

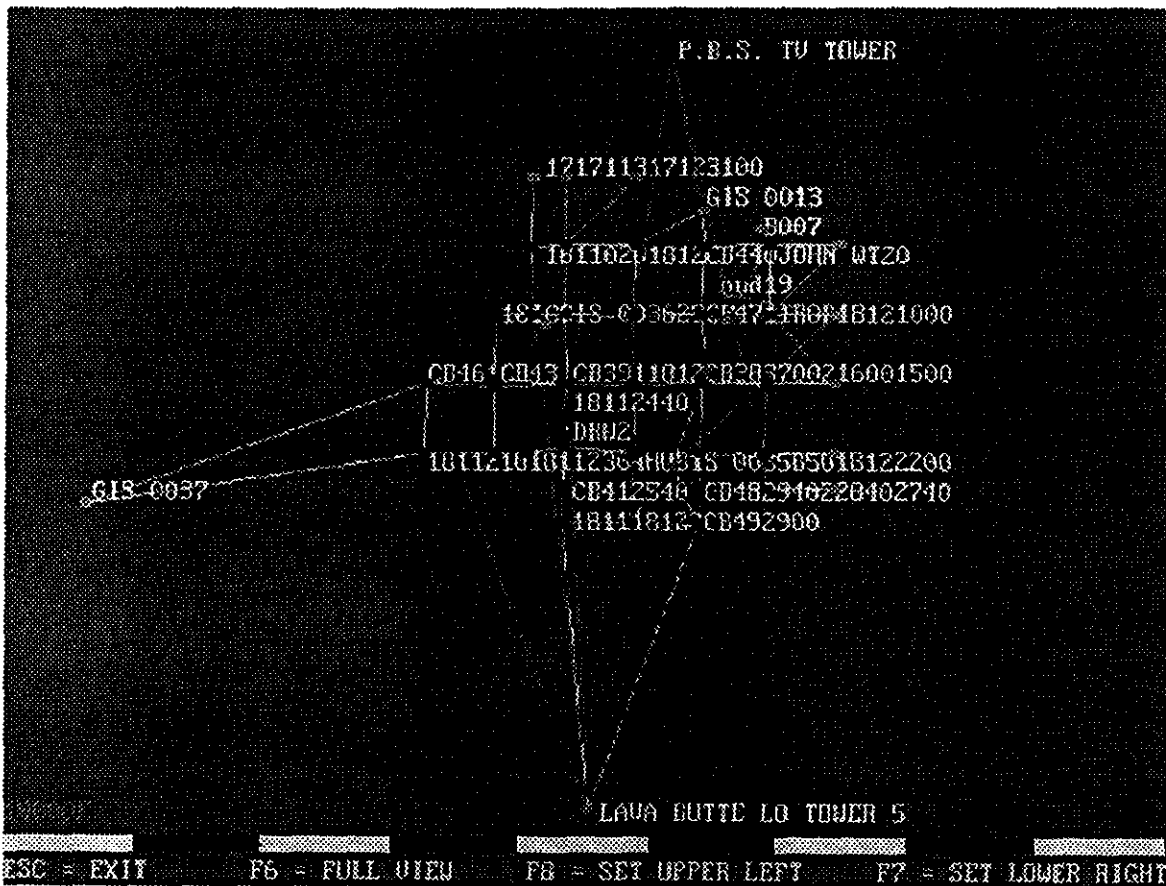
# DESCHUTES COUNTY SECTION CORNER SURVEY

## SOUTHWEST BEND

BY

DESCHUTES COUNTY  
SURVEYOR'S OFFICE

DGMC # 11



## **SOUTHWEST BEND G.P.S. CONTROL SURVEY**

### **GENERAL:**

The purpose of this survey was to establish high precision mapping coordinates on government land corners, section and quarter section corners, with G.P.S. by directly occupying the corners or a secondary monument when not possible to receive adequate gps signals. From the secondary monument a side tie was made by conventional survey methods. The work was performed in of 1992 and 1993 by various personal with 3 Trimble 4000 ST G.P.S. receivers from the Deschutes County Public Works Department. The County Surveyors Office reduced the baseline measurements and computed geodetic coordinates on the NAD 83-91 (North American Datum of 1983, readjusted in 1991) and NAD 83-91 Deschutes County Plane Coordinates in international feet.

### **MEASUREMENTS:**

I used GPSurvey single baseline processor for the reduction of GPS measurements to produce fix solution base lines and holding to Trimble's guideline to high confidence limits for the ratio and rms. criteria.

### **CLOSURES:**

I ran numerous loop closures on the base lines to check for HI errors and isolation of bad lines for remeasure. In the most part loop closures were 1 to 2 ppm for lines with 3 or more independent sessions.

## **ADJUSTMENT:**

### **HORIZONTAL**

A minimal constrained adjustment was accomplished by holding GIS 35 fix with excellent result and many partial constrained adjustments using combinations of two to five fix points, all showing excellent internal consistency. For completion I added ( GIS 13,37,55 ), B007, B009, B011, B013, 17113504, 17113600, 17123100, 18121000, 18121500, 18122200, 18122740 & WT 20 to the system for the fully constrained adjustment of the network. Datum for all adjustments was NAD 83 (1991) in latitude, longitude and ellipsoidal height.

### **ORTHOMETRIC**

First we used NGS GEOID 90 program to compute geoid heights at each control point to make a geoid model of the control area. By fixing orthometric heights of three reliable points in a constrained adjustment, we can cause the geoid model transformation (deflection in latitude and longitude plus a height constant) onto the same orthometric datum. Here we can analyze the record elevation at our control points by using different combinations of fixed height to find errors in data entry, movement of bench marks and bad elevations.

### **MARK DATA SHEET:**

The mark data sheet shows information about each control station in the network, such as name, number, horizontal & vertical datum, coordinates, scale factor, convergence, general information and sketch.

**NOTE: ALL VALUES ARE NAD 83 (1991) GPS**

## DESCHUTES COUNTY COORDINATE SYSTEM:

The County Surveyors Office and the County GIS Section agreed on a conformal mapping projection for the best fit of the 80 % population area of Deschutes County, for a grid to ground distances, being no worse than 1 part in 50,000. This system is the best for the integration maps, deeds, etc., into the County GIS and should be of assistance to local surveyors. The County Surveyor in the process of establishing coordinates at section and 1/4 section corners on the Deschutes County Plane Coordinate System.

### SYSTEM DATA:

DATUM = NAD 83(1991)

PROJECTION = TRANSVERSE MERCATOR

ZONE = DESCHUTES COUNTY

CENTRAL MERIDIAN = W 121° 17' 00.0000"

LATITUDE OF ORIGIN = N 43° 00' 00.000"

ORIGIN NORTHING = 0.00000

ORIGIN EASTING = 3,300,000.00

SCALE ALONG MERIDIAN = 1.00016000

LINEAR UNITS = INTERNATIONAL FOOT



### ACKNOWLEDGMENT:

A project of this magnitude and complexity could not be accomplished without the help and cooperation of many people. To the people who worked in the field on this project, Jeff Kern, Ken Grantham and Don Sweet, Deschutes Co. Surveyor's Office.

A special recognition goes to the author-programmer of Trimnet-Plus, Mike Potterfield of Trimble Navigation, for the opportunity to beta test this very extraordinary gps survey adjustment program. Also his guidance and technical advice helped set the direction of this project.

**GENERAL INFORMATION**

**ON**

**DATA SHEET**

**CORNER NUMBERING**

**GROUND TO GRID REDUCTION**

**AND**

**LEAST SQUARES ADJUSTMENT**

GENERAL INFORMATION  
ABOUT  
CONTROL MARK DATA SHEET

**BOX 1**

**MARK NAME:** Is a name that may be stamped on the monument ( FIRST ) or a point identifier ( 17122604 ).

**MARK SET BY:** Best information obtainable of who may have set mark.

**DATE OF MARK:** Best information obtainable of date that mark was set.

**LOCATION:** What section, township and range that mark is located.

**REFERENCE NUMBER** The reference document and number that has important information about mark at the time the G.P.S. survey was performed. ( CS # = COUNTY SURVEY NUMBER ) (OCRR # = OREGON CORNER RESTORATION RECORD NUMBER) ( DGMC # = DESCHUTES GEODETIC MAPPING CONTROL NUMBER )These records are on file in the County Surveyor's Office.

**BOX 2**

**MARK SKETCH:** A quick free hand sketch of mark to show general location and brief description.

**BOX 3**

**PART 1** Self-explanatory

**PART 2** All the needed information about the datum's and coordinate system to use for transformations.

**PART 3** Latitude and longitude of the horizontal datum used.

Northing, easting, convergence and scale factor of the coordinate system used.

