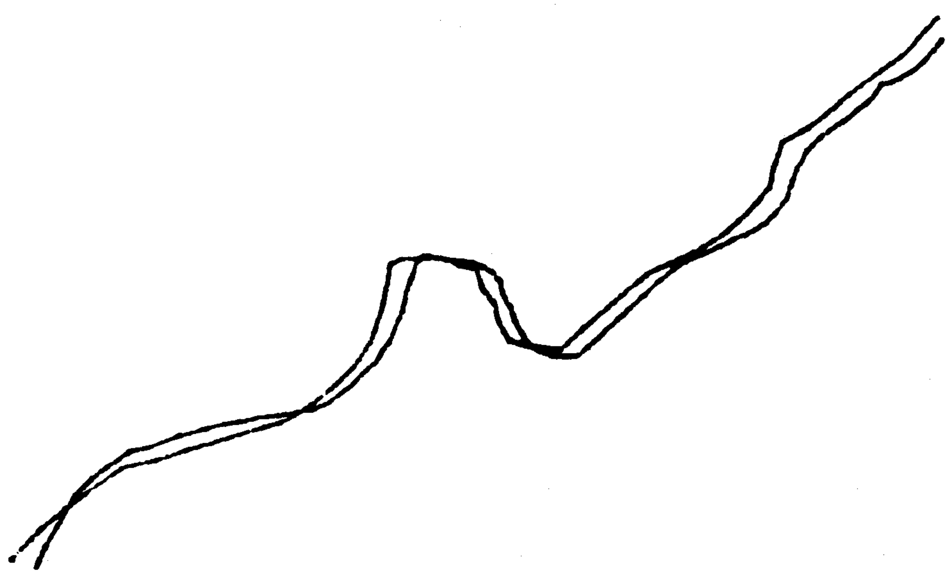
This is experiment number 23
Base line file number: 7
Start X-pt: 445149   Scale: 1: 24000
Start Y-pt: 4974148   Number of points: 75
End X-pt: 446596
End Y-pt: 4975004
Description
Boulder Creek, 1st segment, junction Siletz to 4975n, 1:24,000

Compare line file number 16
Start X-pt: 445110   Scale: 1: 100000
Start Y-pt: 4974158   Number of points: 45
End X-pt: 446589
End Y-pt: 4975038
Description
Boulder Creek, 1st reach, 1:100,000

Base line distance: 1986
Compare line distance: 2001

Channel Index for base line: 1.18
Channel index for compare line: 1.16

Boulder Creek, 1st segment, junction Siletz to 4975m, 1:24,000
Boulder Creek, 1st reach, 1:100,000
Experiment number: 23



-- S T A T I S T I C S --

Experiment number: 23 Polygon file number: 19

Base line description:
Boulder Creek, 1st segment, junction Siletz to 4975n, 1:24,000

Compare line description
Boulder Creek, 1st reach, 1:100,000

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	12	229.85	2298.55	2297.81	44013.4	1123.81
2	39	-728.65	-7286.47	-7287.51	136154.5	1317.92
3	31	755.22	7552.16	7558.65	184142.3	2279.92
4	3	-6.00	-60.01	-65.38	130.8	1.77
5	1	0.00	0.01	0.00	0.0	0.00
6	20	-352.07	-3520.75	-3516.38	61901.4	1685.90
7	84	2089.79	20897.86	20921.60	520496.0	4250.60

FINAL STATISTICS FOR EXPERIMENT NUMBER 23

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 19908.78
Total area by coordinate method, ABS: 41647.32
Ratio of CM to ABS CM: 0.478
Total area by transect method(TM): 19881.34
Total area by transect method, ABS: 41615.81

Width between transects: 10.0

Total number of transects (N): 190
Total length of transects (D)eviation : 1988.13
Total length of transects (D)eviation, ABS: 4161.58

True length of base line (BL): 1985.91
True length of compare line (CL): 2001.00

Scale of base line 1: 24000
Scale of compare line 1:100000

Weighted avg/total area (epsilon): 22.73
Standard deviation: 22.30
Epsilon line width at compare line scale: 0.2273mm
Maximum transect length found: 46.15

Experiment number: 23

Boulder Creek, 1st segment, junction Siletz to 4975m, 1:24,000
Boulder Creek, 1st reach, 1:100,000

1)	0.00
2)	7.00
3)	0.00
4)	0.00
5)	19908.78
6)	41647.32
7)	190.00
8)	1988.13
9)	4161.58
10)	0.00
11)	46.15
12)	946838.35
13)	0.00
14)	124277591.64
15)	1985.91
16)	2001.00
17)	0.00
18)	0.00
19)	1985.92
20)	2076.74
21)	24000.00
22)	100000.00
23)	23.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

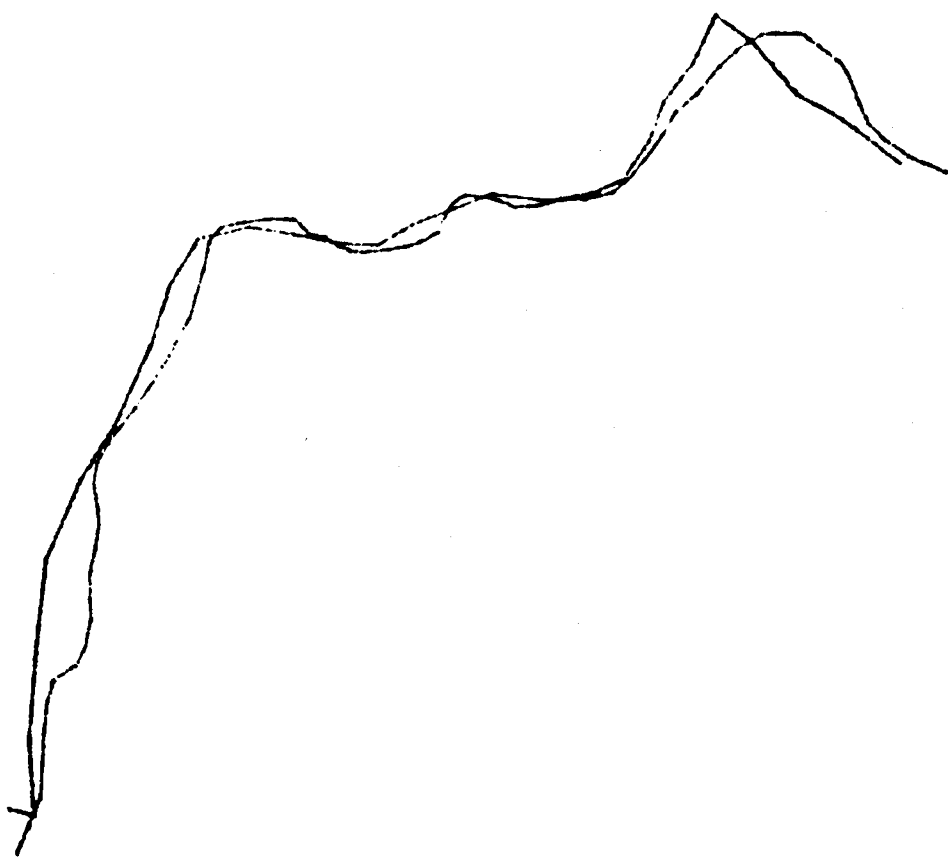
This is experiment number 24
Base line file number: 8
Start X-pt: 446598 Scale: 1: 24000
Start Y-pt: 4975002 Number of points: 69
End X-pt: 447299
End Y-pt: 4975536
Description
Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,(