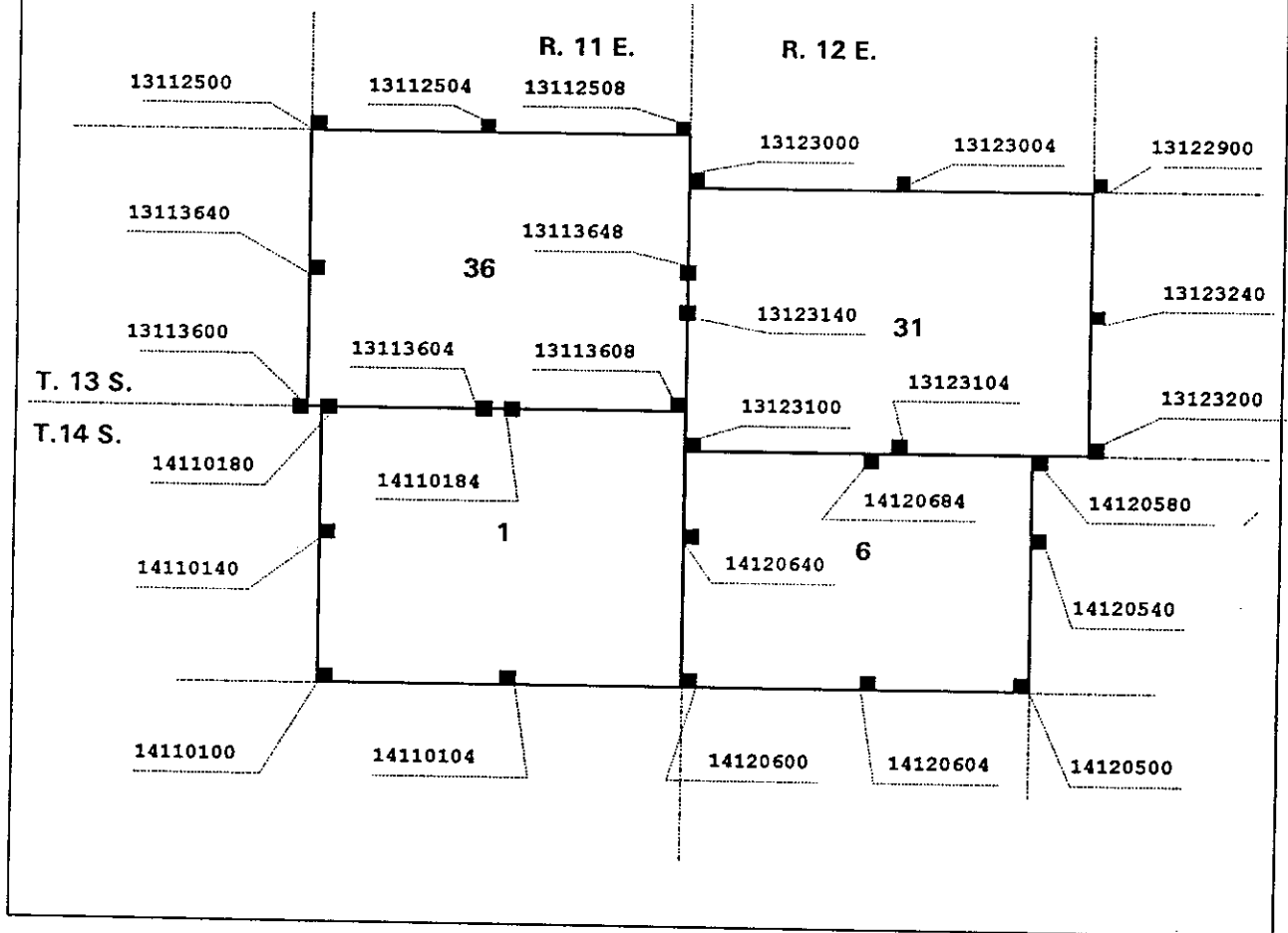
Ellipsoid height: height of mark above the reference ellipsoid

Orthometric height: height of mark on the vertical datum ( elevation ).

Geoid height: the difference between the reference ellipsoid and zero elevation of the vertical datum.

One sigma error: the estimated error of uncertainty at the 68% confidence region.( FGCC Standard )

## CORNER NUMBERING DIAGRAM



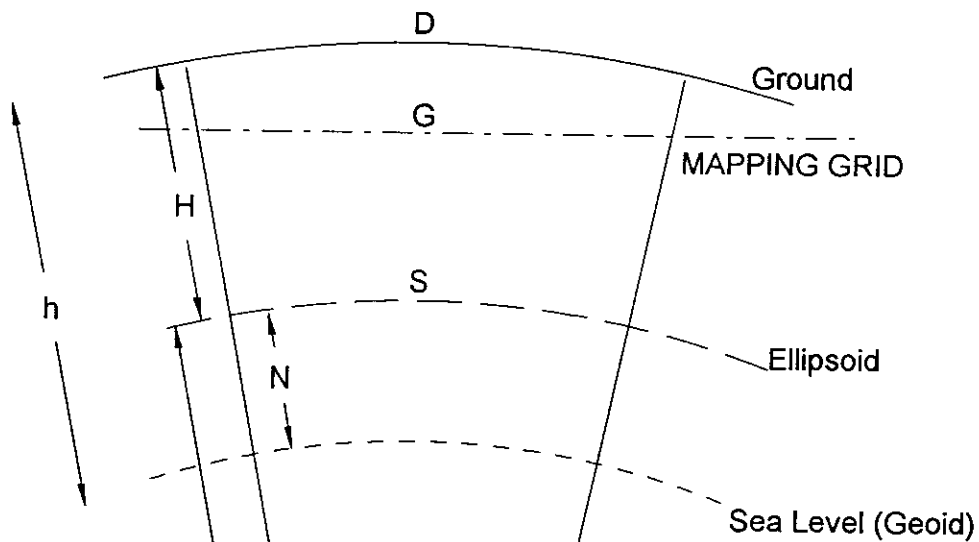
### SECTION & QUARTER CORNER NAMING CONVENTION

MARK NAME: 17 12 23 4 0 A

- |           |  |
|-----------|--|
| <u>17</u> | Township 17 South of the Willamette Base Line      |
| <u>12</u> | Range 12 East of the Willamette Principal Meridian |
| <u>23</u> | Section 23   |
| <u>4</u>  | 4 X 10 chains North from SW. Cor. of Section 23.   |
| <u>0</u>  | 0 X 10 chains East from SW. Cor. of Section 23.    |
| <u>A</u>  | More than one important corner in proximity.       |

Note: The 10 chains is more a fractional part than a distance.

# SATISFACTORY APPROXIMATION OF GROUND TO GRID REDUCTION



Where D=Horizontal Distance  
 G=Grid Distance  
 S=Ellipsoid Distance  
 H=Mean Elevation Above Ellipsoid  
 h=Mean Elevation Above Geoid  
 N=Mean Geoid Height  
 R=Mean Radius of Earth  
 SF=Ellipsoid to grid factor  
 F1=Ground to ellipsoid factor  
 F2=Ground to grid factor

FROM LA PINE TO MADRAS  
 N = -65 feet mean geoid height ( NEGATIVE HEIGHT )  
 R = 20,906,000 feet mean elevation ( ELLIPSOID )

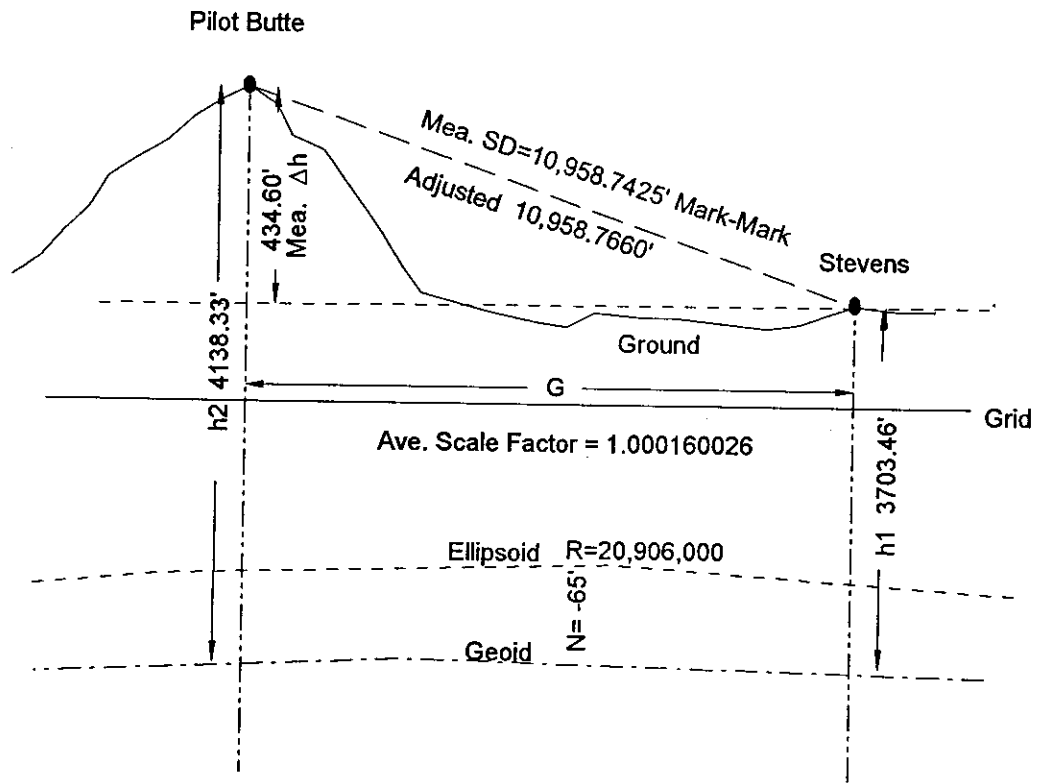
$$S = D \left( \frac{R}{R + h + N} \right) \quad H = h + N$$

$$F1 = \left( \frac{R}{R + h + N} \right) \quad F2 = SF \times F1$$

NOTE: See NOAA Manual NOS NGS 5, State Plane Coordinate System of 1983 by James E. Stem, for more information on this subject



## Transformation of Mark to Mark Distance to Grid Distance



$$G = (SF) \left( \sqrt{\frac{SD^2 - \Delta h^2}{\left(1 + \frac{h_1 + N}{R}\right) \left(1 + \frac{h_2 + N}{R}\right)}} \right)$$

$$G = 1.000160026 \sqrt{\frac{10,958.7425^2 - 434.60^2}{\left(1 + \frac{3703.46 + (-65)}{20906000}\right) \left(1 + \frac{4138.38 + (-65)}{20906000}\right)}}$$

$$G = 1.000160026 \sqrt{\frac{119,905,160.0}{1.00036892}} = 1.000160026 \sqrt{119860941.3}$$

$$G = 1.000160026 \cdot 10,948.1022 = 10,949.8542'$$

Below is the inverse of adjusted coordinates in our data base. As we can see that the measured slope distance from Pilot Butte to Stevens in the EC CARTESIAN column was adjusted by +0.0235 feet, when we add 0.0235 feet to the transformed distance that we computed from the measured slope distance it fits quite well with the inverse of the MAPPING PROJECTION coordinates.

In using a approximation for the radius of the ellipsoid and the geoid height with an average ground to grid factor at intervals for ever 100 feet of elevation should keep the transformation to 1 part to 200,000 or better in a local area.

For more information on this subject see NOAA Technical Memorandum NOS NGS-10 , USE OF CALIBRATION BASE LINES, by Charles J. Fronczek, Appendix I. The geometrical transformation of electronically measured distances.

Datum = NAD-83  
 Coordinate system = User-Defined Transverse Mercator  
 Zone = DESCHUTES COUNTY  
 Linear unit = Internatl Foot

| POINT              | MAPPING PROJECTION                | GEODETIC  | EC CARTESIAN   |
|--------------------|-----------------------------------|---|--|
| Pt# 19 COORDINATES | N= 386640.6780<br>E= 3300025.6995 | N 44°03'37.943010"<br>W 121°16'59.648110"<br>H 4073.9731F<br>h 4138.3327F                                       | X= -7822586.5374<br>Y=-12874379.0293<br>Z= 14480943.1881   |
| GIS 31 PILOT BUTTE |                                   |   |  |
| INVERSE:           |                                   | Az=141°52'23.783806"<br>_+ 0°00'00.244711"<br>t-T Corr= +0.004639"<br>Dist= 10949.8773F<br>Scale=1.000160017592 | NSFA=141°52'24.023877"<br>NSBA=321°53'28.357821"<br>Ell Dist= 10948.1255F<br>Delta H = -434.6198F<br>Delta h = -434.8681F<br>Gnd Dist= 10950.1443F<br>Rad(_)= 20914559.5776F<br>Skew Corr= -0.060692"<br>GsFA=141°52'24.023893"<br>Gsc Dist= 10948.1255F<br>GsBA=321°53'28.357837" |
| Pt# 62 COORDINATES | N= 378026.9887<br>E= 3306786.1854 | N 44°02'12.883064"<br>W 121°15'27.117216"<br>H 3639.3533F<br>h 3703.4646F                                       | X= -7819756.1641<br>Y=-12882740.2050<br>Z= 14474449.0154   |
| STEVENS            |                                   |   |  |

# Getting the Most Out of Least Squares

by Sean Curry and Ron Sawyer

“Least squares! I don’t do that kind of survey—I haven’t done a large network in years. Most of our work is just *regular* survey work. Our compass rule works fine, just press a button and the whole thing’s balanced. Why would we want to use something as sophisticated as least squares? Anyhow, I’m not quite sure what it does.”

Does this sound familiar? Unfortunately, the least squares adjustment method seems to be a mysterious creature to most surveyors. It is frequently thought of as being difficult to learn, or not being applicable to “the type of surveys that I do.” The fact is that least squares is not difficult to understand once a few basic principles are explained; more importantly, it is applicable to nearly all types of survey work, including the small “regular” job. It does not require you to make major changes in your daily practice, although certain field procedures enhance its power.

In addition to producing the best adjustment of field data, least squares provides other benefits not even possible with other adjustment methods. It helps you to locate errors in your survey data, gives you an easy way to plan surveys, and provides a statement on the amount of uncertainty for every point in your network. Our goal in this article is to remove the mystery of least squares by explaining, in nonmathematical terms, some of the basic concepts, and to illustrate its application to a number of common surveying problems.

## Exactly What Is Least Squares?

A least squares adjustment is a rigorous mathematical method for adjusting survey data. It has actually been used by surveyors for a number of years, but was generally implemented only on mainframe computers and was somewhat difficult to handle for the uninitiated user. With the advent of new high-speed, inexpensive personal computers and especially modern software techniques, least squares is now readily available to every surveyor.

As surveyors we have long recognized that adding extra angle and distance observations adds strength to our surveys and allows for error checking. But we also realize that these extra measurements make the resulting survey computations more complex. What can we do to resolve these redundant observations to arrive at a single set of coordinates for all our points? Some type of adjustment must be applied. In the case of interconnecting traverse loops, arriving at the single best solution can be difficult. In fact, how can you even define a “best” solution?

Various approximate adjustment methods such as the compass rule and transit rule have traditionally been used. But how, for example, do you resolve a multiloop traverse

with a compass rule adjustment? You probably attack one loop at a time, first “balancing” the angles by adding the same amount of correction to each angle, and then “correcting” the bearing and distance of each leg, based on some mechanical proportioning of the closure error. Then you move on to the next loop and repeat the process. When all the loops are adjusted, you call it quits if they all fit together pretty well. Otherwise, you might rebalance the loops in some other order to see if the fit gets better.

If this procedure sounds messy and potentially time-consuming, you are right. But even more importantly, it can be shown that the underlying logic of these approximate adjustments is wrong, even for a single traverse loop. Survey errors are random! These methods make assumptions about measurement errors accumulating in proportion to the lengths of traverse legs that just are not true—in fact, they can introduce distortions into the final coordinates that were not present in the original survey.

In addition, approximate adjustment methods provide no means of analyzing your survey. But, you ask, is not a traverse closure good enough? Not at all! It is like your accountant giving you a final bank balance for the year, but not giving you a breakdown of income and expenses by various categories. You would be hard pressed to determine exactly why you ended up where you did financially. Least squares gives you an itemized “accounting sheet” for your survey, showing exactly how each of your field observations fits into the overall survey.

## What Does Least Squares Adjust And How?

As a surveyor, you know that all measurements contain errors. In fact, a measurement is only an estimate of the true value, which is never really known. The table below shows three types of errors commonly present in surveying data (although strictly speaking blunders are not errors), and three methods for handling them.

TABLE 1 - Error Types

| Error Type                                  | Method for Handling       |
|---|---------------------------|
| Blunders (Mistakes, recording errors, etc.) | Eliminate                 |
| Systematic Errors (EDM calibration, etc.)   | Compensate                |
| Random Errors (Normal, unavoidable)         | Adjust with Least Squares |

Blunders (mistakes, recording errors, etc.) must be eliminated! No adjustment method can tolerate blunders, although least squares can help you detect and remove them from your field data. Systematic errors, such as in

# Why We Use Least Squares

by Glennon J. Watson, LS

The story is all too familiar. You have the commission to survey a 150-acre farm. It is a routine job, or is it? This time there is a public highway crossing in one direction and a utility easement crossing in the other. Of course your code of practice requires you to show all the visible improvements on the property.

The solution is routine—traverse the perimeter, traverse the road, and traverse the utility line, then tie them all together. Easy, right? Easy enough in the field, but what happens when you compute and balance the control traverses? In the first loop you get 1 in 35,000 and one second per station in the angles. Great! The first cross-tie results in 1 in 15,000 and three seconds per station. OK? Probably. The second cross-tie produces 1 in 5000 and 12 seconds per station. No good! Third cross-tie? Even worse.

What happened? We measured all the angles the same way, and we measured all the distances from each end of the line. They all checked. We checked all the abstractions. Twice! We looked them over again—nothing wrong. Sure, we picked up a rounding error here and there, but basically nothing is wrong. What should we do? Unfortunately, some of our peers will make it work, but we are not among them. What would you do?

We would routinely try other solutions. Solving different loops in different orders would often help. Perhaps we lost the 1 in 35,000 loop, as fictitious as it actually was, but we would also improve the third and fourth connections—most of the time. Sometimes we would go back in the field to look for something that really was not there. More often than not we would settle. The baselines met the specification, although they could and should have been better.

Have you ever noticed that the error is not on the first loop you solve, and often it is not on the second? It is the third and fourth connections that get you. There is a reason these connections are the ones that do not work. It is because the errors balanced into the first and second loops were balanced improperly. The method used was prejudiced—it hid the errors rather than balanced them. Some balancing methods put the errors where they will not get in the way—if you are lucky.

Even those of us fortunate enough to own a true least squares adjustment program for single-loop traverses only postpone the inevitable. Simply put, a least squares adjustment places the errors where they

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# Least Squares In Practice

by Roger A. Frank, PLS

In late 1969, I was first introduced to least squares adjustments while working with the Orange County Surveyor's Office in Santa Ana, California. At that time, most of our "regular" surveys were still being computed with rotary calculators and trig tables with the aid of the compass rule to adjust and close our traverses.

Orange County was in the process of revalidating and densifying its horizontal control network. To adjust this network, the county had obtained a least squares program called Cosmos from the Canadian equivalent of our National Geodetic Survey (NGS). Of course, the program required a computer with a large memory capacity. The county had two computers that took up about 5000 square feet of the engineering building basement. If the computers were linked together, they would have a whopping 128KB of memory. The county surveyor's office used the computers to run Cosmos at night so that we would not interfere with the more important jobs of assessing property, taxing the residents, and last but certainly not least, printing our paychecks.

Data entry was accomplished by hand-lettered, double-checked code sheets. These would be delivered to the keypunch department to be converted to punched cards. We would then manually check the punched cards for accuracy and make our own corrections on an extra keypunch machine. These trays of punched cards would be delivered to the computer services department in the late afternoon to run that night. Each morning we would pick up the results, figure out why it did not work or how the overall adjustment could be better, and after two or three weeks we would obtain a very satisfactory adjustment.

Quite a process, but when we were done we would have an adjustment where all measurements were weighted according to their strengths, along with a set of statistics showing the precision of each measurement and coordinate. This was something that we could have confidence in, and a far cry from what we could do with our rotary calculators, Peters tables, and compass rule.

In 1975, two of us left the Orange County Surveyor's Office to form our own surveying firm. Of course, we tried to keep up with the latest desktop calculators and computers, the HP 9810, (then HP 85s and HP 86s), but nothing that could perform a true least squares network adjustment. I missed the ability to use least squares to properly

*continued*

## Getting the Most Out of Least Squares

electronic distance meter (EDM) calibration, must be compensated for before any adjustment takes place. What is left?

Random errors! These are small unavoidable errors that are an integral part of the measuring process. They are the few seconds difference in angle readings, and the few hundredths difference in distances that you see all the time in the field. They are no cause for concern, except that they must be adjusted correctly, and that is the job least squares does right.