Compare line file number 17
Start X-pt: 446590 Scale: 1: 100000
Start Y-pt: 4975036 Number of points: 29
End X-pt: 447265
End Y-pt: 4975543
Description
Boulder Creek, 2nd reach, 1:100,000

Base line distance: 1211
Compare line distance: 1156

Channel Index for base line: 1.38
Channel index for compare line: 1.37

Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,000
Boulder Creek, 2nd reach, 1:100,000
Experiment number: 34



-- S T A T I S T I C S --

Experiment number: 24 Polygon file number: 20

Base line description:
Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,

Compare line description
Boulder Creek, 2nd reach, 1:100,000

#	# TRAN- SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	49	871.29	8712.92	8669.12	154149.8	3793.80
2	8	-47.79	-477.93	-484.36	2893.6	46.75
3	9	76.51	765.14	778.99	6622.6	160.15
4	2	-10.06	-100.64	-116.28	585.1	0.66
5	23	241.56	2415.59	2454.44	25777.9	1039.99
6	18	-336.48	-3364.81	-3392.64	63420.0	2936.62

FINAL STATISTICS FOR EXPERIMENT NUMBER 24

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 7909.27
Total area by coordinate method, ABS: 15895.83
Ratio of CM to ABS CM: 0.498
Total area by transect method(TM): 7950.28
Total area by transect method, ABS: 15837.03

Width between transects: 10.0

Total number of transects (N): 109
Total length of transects (D)eviation : 795.03
Total length of transects (D)eviation, ABS: 1583.70

True length of base line (BL): 1211.14
True length of compare line (CL): 1156.25

Scale of base line 1: 24000
Scale of compare line 1:100000

Weighted avg/total area (epsilon): 15.94
Standard deviation: 23.94
Epsilon line width at compare line scale: 0.1594mm
Maximum transect length found: 38.95

Experiment number: 24

Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,(
Boulder Creek, 2nd reach, 1:100,000

1)	0.00
2)	6.00
3)	0.00
4)	0.00
5)	7909.27
6)	15895.83
7)	109.00
8)	795.03
9)	1583.70
10)	0.00
11)	38.95
12)	253448.98
13)	0.00
14)	45551877.33
15)	1211.14
16)	1156.25
17)	0.00
18)	0.00
19)	1211.14
20)	1225.34
21)	24000.00
22)	100000.00
23)	24.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

This is experiment number 25
Base line file number: 9
Start X-pt: 447298 Scale: 1: 24000
Start Y-pt: 4975537 Number of points: 84
End X-pt: 449006
End Y-pt: 4975528
Description
Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,

Compare line file number 18
Start X-pt: 447266 Scale: 1: 100000
Start Y-pt: 4975550 Number of points: 51
End X-pt: 448987
End Y-pt: 4975553
Description
Boulder Creek, 3rd reach, 1:100,000

Base line distance: 1999
Compare line distance: 1971

Channel Index for base line: 1.17
Channel index for compare line: 1.15

Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,000
Boulder Creek, 3rd reach, 1:100,000
Experiment number: 25

-- S T A T I S T I C S --

Experiment number: 25 Polygon file number: 21

Base line description:
Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,

Compare line description
Boulder Creek, 3rd reach, 1:100,000

#	# TRAN- SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	37	948.57	9485.71	9522.05	244117.3	1057.64
2	23	-377.53	-3775.34	-3791.51	62235.9	417.95
3	8	123.42	1234.17	1236.41	19074.3	233.16
4	6	-25.54	-255.44	-257.21	1095.0	13.64
5	4	5.25	52.54	52.98	69.6	3.13
6	2	-0.07	-0.72	-0.55	0.0	0.00
7	3	0.25	2.52	3.29	0.3	0.01
8	5	-7.74	-77.40	-77.81	120.5	2.70
9	5	14.57	145.73	145.44	423.9	7.46
10	5	-27.86	-278.58	-285.49	1590.6	14.90
11	26	612.84	6128.36	6138.17	144680.3	2552.16
12	13	-55.98	-559.82	-557.93	2402.6	44.88
13	2	4.73	47.27	55.10	130.2	3.80
14	10	-193.94	-1939.40	-1949.42	37807.0	312.20
15	33	600.86	6008.57	6015.71	109532.9	1575.28

FINAL STATISTICS FOR EXPERIMENT NUMBER 25

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 16249.25
Total area by coordinate method, ABS: 30089.07
Ratio of CM to ABS CM: 0.540
Total area by transect method(TM): 16218.15
Total area by transect method, ABS: 29991.57

Width between transects: 10.0

Total number of transects (N): 182
Total length of transects (D)eviation : 1621.82
Total length of transects (D)eviation, ABS: 2999.16

True length of base line (BL): 1999.45
True length of compare line (CL): 1971.37

Scale of base line 1: 24000
Scale of compare line 1:100000

Weighted avg/total area (epsilon): 20.71
Standard deviation: 9.46
Epsilon line width at compare line scale: 0.2071mm
Maximum transect length found: 37.08

Experiment number: 25

Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,0
Boulder Creek, 3rd reach, 1:100,000

1)	0.00
2)	15.00
3)	0.00
4)	0.00
5)	16249.25
6)	30089.07
7)	182.00
8)	1621.82
9)	2999.16
10)	0.00
11)	37.08
12)	623280.44
13)	0.00
14)	37728945.63
15)	1999.45
16)	1971.37
17)	0.00
18)	0.00
19)	1999.45
20)	2037.21
21)	24000.00
22)	100000.00
23)	25.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

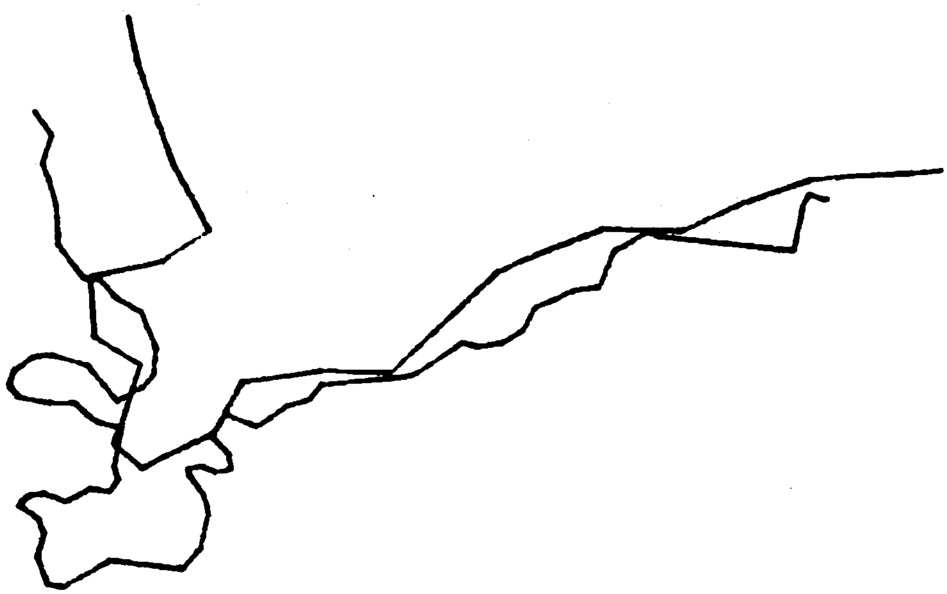
This is experiment number 9
Base line file number: 12
Start X-pt: 473212 Scale: 1: 24000
Start Y-pt: 5091272 Number of points: 76
End X-pt: 474310
End Y-pt: 5091158
Description
Deep Creek from Nehalam River, 1st reach, 1:24,000