Least squares simultaneously adjusts all field data, even in multiloop traverses. In a least squares adjustment, the "best" solution is defined as the solution producing the smallest changes to the input field measurements. These changes between the best-fit measurements and the original field data are called residuals. Technically speaking, the least squares adjustment method minimizes the sum of the squares of the weighted residuals—hence its name.

But now we have introduced a new term—weight. The weight tells the adjustment how much influence a measurement should have. In least squares each observation (distance, angle, etc.) can be given an individual weight.

The weight you place on your measurements might be based on the type of instrument you are using, the method of observation (chained or EDM distance), and the skill of the field crew. Low weights can be given to less accurately known field data and greater weights to observations that are more accurately known. During the adjustment, larger changes will be given to the less accurate data, minimizing the changes to the more accurate data. For example, an angle with short sights can be given a low weight so that it does not influence stronger angles with longer sights. Table 2 summarizes the relationship between weights, precision, and influence on the adjustment.

TABLE 2 - Weights

|                | "Strong"<br>Measurement | "Weak"<br>Measurement |
|----------------|-------------------------|-----------------------|
| Weight         | HIGH                    | LOW                   |
| Precision      | HIGH                    | LOW                   |
| Influence      | HIGH                    | LOW                   |
| Standard Error | LOW                     | HIGH                  |

This ability to weight individual measurements is only available in least squares, and it gives you the extra control needed to produce the best adjustment. However, least squares does far more than compute the best adjustment. It also provides a complete analysis of the survey, including a list of residuals for all measurements, and a statement on the positional accuracy of each computed point. This analysis can assist in the detection of survey blunders and the preplanning of surveys to meet specified accuracy requirements.

### What Are Its Advantages?

Least squares provides a number of advantages over other adjustment methods.

- It is mathematically correct for all types of surveys, including traverses, triangulation, trilateration, resection, and intersection in any combination.

## Why We Use Least Squares

*continued*

are "statistically most probable to have occurred," not where they actually happened. Unfortunately, cross-ties always seem to find the points where the errors actually occurred.

My partners and I knew that if we practiced in a specific location long enough we would eventually uncover our own errors. That thought has been in our minds since the day we began our practice. Our philosophy has been to isolate and correct those errors as they were found rather than to bury them and hope they disappeared. Over the years we have been careful enough not to have experienced many instances where we had to admit our mistakes. Nevertheless, we have had to admit a few, which is never a comfortable thing to do.

We have all heard about network adjustments. They are exotic routines that were once only used by the National Geodetic Survey. What did they do? Simply put, they considered all the measurements of a traverse network simultaneously rather than one at a time. This simultaneous approach considered the fourth loop at the same time it considered the first. Although it still put the errors where they were statistically most likely to occur, the analysis considered all the data rather than just a part of it.

As a practical matter, the least squares adjustment method was rigorous, costly, and took too long to achieve within the time and budget constraints of a particular job. The fact is, we could meet the specifications for the job using one of the less rigorous routines. So why try harder?

The effort involved in "trying harder" is not just for the individual job. It is for your practice. It is why you traverse around the entire block rather than setting out a single baseline with the hope that you will not have to shove the front corners of your rear adjoiner onto the sidewalk. It is so people believe you when you say you have better evidence and measurements now than you did five years ago.

However, something has finally made our lives easier. For the past two years we have been using STAR\*NET—one of a number of available programs—a least squares solution that allows us to solve our traverses. With just a few minutes of additional time we have been able to solve our traverses as networks. I believe the network adjustment could be accomplished in less time, but we have elected to balance the individual loops of the traverses independently before performing the network adjustment. The payoff has resulted in less time spent rechecking material that was checked twice before, fewer returns to the field, and more reliable coordinate values for individual points. The proof of this is not in the abstract, but in the quality of the fourth- and fifth-generation cross-tie traverses added after the adjustment is complete and the map published.

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## Getting the Most Out of Least Squares

- It computes a *single* solution, no matter how complex the survey.
- It does not distort field data, as do some approximate methods.
- It allows independent weighting of all field observations.
- It allows flexibility during data collection—field data can be collected in any order and configuration.
- It gives you a statement of the accuracy of each computed point.
- It helps detect blunders in field data.
- It helps with survey planning.
- It tells you a lot about the survey.

## How Do You Use Least Squares?

You do not need to make major changes to your field procedures in order to use least squares. In fact, least squares adds a lot of flexibility to data collection. Distances and angles can be conveniently collected in any order without worrying about how the survey will be computed, because the adjustment handles all the data simultaneously. Traditionally, cross-ties and extra shots were used mainly to "check in." In least squares, these redundant shots actually become part of the adjustment, adding strength to the survey (more *is* better). Rather than making the survey solution more difficult, redundancies strengthen the survey, make blunder detection easier, and add more confidence that the adjustment is the "best" solution. Also, to make a surveyor's life really easy, additional field data can be added to an existing survey at any time, and the adjustment can be rerun.

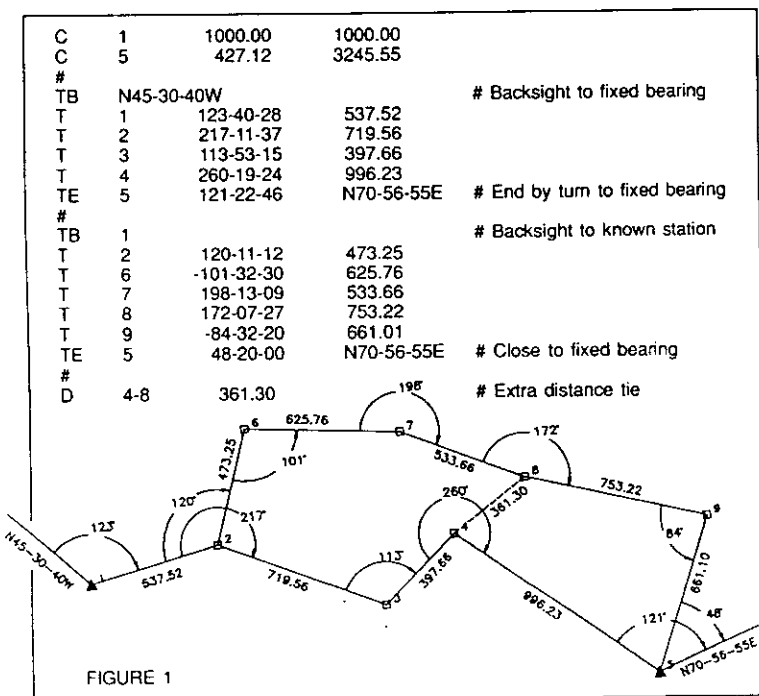


Figure 1 illustrates a small survey with two traverse loops and a distance tie between the loops. The two known points have coordinates supplied, and the rest of the field measurements are supplied as angle and distance traverse

## Why We Use Least Squares

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I would like to relate two specific instances where we have used a network solution to improve our database and our product.

The first involves the villages of Cold Spring and Nelsonville, New York, which are located in Philips-town where we practice. These villages have seen very little construction during the past 18 years of our practice. However, sales of various parcels have resulted in many surveys for our office. Correspondingly, we have developed a network of approximately 350 traverse points that were connected as the individual surveys were performed. The network became too dense for us to handle because the balancing was done linearly and the inevitable breakdown of the data became apparent. A traverse measured through a block connecting older points might result in a 1 in 3000 closure, but what could we do—the error of closure was only a tenth of a foot and the traverse was only 300 feet long.

During the summer of 1990 our college intern reentered and rebalanced the original field data using the least squares network program. The results are incredible. The reliability of the traverses has improved markedly. The integrity of our network has increased substantially. So far, 285 stations representing traverses around and through about 25 blocks have been entered. Because the adjustment runs so quickly we have made intermediate adjustments as each section is added to the network. With the simultaneous adjustment we have been able to strengthen every one of those weakened cross-ties. Even before the entire project was successfully completed in the fall, we knew that our control in the villages was substantially better.

The second instance concerns a surveying problem involving a 60-acre parcel that was surveyed in the late 1940s by a firm whose records we own. The original survey was bounded by three earlier surveys the older firm had done prior to surveying the 60 acres. The firm's basic traverse method involved a 30-second transit using two repetitions on string sights and single slope taping. The surveyors made all the proper corrections, but because they had committed to three sides they forced about one foot into the fourth side to make things work. Our method for this survey involved one and two full circle positions with a one-second instrument and double electronic-distance-meter (EDM) observations from each end of each line.

This particular parcel narrowed considerably near its middle so we decided to cross-tie the traverse in that area. Since we had the original notes, we were able to recover and traverse through about 60 percent of the original baseline points. Most of the points, which were on exposed ledge rock, were "4-cuts," a variation of a crosscut that the surveyor used

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## Getting the Most Out of Least Squares

legs. The sample data field uses a simple code to indicate coordinates (C), traverse lines (TB, TE, and T), and distances (D).

Once the field data has been prepared, you need to decide how the observations will be weighted. You do this by establishing a "standard error" for each observation. Think of the standard error as a way of expressing your confidence in your field data. For example, you might decide that your distances have standard errors of 0.02 feet  $\pm 3$ ppm, and your angles five seconds. These values are normally determined from instrument specifications and observation procedures. In addition, you might choose a centering error of 0.005 feet to account for imprecise instrument centering. This centering error value will increase the standard error value for angles with short sights so that they have less influence in the adjustment than those with long sights. The least squares adjustment will use these standard error values to determine weights for all the field data in order to arrive at the best solution.

Now that you have established the amount of influence that each measurement will have, you can run the adjustment and analyze the output. Although the specifics of running an adjustment depend on the package being used, some output elements are common to most least squares programs. These include:

- A brief summary of the overall strength of the adjustment. This summary often provides a useful breakdown of how individual measurement types (distances, angles, etc.) fit into the adjustment.
- A list of residuals for all input observations. This list is a valuable tool for finding blunders in the survey and for checking the weights you assigned to your input observations.
- A list of adjusted coordinates for all stations in the survey. These coordinates can be transferred to your CAD or COGO package.
- A list of the computed positional tolerances (error ellipses) for all stations in the adjustment. The ellipses (to be discussed next) show the amount of uncertainty in the computed position of each point, and can often be viewed graphically.

### What Do Error Ellipses Reveal?

Error ellipses are used to indicate the amount of uncertainty in a computed point's position, sometimes called the point's positional tolerance. As one surveyor put it, "It's not that the *point* is uncertain—it's a well-established monument. It's my *idea* of where the point is (as expressed by its coordinates) that has some possible error." If you look at the northing or easting of a point by itself, you can express its error as plus or minus so many hundredths of a foot. However, to show the combined effects of the uncertainty in northing and easting requires an error ellipse.

Why does the point have this positional uncertainty anyway? Again, as the surveyor said, "Surveying is one of the few professions where you rarely get to measure what you really want. You want coordinates, but you have to settle for measuring angles and distances, and then com-

puting coordinates." Remember that all your measurements are affected by small random errors. Therefore, you would expect any value computed from these measurements to also be affected. Least squares, as a part of the solution process, computes how much uncertainty in the coordinates results from the random errors in the field measurements. It is all there in the solution—you do not need to go to any trouble. These positional uncertainties, as represented by the error ellipses, are also affected by the geometry of the survey.

Two simple cases of error ellipses are illustrated in Figure 2. The ellipse dimensions indicate the size of the error region, and the orientation indicates the weaker and stronger directions.

### Why We Use Least Squares

*continued*

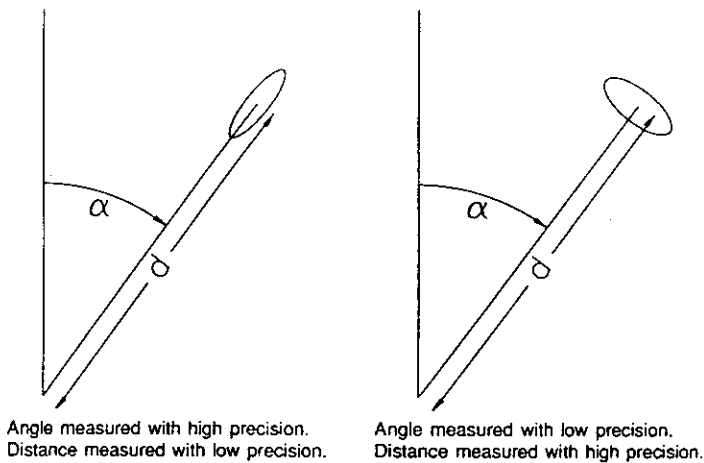
to distinguish his baselines. The solution used the weighting options in the least squares network program. First, we balanced the network of our new measurements as a control. Then we added the older survey measurements, giving them considerably looser constraints, and readjusted. After all the observations were subjected to the network solution, we compared the residuals (the differences between the observed values and the adjusted values) in our angles and distances to those that were produced when our data alone was considered. There was very little change. When we compared the older data (that had been adjusted by the original surveyor) we noticed larger residuals, as might be expected with the older methods. As a result, we were able to isolate errors into specific sections of the earlier survey and replace the corners much closer to the original surveyor's positions than if we had simply translated and rotated his data to fit our new baseline.

The foregoing is not the product of a mathematician. Had it been, the reasons why the least squares network solution works would be explained in detail. Rather, it is the product of a surveyor who tries to deliver a reliable product to his client and still profit from the work. Not only has the use of least squares network solutions enhanced our ability to do both, but it has made it simple to do so. It has improved our product while decreasing the time necessary to reach a solution that meets specifications. We have concluded that a least squares network solution has brought our balancing procedures into line with improvements in our traversing procedures, which occurred when our transit and tape were retired in favor of a theodolite and EDM. ▲

*Glenn J. Watson, LS, is a founding partner of Badey & Watson, a surveying and civil engineering firm located in Cold Spring, New York. He has 30 years of surveying experience. Watson is a member of the American Congress on Surveying and Mapping, New York State Association of Professional Land Surveyors, Inc., and New York State Society of Professional Engineers, Inc.*

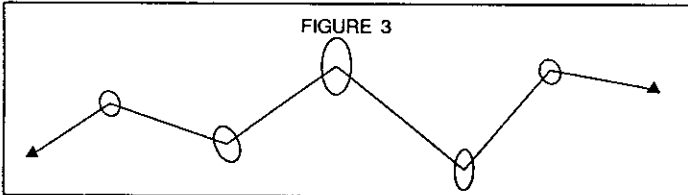
## Getting the Most Out of Least Squares

FIGURE 2



In a simple traverse between two fixed points, the error ellipses tend to increase in size according to the point's distance from a fixed station, as shown in Figure 3.

FIGURE 3



You should realize that least squares gives numerical values for the positional uncertainty of each point. For example, Figure 4 shows an actual ellipse that resulted from the adjustment of a multiloop traverse survey. Also shown are the ground dimensions of the error ellipse around the point. Even survey loops that close with very high precision may have large ellipses around the points, depending on the geometry of the survey.

Take the example of the surveyor who traversed through several miles of forest to discover that his newly located section corner was a half a foot away from a monument he found. When he traversed back, he closed to 1:55,000—so should the corner be reset? A least squares adjustment of the survey shows that the error ellipse for the new corner was over 1.5 feet long. This ellipse obviously raises some doubt about whether the new point is really any better than the existing monument. The closing

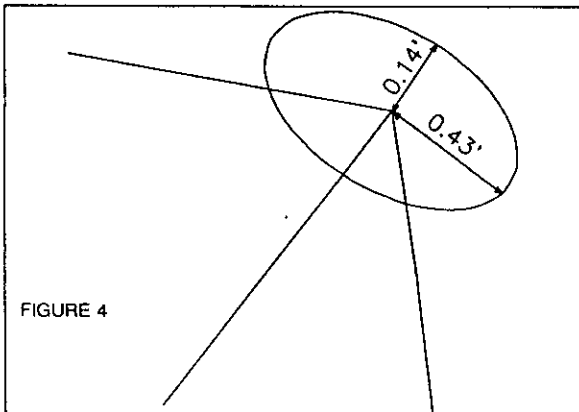


FIGURE 4

*continued*

weigh and adjust our surveys, which were generally multiloop traverses. While our compass rule programs worked, in order to really use all the data we had to adjust each loop several times, or adjust the big loop and hope the cross connections would fit. This was a tedious and only an approximate procedure.

On several occasions where we had large control nets for cities or a Federal agency, we did manage to coerce the county into adjusting them with Cosmos. During these years, I always had my ear to the ground trying to find a program package to do even a small amount of least squares on computers that a mid-sized surveying firm such as ours could afford.

In 1987, we started converting our office from the tried and true HP 86s to IBM PC compatibles. These newer computers had memory and capabilities rivaling or exceeding the older mainframes we previously used for least squares.

I checked with NGS, which was in the process of converting one of its programs, called Adjust, to work on a PC. We obtained a prerelease copy of this program and used it to adjust an aerial control network of about 70 stations. While the program worked, it was difficult for non-NGS-trained personnel to decipher the instructions and code the inputted data. We also had to break the project into two sections due to capacity limitations.

So we kept looking and came across another reasonably priced package. We purchased it and found data input to be quite easy. During initial testing, however, we discovered we would get different answers depending on the order in which the data was entered. In other words, it did not work.

I then acquired (for a nominal donation) a package from one of the top-rated western universities. While this one may have been effective, it had such a lack of documentation that I could never get it to function.

Undaunted by these unsuccessful ventures, in mid-1988 I obtained a commercial package that lives up to its advertisements. The package has usable documentation, easy coding of input data, and a very helpful blunder detection feature. The authors are open to suggestions and the program continues to improve due to input from users.

We can now properly adjust our normal traverses as well as complex networks and have confidence in our results. And, unlike the old days, the process of coding, checking, and adjusting is completed in two to three hours instead of two to three weeks. This tool allows us to do numerous tasks that we were unable to reasonably do before.

Our firm purchased and began using GPS (Global Positioning System) survey equipment for control at about the same time we obtained a workable least squares package. (Of course, our GPS system has its own least squares package that deals with the Earth Centered Three Dimensional Rectangular system but does not work well with conventional surveys). GPS

*continued*



precision resulting from a compass rule adjustment tells you nothing about the positional accuracies of individual points. Only error ellipses can do that correctly.

### A Word About Finding Blunders

As you know by now, blunders cannot be part of the adjustment; they must be located and removed from your field data. Least squares provides some useful tools for locating blunders. Normally, the entire adjustment is subjected to a statistical test (called the Chi Square test for the experts in the crowd) that checks the overall validity of your data, the standard errors that you assigned, and the adjustment results. You do not have to understand statistics to know that if your adjustment fails this test, you had better start looking for the source of the problem. This test is usually a part of the adjustment program, and failing it sounds a warning bell to alert you to a potential problem.

Let us imagine that you carefully prepared your field data, assigned standard errors that really reflect the way you survey, and have run your first least squares adjustment. Unfortunately, the program has told you that your survey "Fails the Test." Should you give up and return to the compass rule, because it never gave you such discouraging news? If you have read this far, you know by now we are not going to allow that.

At this point, you need to perform some detective work, with the adjustment providing all the clues you need to find the source of your problems. There are a number of techniques for finding blunders in a least squares adjustment, including automated blunder detection routines in some software. However, one simple manual technique is to look at the resulting *residuals* on your field data after the adjustment. If everything was perfect, you would expect the residuals to be roughly equal to the standard errors that you chose for your field data. Due to random errors, there will be some variation up and down, but if a residual exceeds three times its standard error, there may be a problem.