Compare line file number 34
Start X-pt: 473337 Scale: 1: 250000
Start Y-pt: 5091408 Number of points: 24
End X-pt: 474470
End Y-pt: 5091200
Description
Deep Creek, first reach (from Nehalem), 1:250000

Base line distance: 2758
Compare line distance: 2083

Channel Index for base line: 2.50
Channel index for compare line: 1.81

Deep Creek from Nehalam River, 1st reach, 1:24,000
Deep Creek, first reach (from Nehalem), 1:250000
Experiment number: 9



-- S T A T I S T I C S --

Experiment number: 9 Polygon file number: 40

Base line description:
Deep Creek from Nehalam River, 1st reach, 1:24,000

Compare line description
Deep Creek, first reach (from Nehalem), 1:250000

#	# TRAN- SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	16	2377.09	47541.79	48409.36	7192085.8	18186.26
2	8	-341.30	-6825.94	-6926.91	295516.9	2652.97
3	3	333.61	6672.16	8784.04	976809.3	4834.44
4	1	-4.24	-84.81	-96.29	408.3	0.00
5	67	3509.34	70186.85	72194.90	3781442.1	74902.91

FINAL STATISTICS FOR EXPERIMENT NUMBER 9

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 122365.11
Total area by coordinate method, ABS: 136411.50
Ratio of CM to ABS CM: 0.897
Total area by transect method(TM): 117490.05
Total area by transect method, ABS: 131311.55

Width between transects: 20.0

Total number of transects (N): 95
Total length of transects (D)eviation : 5874.50
Total length of transects (D)eviation, ABS: 6565.58

True length of base line (BL): 2757.92
True length of compare line (CL): 2082.84

Scale of base line 1: 24000
Scale of compare line 1:250000

Weighted avg/total area (epsilon): 89.77
Standard deviation: 107.87
Epsilon line width at compare line scale: 0.3591mm
Maximum transect length found: 194.22

Experiment number: 9

Deep Creek from Nehalam River, 1st reach, 1:24,000
Deep Creek, first reach (from Nehalem), 1:250000

1)	0.00
2)	5.00
3)	0.00
4)	0.00
5)	122365.11
6)	136411.50
7)	95.00
8)	5874.50
9)	6565.58
10)	0.00
11)	194.22
12)	12246262.31
13)	0.00
14)	6348836177.97
15)	2757.92
16)	2082.84
17)	0.00
18)	0.00
19)	2757.92
20)	2434.25
21)	24000.00
22)	250000.00
23)	9.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

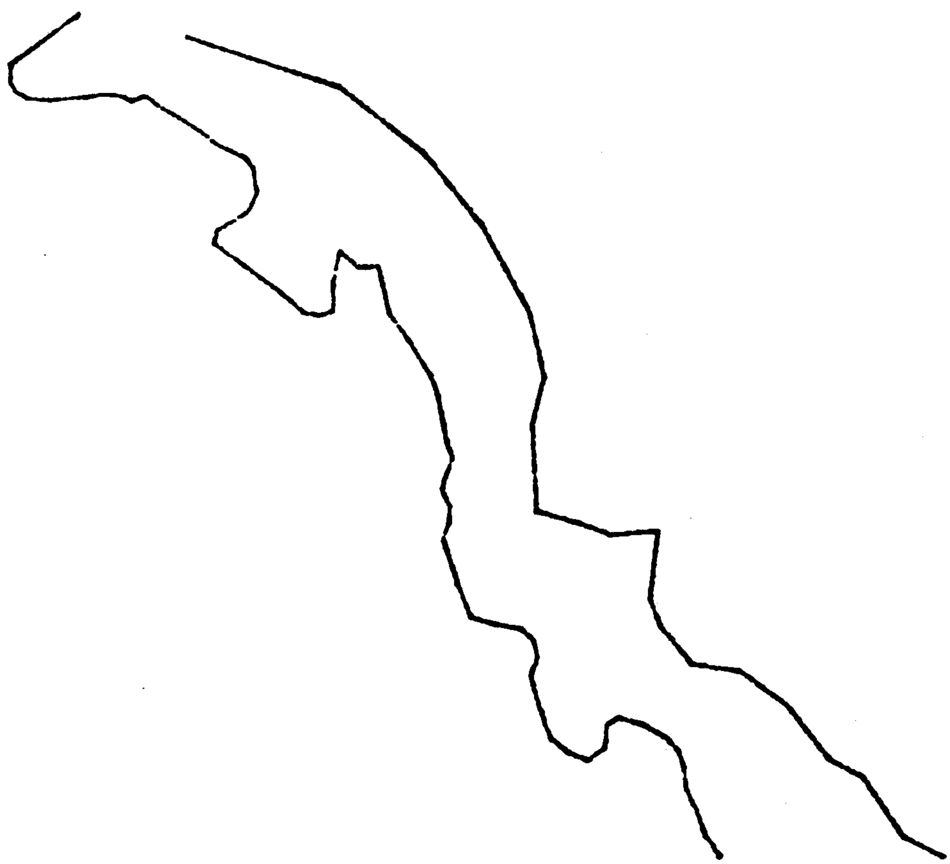
This is experiment number 12
Base line file number: 14
Start X-pt: 475052 Scale: 1: 24000
Start Y-pt: 5090989 Number of points: 66
End X-pt: 475805
End Y-pt: 5090000
Description
Deep Creek, reach #2, 1:24,000

Compare line file number 35
Start X-pt: 475177 Scale: 1: 250000
Start Y-pt: 5090970 Number of points: 20
End X-pt: 476070
End Y-pt: 5090001
Description
Deep Creek, 2nd reach, 1:250,000

Base line distance: 1837
Compare line distance: 1495

Channel Index for base line: 1.48
Channel index for compare line: 1.13

Deep Creek, reach #2, 1:24,000
Deep Creek, 2nd reach, 1:250,000
Experiment number: 12



-- S T A T I S T I C S --

Experiment number: 12 Polygon file number: 43

Base line description:
Deep Creek, reach #2, 1:24,000

Compare line description
Deep Creek, 2nd reach, 1:250,000

#	# TRAN- SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	56	8213	205316	208417	30565252	47210

FINAL STATISTICS FOR EXPERIMENT NUMBER 12

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 208417.06
Total area by coordinate method, ABS: 208417.06
Ratio of CM to ABS CM: 1.000
Total area by transect method(TM): 205315.98
Total area by transect method, ABS: 205315.98