TABLE 3 - Checking For Blunders

| Residuals in Angles    |      |          |               |             |        |        |
|------------------------|------|----------|---------------|-------------|--------|--------|
| At                     | From | To       | Adj Angle     | Residual    | StdErr | StdRes |
| 1                      | 4    | 2        | +58-15-40.22  | +0-00-27.22 | 4.00   | 6.8'   |
| 3                      | 2    | 4        | +129-57-21.68 | +0-00-32.68 | 4.00   | 8.2'   |
| 4                      | 3    | 1        | +99-58-37.68  | +0-00-29.68 | 4.00   | 7.4'   |
| 1                      | 2    | 6        | +61-47-49.93  | -0-00-02.07 | 4.00   | 0.5    |
| 6                      | 1    | 7        | +90-00-02.47  | -0-00-02.53 | 4.00   | 0.6    |
| Residuals in Distances |      |          |               |             |        |        |
| At                     | To   | Adj Dist | Residual      | StdErr      | StdRes |        |
| 1                      | 2    | 973.9700 | -0.0090       | 0.030       | 0.3    |        |
| 2                      | 3    | 422.5785 | 0.0675        | 0.030       | 2.3    |        |
| 3                      | 4    | 512.6738 | 0.0298        | 0.030       | 1.0    |        |

Table 3 shows an excerpt from an actual adjustment containing a blunder. The last column in the table, called the *standardized residual*, is the ratio of the residuals to the input standard errors. Those with values above 3.0 are flagged to draw your attention to them. You can see imme-

control and conventional surveys with least squares adjustment work hand in hand. One of the great advantages of GPS is that the points do not have to be intervisible. One of the disadvantages of GPS points, when later used in conventional surveys, is that they generally are *not* intervisible, and hence, no backsight is available. Using least squares we can easily start at one known GPS point with no backsight, conventionally survey to another known point, and adjust between the two. If a third known point is included anywhere in the traverse, sufficient redundancy is introduced to allow complete confidence in this no-backsight, no-check-in-azimuth type of survey.

Given the task of locating a series of intersecting transmission lines in a refinery and determining clearances for additional construction, we measured a baseline along one side of the project, turned horizontal and vertical angles from the ends of this baseline to all the insulators at each end of the subject lines and to the low point of each line, and coded the angles into the least squares program. The software produced the horizontal locations of all the subject lines, the elevation of both ends of each line, and the low point of the catenary. Although these results could have been achieved by other methods, this procedure saved us much time in both the field and the office, and again, we have a lot of confidence in our answers.

When we were surveying the centerline of a winding mountain road with 300-plus courses, most of which were 50 to 100 feet in length but with visibility into a broad river wash on one side, we set a large sight on a known control station in the wash area about two miles away. We then turned angles to this sight at all the traverse points from which it could be seen. Using least squares, this redundant data was easily incorporated into the traverse adjustment along the road and allowed us to have a high level of confidence in our azimuths and in the entire survey. It might be worthy to note here that using this same technique, but turning to a natural sight whose position is not known from a number of points in the survey, should control azimuth nearly as well.

Somewhere in the past I have heard that the difference between a technician and a professional is that the technician uses his education, training, and the available equipment to perform his job as trained or educated, while a professional uses his education, training, and equipment to innovate new, better, or more efficient methods of performing his projects.

The least squares method is a valuable tool that is now readily available to all professional surveyors. It allows these professionals to expand their capabilities to the limits of their imaginations. ▲

Roger A. Frank, PLS, is a principal of Johnson-Frank & Associates, Inc., a land surveying firm based in Anaheim, California. He is registered in seven western states and specializes in high-order horizontal and vertical control, aerial control, and boundary determination.

diately that there are several very large standardized residuals on the angles. A good place to start looking for blunders would be the angle with the largest standardized residual. That may not always be the one, and you may need to look at the next few angles as well, but it represents a good clue.

### Using Preanalysis To Plan Surveys

Least squares can be used to compute the accuracies of survey points, and the relative accuracies between points, *before* any field observations are made. How is this possible? First you supply a list of input station names along with their approximate coordinates scaled from a map or photograph, indicating roughly where the survey points are planned. Then you enter a list of the proposed measurements, using "From and To" station names rather than actual field survey data. Finally, just as in regular data, you need to indicate standard error values for these proposed measurements so that the proper weighting can be applied.

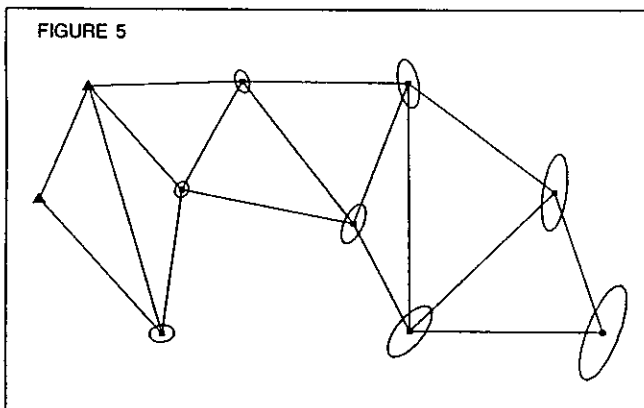


FIGURE 5  
Preanalysis results for a small network. The shape and size of the error ellipses indicate increasing positional uncertainty as we move away from the fixed stations.

The least squares preanalysis will now take this proposed survey and generate computed accuracies (error ellipses) for all survey stations. You can then review the results, and add or delete measurements as needed to meet the required accuracy specifications. Even if the actual survey varies somewhat from the proposed configuration, this technique allows you to develop a general plan for each survey that will result in the most efficient use of your field time.

### What Else Can I Use It For?

Because least squares allow so much flexibility in data collection, and because it provides a single "best-fit" solution no matter what kind of survey was performed, you can use it to help you in a variety of field applications. For example, imagine that you are running a traverse and reach a point where several short legs would be required. You know that the short sights will weaken the traverse, but with least squares you can set an additional point, and observe all possible distances and angles to it. The adjustment will use all the data, and strengthen the corner considerably.

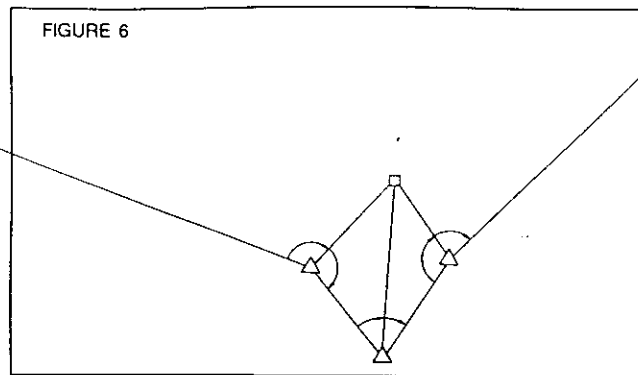


FIGURE 6  
Strengthening of traverse with short traverse legs by observing a remote point.

Resections can be easily handled, with any number and combination of angle and distance observations. Least squares will automatically compute the best coordinates, plus produce an error ellipse showing how accurate the resection was. Traversing becomes much more flexible. You can begin with or without a backsight to a known bearing, and close to a known point with or without a closing angle to another known bearing. Solar azimuths, appropriately weighted, can be added wherever needed to strengthen the traverse. Additional distance and angle ties can be observed wherever possible. They will assist with blunder detection and will strengthen the traverse.

Least squares is a powerful adjustment technique that gives you a complete accounting sheet for your surveys. It gives you the best possible results while preserving your field data as much as possible. It provides you with a detailed statement of how each observation fits into the adjustment, and a statement of accuracy for each computed point. All this information allows you to make intelligent and informed decisions about the strength of any particular survey. Least squares also provides tools for locating blunders in field data, and for preplanning surveys to meet accuracy specifications. Least squares is the *only* adjustment method that does justice to your high precision equipment and your good field practice.

Several states and many Federal government agencies are now (or soon will be) requiring the use of least squares adjustments and positional tolerance statements for all surveys, rather than the more traditional traverse closing precisions. In the near future, we will probably look back and wonder how we ever managed without least squares. ▲

Sean Curry, PhD, serves as director of development at STARPLUS Software, Inc. in Oakland, California. He has graduate degrees from the University of California Berkeley in civil engineering. He taught surveying at this same university and has extensive experience in software development for the surveying and photogrammetry communities.

Ron Sawyer serves as director of sales at STARPLUS Software, Inc. He has a Master of Science degree in architectural engineering from the University of Illinois and is a registered civil engineer in the state of California. He has developed software for civil engineers and surveyors both as a private consultant and as a manager of a software service company.

**DESCHUTES**

**COUNTY**

**CONTROL**

**POINTS**

**HELD**

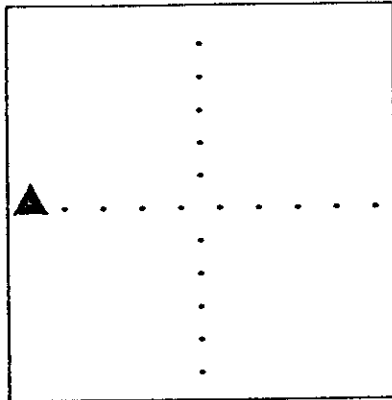
**FIX**

DESCHUTES COUNTY PRIME CONTROL NETWORK  
CONTROL STATION DESCRIPTION

NAME: GIS 0013  
GIS # 0013  
ORDER C-1st. ( GPS )

HORIZONTAL DATUM: NAD 83 (1991)  
VERT. DATUM: NGVD 29 & NAVD 88

STATION LOCATION



T. 18 S.- R. 12 E., SEC. 5

LATITUDE: 44° 02' 39.71324" N  
LONGITUDE: 121° 19' 25.05079" W

----- EC CARTESIAN -----  
X: -2387685.327 METERS  
Y: -3923407.174 METERS  
Z: +4412398.193 METERS

----- HEIGHT -----  
ELLIPSOIDAL: 1095.966 METERS  
NGVD 29 : 1115.545 METERS  
NAVD 88 : 1116.715 METERS  
---- SPC -- OREGON SOUTH ----  
NORTH: 264457.798±.002 METERS  
EAST: 1433989.701±.002 METERS

SCALE FACTOR: 1.000011578  
CONVERGENCE: - 0° 33' 48.53 "

The horizontal coordinates & ellipsoidal height was determined by GPS observations constrained by Oregon High Percision Network. Adjusted by Deschutes Co. Surveyor's Office in July 1991. The orthometric height was determined by GPS.

SURFACE MARKER:  
MARK IS STAMPED - GIS 0013  
AGENCY INSCRIPTION - DESCHUTES COUNTY SURVEYORS OFFICE  
THE STATION IS LOCATED ABOUT 1 MILE SOUTHWEST OF BEND.

TO REACH THE STATION FROM BEND, START AT THE INTERSECTION OF US HWY 20 (GREENWOOD AV.) & US HWY 97 (3RD ST.), PROCEED SOUTH ON HWY 97 0.3 MI., TURN RIGHT ON FRANKLIN AVE & PROCEED 0.6 MI., TURN LEFT ON BOND ST. & PROCEED SOUTH FOR 0.4 MI., TURN RIGHT ON COLORADO AVE. AND PROCEED WESTERLY FOR 0.75 MI. TO THE STATION ON LEFT.

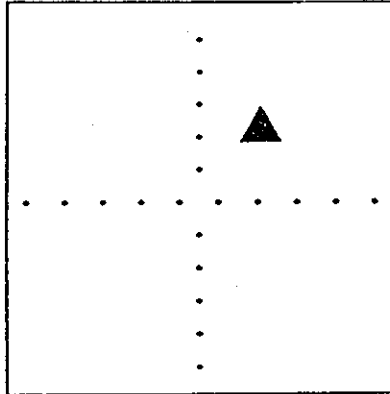
THE STATION MARK IS A 3 1/2 IN. STANDARD DESCHUTES COUNTY ALUMINUM DISK IN A MASS OF CONCRETE 0.3 FT ABOVE GROUND LEVEL, 2 FT. SOUTH OF BIKE PATH, N 60 E 110 FT. FROM A 1 FT. PINE TREE, ABOUT 450 FEET EASTERLY FO THE INTERSECTION TO COLORADO AVE. AND COLUMBIA STREET.

DESCHUTES COUNTY PRIME CONTROL NETWORK  
CONTROL STATION DESCRIPTION

NAME: GIS 0035  
GIS # 0035  
ORDER C-1st. ( GPS )

HORIZONTAL DATUM: NAD 83 (1991)  
VERT. DATUM: NGVD 29 & NAVD 88

STATION LOCATION



T. 18 S.- R. 12 E., SEC.30

LATITUDE: 43° 59' 27.22059" N  
LONGITUDE: 121° 19' 54.79581" W

----- EC CARTESIAN -----  
X: -2390428.171 METERS  
Y: -3926638.995 METERS  
Z: +4408180.587 METERS

----- HEIGHT -----  
ELLIPSOIDAL: 1176.031 METERS  
NGVD 29 : 1195.480 METERS  
NAVD 88 : 1196.648 METERS  
---- SPC -- OREGON SOUTH ----  
NORTH: 258523.399±.003 METERS  
EAST: 1433268.500±.003 METERS

SCALE FACTOR: 0.999997699  
CONVERGENCE: - 0° 34' 08.88 "

The horizontal coordinates & ellipsoidal height was determined by GPS observations constrained by Oregon High Percision Network. Adjusted by Deschutes Co. Surveyor's Office in July 1991. The orthometric height was determined by differential leveling.

SURFACE MARKER:  
MARK IS STAMPED - GIS 0035  
AGENCY INSCRIPTION - NONE  
THE STATION IS LOCATED ABOUT 5 MILE SOUTH OF BEND.

TO REACH THE STATION FROM BEND, START AT THE INTERSECTION OF US HWY 20 (GREENWOOD AV.) & US HWY 97 (3RD ST.), PROCEED SOUTH ON HWY 97 FOR 5.1 MI TO THE INTERSECTION WITH BAKER ROAD, TURN LEFT ON DIRT ROAD (UNDER CONSTRUCTION FOR 10 YEARS) AND PROCEED EAST FOR 1000 FEET TO THE STATION ON THE RIGHT.

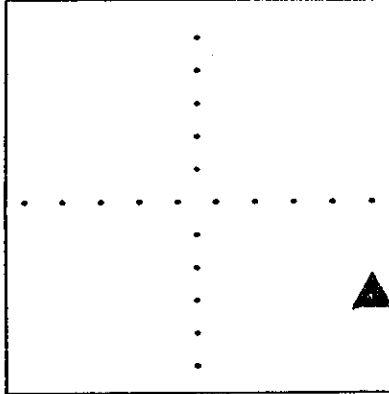
THE STATION MARK IS A 2 IN BRASS DISK GROUTED IN A ROCK OUTCROP AT GROUND LEVEL.  
8.6 FEET NORTHERLY FROM A WIRE FENCE LINE  
2 FEET NORTH FROM AWITNESS POST.

DESCHUTES COUNTY PRIME CONTROL NETWORK  
CONTROL STATION DESCRIPTION

NAME: GIS 0037  
GIS # 0037  
ORDER C-1st. ( GPS )

HORIZONTAL DATUM: NAD 83 (1991)  
VERT. DATUM: NGVD 29 & NAVD 88

STATION LOCATION



T. 18 S.- R. 10 E., SEC.27

LATITUDE: 43° 58' 57.50831" N  
LONGITUDE: 121° 30' 16.88130" W

----- EC CARTESIAN -----  
X: -2402737.705 METERS  
Y: -3920191.367 METERS  
Z: +4407788.395 METERS

----- HEIGHT -----  
ELLIPSOIDAL: 1561.593 METERS  
NGVD 29 : 1580.756 METERS  
NAVD 88 : 1581.973 METERS  
---- SPC -- OREGON SOUTH ----  
NORTH: 257758.406±.005 METERS  
EAST: 1419396.495±.005 METERS

SCALE FACTOR: 0.999995635  
CONVERGENCE: - 0° 41' 14.48 "

The horizontal coordinates & ellipsoidal height was determined by GPS observations constrained by Oregon High Percision Network. Adjusted by Deschutes Co. Surveyor's Office in July 1991. The orthometric height was determined by differential leveling.

SURFACE MARKER:  
MARK IS STAMPED - GIS 0037  
AGENCY INSCRIPTION - NONE  
THE STATION IS LOCATED ABOUT 11 MILE SOUTHWEST OF BEND.

TO REACH THE STATION FRCM BEND, START AT THE INTERSECTION OF US HWY 20 (GREENWOOD AV.) & US HWY 97 (3RD ST.), PROCEED SOUTH ON HWY 97 0.3 MI., TURN RIGHT ON FRANKLIN AVE & PROCEED 0.6 MI., LEFT ON BOND ST. & PROCEED SOUTH 0.4 MI., TURN RIGHT ON COLORADO AVE AND PROCEED 1.10 MI. TO THE INTERSECTION WITH CENTURY DRIVE HWY., TURN LEFT AND PROCEED SOUTHERLY 10.7 MI. TO THE STATION ON THE RIGHT.

THE STATION MARK IS A 2 IN. BRASS DISK CROUTED IN A LARGE BOULDER 1.5 FEET ABOVE GROUND LEVEL.  
100 FEET NORTHERLY FROM THE NORTH EDGE OF ROAD  
2 FEET SOUTH FROM A WITNESS POST.

**DESCHUTES COUNTY PRIME CONTROL NETWORK  
CONTROL STATION DESCRIPTION**

|   |   |
|---|---|
| NAME: LAVA BUTTE 1933 1984<br>GIS # 0055<br>ORDER C-1st. ( GPS )  | HORIZONTAL DATUM: NAD 83 (1991)<br>VERT. DATUM: NGVD 29 & NAVD 88   |
| <p align="center">STATION LOCATION</p> <div style="border: 1px solid black; width: 150px; height: 150px; margin: 0 auto; position: relative;"> <div style="position: absolute; top: 50%; left: 50%; transform: translate(-50%, -50%);"> </div> </div> <p>T. 19 S.- R. 11 E., SEC.24</p> | LATITUDE: 43° 55' 04.28799" N<br>LONGITUDE: 121° 21' 21.71654" W<br><br>----- EC CARTESIAN -----<br>X: -2395139.608 METERS<br>Y: -3930648.053 METERS<br>Z: +4402569.531 METERS<br><br>----- HEIGHT -----<br>ELLIPSOIDAL: 1510.666 METERS<br>NGVD 29 : 1529.937 METERS<br>NAVD 88 : 1531.127 METERS<br>---- SPC -- OREGON SOUTH ----<br>NORTH: 250428.210±.004 METERS<br>EAST: 1431248.809±.006 METERS<br><br>SCALE FACTOR: 0.999980163<br>CONVERGENCE: - 0° 35' 08.35 " |

The horizontal coordinates & ellipsoidal height was determined by GPS observations constrained by Oregon High Percision Network. Adjusted by Deschutes Co. Surveyor's Office in July 1991. The orthometric height was determined by GPS.

**SURFACE MARKER:**  
 MARK IS STAMPED - LAVA BUTTE 1933 1984  
 AGENCY INSCRIPTION - USC & GS  
 THE STATION IS LOCATED ABOUT 10 MILE SOUTH OF BEND.

-----

TO REACH THE STATION FROM BEND, START AT THE INTERSECTION OF US HWY 20 (GREENWOOD AV.) & US HWY 97 (3RD ST.), PROCEED SOUTH ON HWY 97 FOR 11.1 MI TO THE ENTRANCE OF LAVA BUTTE VISITOR CENTER, TURN RIGHT AND PROCEED 400 FEET WEST TO VISITO CENTER, TURN RIGH ON ROAD TO TOP OF LAVA BUTTE, PROCEED 1.3 MI. TO PARKING LOT ON TOP OF BUTTE, THE STATION IS 300 FEET UP HILL ALONG A FOOT PATH BY THE LOOKOUT HOUSE.