Width between transects: 25.0

Total number of transects (N): 56
Total length of transects (D)eviation : 8212.64
Total length of transects (D)eviation, ABS: 8212.64

True length of base line (BL): 1837.34
True length of compare line (CL): 1495.19

Scale of base line 1: 24000
Scale of compare line 1:250000

Weighted avg/total area (epsilon): 146.65
Standard deviation: 217.28
Epsilon line width at compare line scale: 0.5866mm
Maximum transect length found: 245.27

Experiment number: 12

Deep Creek, reach #2, 1:24,000
Deep Creek, 2nd reach, 1:250,000

1)	0.00
2)	1.00
3)	0.00
4)	0.00
5)	208417.06
6)	208417.06
7)	56.00
8)	8212.64
9)	8212.64
10)	0.00
11)	245.27
12)	30565251.95
13)	0.00
14)	9839422866.63
15)	1837.34
16)	1495.19
17)	0.00
18)	0.00
19)	1837.34
20)	1885.93
21)	24000.00
22)	250000.00
23)	12.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

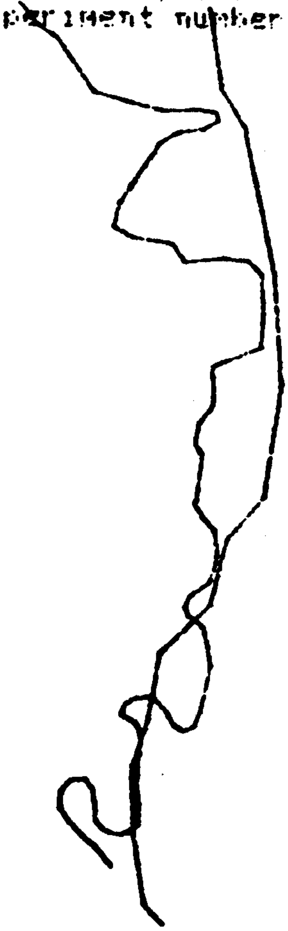
This is experiment number 37
Base line file number: 17
Start X-pt: 475813 Scale: 1: 24000
Start Y-pt: 5089998 Number of points: 77
End X-pt: 475914
End Y-pt: 5088992
Description
Deep Creek, reach 3, 5090 to 5089

Compare line file number 27
Start X-pt: 476026 Scale: 1: 250000
Start Y-pt: 5089995 Number of points: 15
End X-pt: 475972
End Y-pt: 5088924
Description
Deep Creek, 3rd reach, 1:250,000, (2nd digitization)

Base line distance: 1771
Compare line distance: 1139

Channel Index for base line: 1.75
Channel index for compare line: 1.06

Deep Creek, reach 3, 5090 to 5089
Deep Creek, 3rd reach, 1:250,000, (2nd digitization)
Experiment number: 37



-- S T A T I S T I C S --

Experiment number: 37 Polygon file number: 32

Base line description:
Deep Creek, reach 3, 5090 to 5089

Compare line description
Deep Creek, 3rd reach, 1:250,000, (2nd digitization)

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	38	2920.05	58401.04	58420.17	4489208.2	75990.76
2	5	-263.63	-5272.64	-5477.19	288792.3	422.67
3	2	37.93	758.57	935.05	17732.5	501.95
4	4	-23.30	-465.94	-502.24	2925.2	6.19
5	4	232.27	4645.43	4301.82	249797.8	3141.41

FINAL STATISTICS FOR EXPERIMENT NUMBER 37

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 57677.61
Total area by coordinate method, ABS: 69636.47
Ratio of CM to ABS CM: 0.828
Total area by transect method(TM): 58066.46
Total area by transect method, ABS: 69543.61

Width between transects: 20.0

Total number of transects (N): 53
Total length of transects (D)eviation : 2903.32
Total length of transects (D)eviation, ABS: 3477.18

True length of base line (BL): 1770.76
True length of compare line (CL): 1138.69

Scale of base line 1: 24000
Scale of compare line 1:250000

Weighted avg/total area (epsilon): 72.50
Standard deviation: 126.48
Epsilon line width at compare line scale: 0.2900mm
Maximum transect length found: 169.66

Experiment number: 37

Deep Creek, reach 3, 5090 to 5089
Deep Creek, 3rd reach, 1:250,000, (2nd digitization)

1)	0.00
2)	5.00
3)	0.00
4)	0.00
5)	57677.61
6)	69636.47
7)	53.00
8)	2903.32
9)	3477.18
10)	0.00
11)	169.66
12)	5048455.94
13)	0.00
14)	4455694148.34
15)	1770.76
16)	1138.69
17)	0.00
18)	0.00
19)	1770.76
20)	1440.23
21)	24000.00
22)	250000.00
23)	37.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

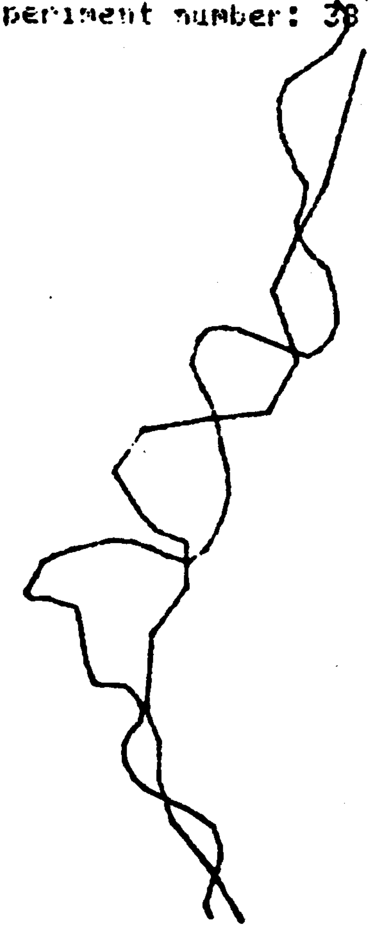
This is experiment number 38
Base line file number: 18
Start X-pt: 475909 Scale: 1: 24000
Start Y-pt: 5088994 Number of points: 85
End X-pt: 475770
End Y-pt: 5087998
Description
Deep Creek, reach 4, 5089-5088, 1:24,000

Compare line file number 28
Start X-pt: 475936 Scale: 1: 250000
Start Y-pt: 5088943 Number of points: 20
End X-pt: 475803
End Y-pt: 5087993
Description
Deep Creek, 4th reach, 1:250,000 (2nd digitization)

Base line distance: 1542
Compare line distance: 1185

Channel Index for base line: 1.53
Channel index for compare line: 1.23

Deep Creek, reach 4, 5089-5088, 1:24,000
Deep Creek, 4th reach, 1:250,000 (2nd digitization)
Experiment number: 38



-- S T A T I S T I C S --

Experiment number: 38 Polygon file number: 33

Base line description:
Deep Creek, reach 4, 5089-5088, 1:24,000

Compare line description
Deep Creek, 4th reach, 1:250,000 (2nd digitization)

#	# TRAN- SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	12	448.77	8975.36	8952.80	334810.7	5739.48
2	6	-287.37	-5747.34	-5758.64	275807.5	1258.06
3	5	386.98	7739.50	7855.34	607964.1	3293.35
4	7	-597	-11933	-12218	1041416	5812
5	13	896	17927	18738	1291923	25067
6	4	-95	-1903	-1979	47070	116
7	2	51	1016	930	23627	186

FINAL STATISTICS FOR EXPERIMENT NUMBER 38

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 16520.48
Total area by coordinate method, ABS: 56431.09
Ratio of CM to ABS CM: 0.293
Total area by transect method(TM): 16074.02
Total area by transect method, ABS: 55241.09

Width between transects: 20.0

Total number of transects (N): 49
Total length of transects (D)eviation : 803.70
Total length of transects (D)eviation, ABS: 2762.05

True length of base line (BL): 1542.34
True length of compare line (CL): 1184.86

Scale of base line 1: 24000
Scale of compare line 1:250000

Weighted avg/total area (epsilon): 64.20
Standard deviation: 42.98
Epsilon line width at compare line scale: 0.2568mm
Maximum transect length found: 157.74

Experiment number: 38

Deep Creek, reach 4, 5089-5088, 1:24,000
Deep Creek, 4th reach, 1:250,000 (2nd digitization)

1)	0.00
2)	7.00
3)	0.00
4)	0.00
5)	16520.48
6)	56431.09
7)	49.00
8)	803.70
9)	2762.05
10)	0.00
11)	157.74
12)	3622619.06
13)	0.00
14)	625604844.30
15)	1542.34
16)	1184.86
17)	0.00
18)	0.00
19)	1542.34
20)	1276.26
21)	24000.00
22)	250000.00
23)	38.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

This is experiment number 39
Base line file number: 19

Start X-pt:	475772	Scale: 1:	24000
Start Y-pt:	5087998	Number of points:	74
End X-pt:	476027		
End Y-pt:	5086994		

Description
Deep Creek, 5th reach, 5088 - 5087, 1:24,000

Compare line file number 29

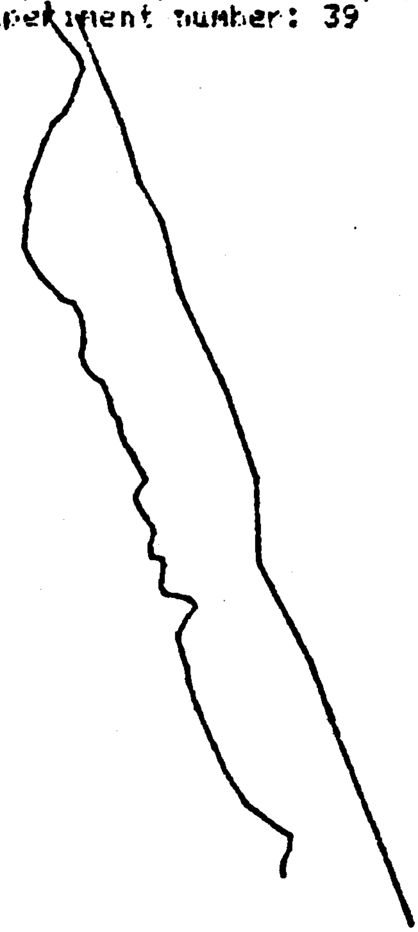
Start X-pt:	475803	Scale: 1:	250000
Start Y-pt:	5087984	Number of points:	11
End X-pt:	476172		
End Y-pt:	5086938		

Description
Deep Creek, 5th reach, 1:250,000 (2nd digitization)

Base line distance: 1171
Compare line distance: 1118

Channel Index for base line: 1.13
Channel index for compare line: 1.01

Deep Creek, 5th reach, 5088 - 5067, 1:24,000
Deep Creek, 5th reach, 1:250,000 (2nd digitization)
Experiment number: 39



FINAL STATISTICS FOR EXPERIMENT NUMBER 39

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): 120675.17
Total area by coordinate method, ABS: 120675.17
Ratio of CM to ABS CM: 1.000
Total area by transect method(TM): 120430.62
Total area by transect method, ABS: 120430.62

Width between transects: 25.0

Total number of transects (N): 45
Total length of transects (D)eviation : 4817.22
Total length of transects (D)eviation, ABS: 4817.22

True length of base line (BL): 1171.31
True length of compare line (CL): 1117.88

Scale of base line 1: 24000
Scale of compare line 1:250000

Weighted avg/total area (epsilon): 107.05
Standard deviation: 202.97
Epsilon line width at compare line scale: 0.4282mm
Maximum transect length found: 155.45

-- S T A T I S T I C S --

Experiment number: 39 Polygon file number: 34

Base line description:
Deep Creek, 5th reach, 5088 - 5087, 1:24,000

Compare line description
Deep Creek, 5th reach, 1:250,000 (2nd digitization)

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	45	4817	120431	120675	12918210	41199

Experiment number: 39

Deep Creek, 5th reach, 5088 - 5087, 1:24,000
Deep Creek, 5th reach, 1:250,000 (2nd digitization)

1)	0.00
2)	1.00
3)	0.00
4)	0.00
5)	120675.17
6)	120675.17
7)	45.00
8)	4817.22
9)	4817.22
10)	0.00
11)	155.45
12)	12918210.11
13)	0.00
14)	4971640201.14
15)	1171.31
16)	1117.88
17)	0.00
18)	0.00
19)	1171.31
20)	1307.51
21)	24000.00
22)	250000.00
23)	39.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

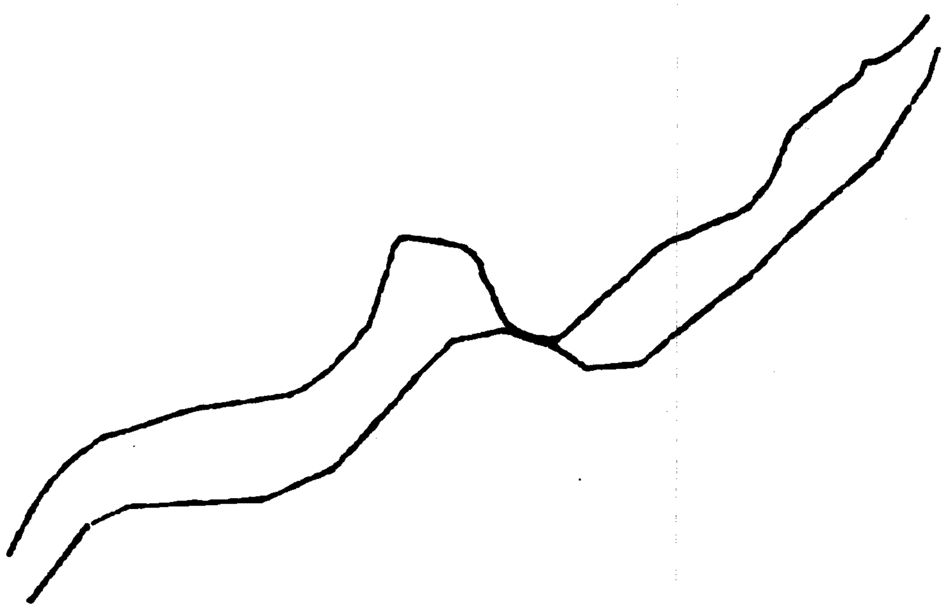
This is experiment number 40
Base line file number: 7
Start X-pt: 445149 Scale: 1: 24000
Start Y-pt: 4974148 Number of points: 75
End X-pt: 446596
End Y-pt: 4975004
Description
Boulder Creek, 1st segment, junction Siletz to 4975n, 1:24,000

Compare line file number 22
Start X-pt: 445178 Scale: 1: 250000
Start Y-pt: 4974071 Number of points: 20
End X-pt: 446612
End Y-pt: 4974951
Description
Boulder Creek, 1st reach, 1:250,000

Base line distance: 1986
Compare line distance: 1841

Channel Index for base line: 1.18
Channel index for compare line: 1.09

Boulder Creek, 1st segment, junction Siletz to 4975m, 1:24,000
Boulder Creek, 1st reach, 1:250,000
Experiment number: 40



-- S T A T I S T I C S --

Experiment number: 40 Polygon file number: 35

Base line description:
Boulder Creek, 1st segment, junction Siletz to 4975n, 1:24,000

Compare line description
Boulder Creek, 1st reach, 1:250,000

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	68	-7590	-189749	-192085	21439873	54877

FINAL STATISTICS FOR EXPERIMENT NUMBER 40

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): -192084.53
Total area by coordinate method, ABS: 192084.53
Ratio of CM to ABS CM: -1.000
Total area by transect method(TM): -189748.67
Total area by transect method, ABS: 189748.67

Width between transects: 25.0

Total number of transects (N): 68
Total length of transects (D)eviation : -7589.95
Total length of transects (D)eviation, ABS: 7589.95

True length of base line (BL): 1985.91
True length of compare line (CL): 1840.75

Scale of base line 1: 24000
Scale of compare line 1:250000

Weighted avg/total area (epsilon): 111.62
Standard deviation: 234.26
Epsilon line width at compare line scale: 0.4465mm
Maximum transect length found: 184.78

Experiment number: 40

Boulder Creek, 1st segment, junction Siletz to 4975m, 1:24,000
Boulder Creek, 1st reach, 1:250,000

1)	0.00
2)	1.00
3)	0.00
4)	0.00
5)	-192084.53
6)	192084.53
7)	68.00
8)	-7589.95
9)	7589.95
10)	0.00
11)	184.78
12)	21439872.79
13)	0.00
14)	10541057780.20
15)	1985.91
16)	1840.75
17)	0.00
18)	0.00
19)	1985.92
20)	1977.48
21)	24000.00
22)	250000.00
23)	40.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

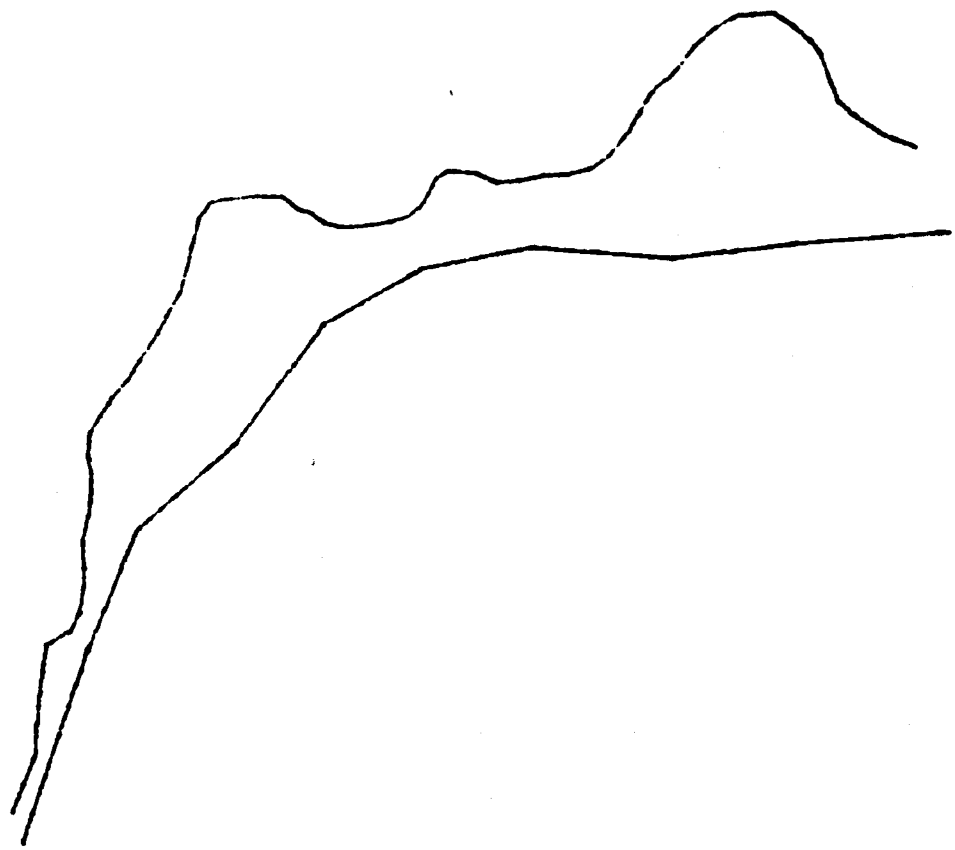
This is experiment number 41
Base line file number: 8
Start X-pt: 446598 Scale: 1: 24000
Start Y-pt: 4975002 Number of points: 69
End X-pt: 447299
End Y-pt: 4975536
Description
Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,

Compare line file number 23
Start X-pt: 446604 Scale: 1: 250000
Start Y-pt: 4974979 Number of points: 10
End X-pt: 447325
End Y-pt: 4975470
Description
Boulder Creek, 2nd reach, 1:250,000

Base line distance: 1211
Compare line distance: 990

Channel Index for base line: 1.38
Channel index for compare line: 1.13

Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,000
Boulder Creek, 2nd reach, 1:250,000
Experiment number: 41



-- S T A T I S T I C S --

Experiment number: 41 Polygon file number: 36

Base line description:
Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,(

Compare line description
Boulder Creek, 2nd reach, 1:250,000

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	36	-3106	-77652	-79307	6842579	68208

FINAL STATISTICS FOR EXPERIMENT NUMBER 41

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): -79306.85
Total area by coordinate method, ABS: 79306.85
Ratio of CM to ABS CM: -1.000
Total area by transect method(TM): -77651.82
Total area by transect method, ABS: 77651.82

Width between transects: 25.0

Total number of transects (N): 36
Total length of transects (D)eviation : -3106.07
Total length of transects (D)eviation, ABS: 3106.07

True length of base line (BL): 1211.14
True length of compare line (CL): 989.62

Scale of base line 1: 24000
Scale of compare line 1:250000

Weighted avg/total area (epsilon): 86.28
Standard deviation: 261.17
Epsilon line width at compare line scale: 0.3451mm
Maximum transect length found: 217.70

Experiment number: 41

Boulder Creek, 2nd reach, from 4975 to junction L. Boulder, 1:24,
Boulder Creek, 2nd reach, 1:250,000

1)	0.00
2)	1.00
3)	0.00
4)	0.00
5)	-79306.85
6)	79306.85
7)	36.00
8)	-3106.07
9)	3106.07
10)	0.00
11)	217.70
12)	6842578.90
13)	0.00
14)	5409345056.32
15)	1211.14
16)	989.62
17)	0.00
18)	0.00
19)	1211.14
20)	1084.85
21)	24000.00
22)	250000.00
23)	41.00
24)	0.00

-- R E P O R T   O F   L I N E   O V E R L A Y --

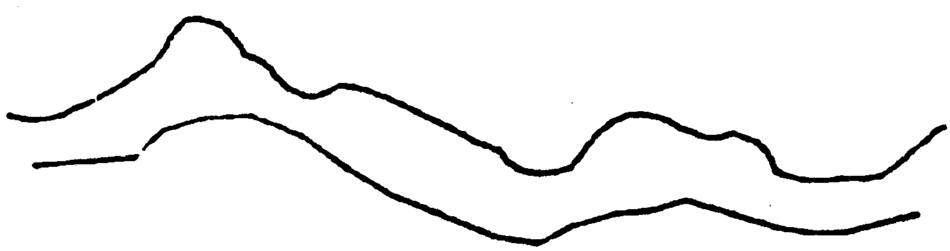
This is experiment number 42
Base line file number: 9
Start X-pt: 447298   Scale: 1: 24000
Start Y-pt: 4975537   Number of points: 84
End X-pt: 449006
End Y-pt: 4975528
Description
Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,(

Compare line file number 24
Start X-pt: 447340   Scale: 1: 250000
Start Y-pt: 4975442   Number of points: 20
End X-pt: 448954
End Y-pt: 4975364
Description
Boulder Creek, 3rd reach, 1:250,000

Base line distance: 1999
Compare line distance: 1722

Channel Index for base line: 1.17
Channel index for compare line: 1.07

Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,000
Boulder Creek, 3rd reach, 1:250,000
Experiment number: 42



-- S T A T I S T I C S --

Experiment number: 42 Polygon file number: 37

Base line description:
Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,

Compare line description
Boulder Creek, 3rd reach, 1:250,000

#	# TRAN-SECTS	TOTAL TRANSECT LENGTH	AREA TRANS. METHOD	AREA COORD. METHOD	WEIGHTED AVERAGE	VARIANCE
1	69	-8904	-222606	-222446	28705997	68991

FINAL STATISTICS FOR EXPERIMENT NUMBER 42

ABS=Absolute value, unsigned values are to be assumed.

Total area by coordinate method (CM): -222446.24
Total area by coordinate method, ABS: 222446.24
Ratio of CM to ABS CM: -1.000
Total area by transect method(TM): -222605.90
Total area by transect method, ABS: 222605.90

Width between transects: 25.0

Total number of transects (N): 69
Total length of transects (D)eviation : -8904.24
Total length of transects (D)eviation, ABS: 8904.24

True length of base line (BL): 1999.45
True length of compare line (CL): 1721.58

Scale of base line 1: 24000
Scale of compare line 1:250000

Weighted avg/total area (epsilon): 129.05
Standard deviation: 262.66
Epsilon line width at compare line scale: 0.5162mm
Maximum transect length found: 190.27

Experiment number: 42

Boulder Creek, 3rd reach, from junction L. Boulder to 449e, 1:24,
Boulder Creek, 3rd reach, 1:250,000

1)	0.00
2)	1.00
3)	0.00
4)	0.00
5)	-222446.24
6)	222446.24
7)	69.00
8)	-8904.24
9)	8904.24
10)	0.00
11)	190.27
12)	28705996.55
13)	0.00
14)	15346730029.70
15)	1999.45
16)	1721.58
17)	0.00
18)	0.00
19)	1999.45
20)	1996.82
21)	24000.00
22)	250000.00
23)	42.00
24)	0.00

APPENDIX C

Reports from program BOX

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	0.00	7.41	24000
B	0.00	7.41	24000
L	0.00	7.41	24000
R	0.00	7.41	24000

This is a systematic random sample...

Start length = 16.0 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	16.0	0.000	90.93	82.00	82.00
2	32.0	0.001	95.44	87.10	87.10
3	64.0	0.004	97.70	92.18	92.18
4	128.0	0.016	98.85	95.72	95.72
5	256.0	0.066	99.46	97.89	97.89
6	512.0	0.262	99.75	99.02	99.02
7	1024.0	1.049	99.90	99.61	99.61
8	2048.0	4.194	99.97	99.86	99.86
9	4096.0	16.777	99.99	99.97	99.97

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	26.04	16.46	62500
B	26.04	16.46	62500
L	26.04	16.46	62500
R	26.04	16.46	62500

This is a systematic random sample...

Start length = 52.5 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	52.5	0.003	75.18	58.37	58.37
2	105.0	0.011	87.57	67.16	67.16
3	210.0	0.044	93.87	79.46	79.46
4	420.0	0.176	97.17	89.16	89.16
5	840.0	0.706	98.76	95.06	95.06
6	1680.0	2.822	99.46	97.82	97.82
7	3360.0	11.290	99.78	99.11	99.11
8	6720.0	45.158	99.93	99.70	99.70
9	13440.0	180.634	99.98	99.93	99.93

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	23.16	17.22	100000
B	23.16	17.22	100000
L	23.16	17.22	100000
R	23.16	17.22	100000

This is a systematic random sample...

Start length = 52.5 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	52.5	0.003	77.56	60.70	60.70
2	105.0	0.011	88.65	69.41	69.41
3	210.0	0.044	94.47	81.32	81.32
4	420.0	0.176	97.14	89.43	89.43
5	840.0	0.706	98.54	94.23	94.23
6	1680.0	2.822	99.24	96.96	96.96
7	3360.0	11.290	99.70	98.79	98.79
8	6720.0	45.158	99.90	99.60	99.60
9	13440.0	180.634	99.96	99.82	99.82
10	26880.0	722.534	99.99	99.97	99.97

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	102.13	191.67	250000
B	102.13	191.67	250000
L	102.13	191.67	250000
R	102.13	191.67	250000

This is a systematic random sample...

Start length = 205.0 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

		AREA	PROBABILITIES		
#	LENGTHm	(km)	avg	minD	minZ
1	205.0	0.042	75.04	68.09	68.09
2	410.0	0.168	83.65	71.51	71.51
3	820.0	0.672	91.45	77.79	77.79
4	1640.0	2.690	95.57	85.52	85.52
5	3280.0	10.758	97.68	91.61	91.61
6	6560.0	43.034	98.84	95.52	95.52
7	13120.0	172.134	99.44	97.77	97.77
8	26240.0	688.538	99.71	98.85	98.85
9	52480.0	2754.150	99.86	99.44	99.44
10	104960.0	11016.602	99.94	99.78	99.78
11	209920.0	44066.406	99.98	99.91	99.91

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	0.00	7.41	24000
B	0.00	7.41	24000
L	0.00	7.41	24000
R	23.16	17.22	100000

This is a systematic random sample...

Start length = 52.5 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	52.5	0.003	92.49	76.18	75.55
2	105.0	0.011	96.26	86.39	86.19
3	210.0	0.044	98.13	92.81	92.76
4	420.0	0.176	99.08	96.36	96.36
5	840.0	0.706	99.52	98.11	98.09
6	1680.0	2.822	99.74	98.95	98.95
7	3360.0	11.290	99.86	99.43	99.43
8	6720.0	45.158	99.94	99.76	99.76
9	13440.0	180.634	99.97	99.87	99.87
10	26880.0	722.534	99.98	99.90	99.90

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	0.00	7.41	24000
B	26.04	16.46	62500
L	23.16	17.22	100000
R	0.00	7.41	24000

This is a systematic random sample...

Start length = 52.5 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	52.5	0.003	86.86	67.86	67.67
2	105.0	0.011	93.58	80.17	79.90
3	210.0	0.044	96.95	89.34	89.27
4	420.0	0.176	98.60	94.68	94.65
5	840.0	0.706	99.31	97.24	97.24
6	1680.0	2.822	99.69	98.74	98.74
7	3360.0	11.290	99.89	99.54	99.54

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	0.00	7.41	24000
B	0.00	7.41	24000
L	26.04	16.46	62500
R	26.04	16.46	62500

This is a systematic random sample...

Start length = 52.5 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	52.5	0.003	86.05	62.55	62.55
2	105.0	0.011	93.14	76.19	75.85
3	210.0	0.044	96.67	87.55	87.50
4	420.0	0.176	98.40	93.82	93.79
5	840.0	0.706	99.19	96.80	96.79
6	1680.0	2.822	99.62	98.48	98.48
7	3360.0	11.290	99.82	99.28	99.28

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	0.00	7.41	24000
B	26.04	16.46	62500
L	26.04	16.46	62500
R	23.16	17.22	100000

This is a systematic random sample...

Start length = 52.5 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	52.5	0.003	81.42	61.09	61.09
2	105.0	0.011	90.80	71.96	71.72
3	210.0	0.044	95.32	83.31	83.28
4	420.0	0.176	97.46	90.52	90.50
5	840.0	0.706	98.63	94.89	94.87
6	1680.0	2.822	99.31	97.37	97.37
7	3360.0	11.290	99.65	98.62	98.62
8	6720.0	45.158	99.83	99.31	99.31

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	0.00	7.41	24000
B	26.04	16.46	62500
L	23.16	17.22	100000
R	102.13	191.67	250000

This is a systematic random sample...

Start length = 205.0 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	205.0	0.042	90.30	73.39	70.89
2	410.0	0.168	94.14	82.55	79.23
3	820.0	0.672	96.90	89.90	88.27
4	1640.0	2.690	98.47	94.45	94.11
5	3280.0	10.758	99.31	97.31	97.27
6	6560.0	43.034	99.74	98.97	98.97
7	13120.0	172.134	99.91	99.65	99.65

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	26.04	16.46	62500
B	102.13	191.67	250000
L	23.16	17.22	100000
R	102.13	191.67	250000

This is a systematic random sample...

Start length = 205.0 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	205.0	0.042	84.40	69.82	68.47
2	410.0	0.168	89.95	76.32	74.66
3	820.0	0.672	94.66	84.30	83.38
4	1640.0	2.690	97.30	91.03	90.61
5	3280.0	10.758	98.65	95.16	95.08
6	6560.0	43.034	99.33	97.59	97.51
7	13120.0	172.134	99.65	98.70	98.69
8	26240.0	688.538	99.83	99.34	99.34

ANALYSIS OF AREAL PROBABILITY

LINE (T,B,L,R)	MEAN	SD	SCALE
T	102.13	191.67	250000
B	102.13	191.67	250000
L	102.13	191.67	250000
R	23.16	17.22	100000

This is a systematic random sample...

Start length = 205.0 meters
Increment multiplier = 2.0
Program will stop when all probabilities >= 99.00
Number of random points generated per pass = 300

#	LENGTHm	AREA (km)	PROBABILITIES avg	minD	minZ
1	205.0	0.042	80.00	68.94	68.37
2	410.0	0.168	87.14	73.60	72.90
3	820.0	0.672	93.45	81.50	80.70
4	1640.0	2.690	96.89	89.39	89.11
5	3280.0	10.758	98.50	94.37	94.34
6	6560.0	43.034	99.27	97.13	97.13
7	13120.0	172.134	99.63	98.50	98.50
8	26240.0	688.538	99.81	99.24	99.24

APPENDIX D

Maps and stream reaches used in analysis

Lines DC1 through DC5

These stream reaches were of Deep Creek

1:24,000 BIRKENFELD QUADRANGLE, published 1979, aerial photographs taken 1973. Projection: Oregon State Plane.

1:62,500 BIRKENFELD QUADRANGLE, published 1955, aerial photographs taken 1953. Projection: Polyconic.

1:100,000 NEHALEM RIVER, published 1979, compiled from the 1:24,000 and 1:62,500 maps, plaimetry revised from 1975 aerial photographs. Projection: UTM.

1:250,000

DC1: from junction of Deep Creek and Nehalem River to first drainage entering from the north.
DC2: from junction of second drainage entering from north to intersection with 5,090,000n UTM meter grid line.
DC3: from 5,090,000n meters to 5,089,000n meters.
DC4: from 5,089,000n meters to 5,088,000n meters.
DC5: from 5,088,000n meters to 5,087,000n meters.

LINES BC1 through BC3

These stream reaches were of Boulder Creek

1:24,000 WARNICKE CREEK QUADRANGLE, published 1974, aerial photographs taken 1972. Projection: Oregon State Plane.

1:62,500 VALSETZ QUADRANGLE, published 1956, aerial photographs taken 1939. Projection: Polyconic.

1:100,000 CORVALLIS QUADRANGLE, published 1980, compiled from the 1:24,000 and 1:62,500 maps, plaimetry revised from 1975-1976 aerial photographs. Projection: UTM.

1:250,000 SALEM QUADRANGLE, published 1960, revised 1979, planimetry from 1975 aerial photographs. Projection: UTM.

BC1: from junction with Siletz river to intersection with 4,975,000n meter grid line.
BC2: from intersection with 4,975,000n meter grid line to junction with Little Boulder Creek.
BC3: from junction of Little Boulder Creek to intersection with 449,000e meter grid line.

Charles T. Traylor, "The Evaluation of a Methodology to Measure Manual Digitization Error in Cartographic Data Bases", unpublished doctoral dissertation, University of Kansas, 1979

J. Perkal, "On the length of empirical curves", Discussion Paper 10 Ann Arbor MI, Michigan Inter-University Community of Mathetical Geographers, 1966

Charles T. Traylor, "The Evaluation of a Methodology to Measure Manual Digitization Error in Cartographic Data Bases", unpublished doctoral dissertation, University of Kansas, 1979

J. Perkal, "On the length of empirical curves", Discussion Paper 10 Ann Arbor MI, Michigan Inter-University Community of Mathetical Geographers, 1966

Charles T. Traylor, "The Evaluation of a Methodology to Measure Manual Digitization Error in Cartographic Data Bases", unpublished doctoral dissertation, University of Kansas, 1979

J. Perkal, "On the length of empirical curves, Discussion Paper 10 Ann Arbor MI, Michigan Inter-University Community of Mathetical Geographers, 1966

Charles T. Traylor, "The Evaluation of a Methodology to Measure Manual Digitization Error in Cartographic Data Bases", unpublished doctoral dissertation