-----

THE STATION MARK IS A 3 1/2 IN. DISK SET IN CONCRETE FLUSH WITH ASPHALT WALK AREA.  
 10 FEET SOUTHERLY FROM SOUTHEAST CORNER OF LOOKOUT HOUSE

## CONTROL MARK DATA

NAME OF MARK: B007 COUNTY: DESCHUTES  
 MARK SET BY: OREGON HIGHWAY DIVISION STATE: OREGON  
 DATE OF MARK: 1991 COUNTRY: U.S.A.  
 LOCATION: SECTION 5 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

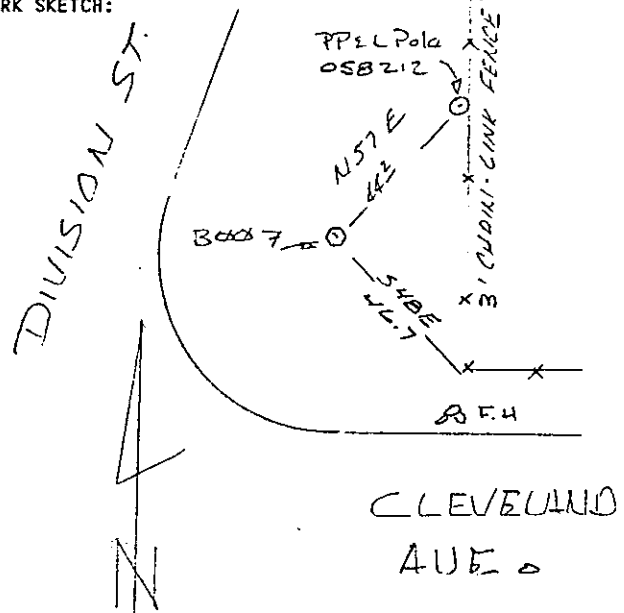
**MARK DESCRIPTION:**

TO REACH THE MARK FROM THE INTERSECTION OF HWY. 97 (3 RD STREET) & HWY. 20 (GREENWOOD AVE.) PROCEED SOUTH ON HWY. 97 FOR 1.8 MI. TO WILSON AVE., TURN RIGHT & PROCEED WEST FOR 0.16 MI. TO DIVISION ST., TURN LEFT & PROCEED SOUTH FOR 0.24 MI TO THE MARK ON THE LEFT.

THE MARK IS A STANDARD OREGON STATE HIGHWAY REFERENCE BRASS CAP MARKED "GPS B007" SET 1 FT. BELOW GROUND LEVEL IN A 6" STEEL PIPE IN CONCRETE. THE IS NEAR THE RADIUS OF THE NE CURB RETURN

44.2 FT. SW FROM A POWER POLE.  
46.7 FT. NW FROM A CHAIN-LINK FENCE COR.

**MARK SKETCH:**



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1991-1992  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

**GEODETTIC AND MAPPING COORDINATES**

|      |                    |                           | ONE SIGMA<br>ERROR |
|------|--------------------|---------------------------|--------------------|
| B007 | Latitude           | N 44°02'27.019645"        |                    |
|      | Longitude          | W 121°18'21.072018"       |                    |
|      | Scale Factor       | 1.000160040060            |                    |
|      | Convergence        | -0°00'56.3589"            |                    |
|      | Northing(y)        | 379458.4663               | 0.010490F          |
|      | Easting (x)        | 3294077.1219              | 0.010372F          |
|      | Ellipsoid Height   | 3639.4525 <i>1109.307</i> | 0.012271F          |
|      | Orthometric Height | 3703.6639                 | 0.016525F          |
|      | Geoid Height       | -64.2114                  | 0.011068F          |



## CONTROL MARK DATA

NAME OF MARK: B009 COUNTY: DESCHUTES  
 MARK SET BY: OREGON HIGHWAY DIVISION STATE: OREGON  
 DATE OF MARK: 1991 COUNTRY: U.S.A.  
 LOCATION: SECTION 8 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

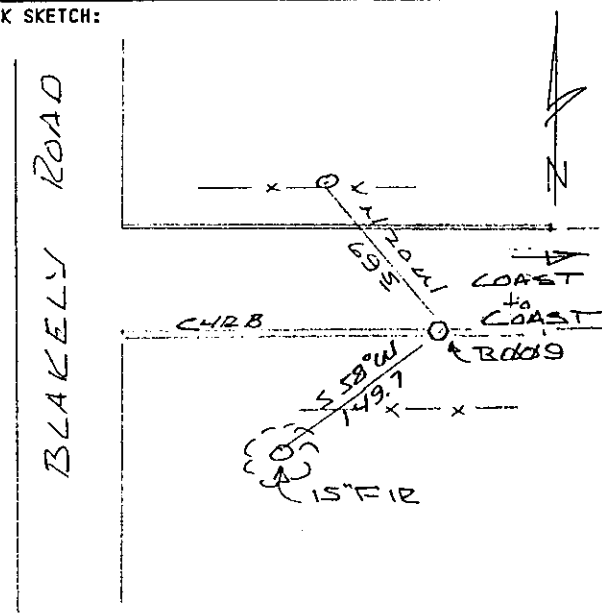
**MARK DESCRIPTION:**

TO REACH THE MARK FROM THE INTERSECTION OF HWY. 97 (3 RD STREET) & HWY. 20 (GREENWOOD AVE.) PROCEED SOUTH ON HWY. 97 FOR 2.44 MI. TO THE ROAD INTO COAST TO COAST STORE, TURN RIGHT & PROCEED WEST FOR 0.19 MI. TO THE MARK ON THE LEFT.

THE MARK IS A STANDARD OREGON STATE HIGHWAY REFERENCE BRASS CAP MARKED "GPS B009" GROUTED INTO THE TOP OF THE SOUTH CURB.

149.7 FT. NE FROM A 15" FIR TREE.  
69.5 FT. SE FROM A YARD LIGHT POLE.

**MARK SKETCH:**



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1991-1992  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

**GEODETIC AND MAPPING COORDINATES**

|      |                    | ONE SIGMA<br>ERROR  |
|------|--------------------|---------------------|
| B009 | Latitude           | N 44°01'36.926693"  |
|      | Longitude          | W 121°19'04.035684" |
|      | Scale Factor       | 1.000160093814      |
|      | Convergence        | -0°01'26.2043"      |
|      | Northing (y)       | 374386.2208         |
|      | Easting (x)        | 3290936.2048        |
|      | Ellipsoid Height   | 3723.0593           |
|      | Orthometric Height | 3787.1463           |
|      | Geoid Height       | -64.0871            |
|      |                    | 0.007863F           |
|      |                    | 0.008004F           |
|      |                    | 0.010448F           |
|      |                    | 0.016355F           |
|      |                    | 0.012583F           |

*1134.79'*

## CONTROL MARK DATA

NAME OF MARK: B011 COUNTY: DESCHUTES  
 MARK SET BY: OREGON HIGHWAY DIVISION STATE: OREGON  
 DATE OF MARK: 1991 COUNTRY: U.S.A.  
 LOCATION: SECTION 17 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

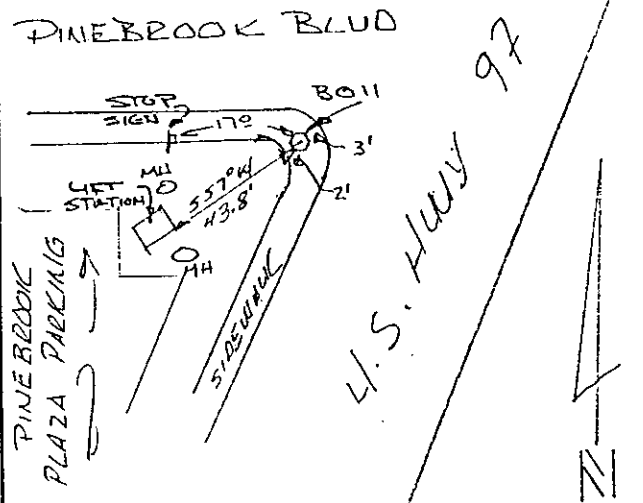
**MARK DESCRIPTION:**

TO REACH THE MARK FROM THE INTERSECTION OF HWY. 97 (3 RD STREET) & HWY. 20 (GREENWOOD AVE.) PROCEED SOUTH ON HWY. 97 FOR 2.85 MI. TO THE MARK ON THE RIGHT.

THE MARK IS A STANDARD OREGON STATE HIGHWAY REFERENCE BRASS CAP MARKED "GPS B011" GROUTED INTO THE CONCRETE SIDEWALK AN THE SW COR. OF 97 & PINEBROOK BLVD.

3 FT. WEST OF CURB FACE.  
17 FT. EAST OF STOP SIGN.

**MARK SKETCH:**



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1991-1992  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

**GEODETTIC AND MAPPING COORDINATES**

|      |                    |                     | ONE SIGMA<br>ERROR |
|------|--------------------|---------------------|--------------------|
| B011 | Latitude           | N 44°01'16.638100"  |                    |
|      | Longitude          | W 121°18'58.907837" |                    |
|      | Scale Factor       | 1.000160086234      |                    |
|      | Convergence        | -0°01'22.6321"      |                    |
|      | Northing(y)        | 372331.2762         | 0.011777F          |
|      | Easting (x)        | 3291310.0944        | 0.011678F          |
|      | Ellipsoid Height   | 3720.9551           | 0.013249F          |
|      | OrthoMetric Height | 3784.9941           | 0.018770F          |
|      | Geoid Height       | -64.0390            | 0.013296F          |

*1134.149*

## CONTROL MARK DATA

NAME OF MARK: B013 COUNTY: DESCHUTES  
 MARK SET BY: OREGON HIGHWAY DIVISION STATE: OREGON  
 DATE OF MARK: 1991 COUNTRY: U.S.A.  
 LOCATION: SECTION 17 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

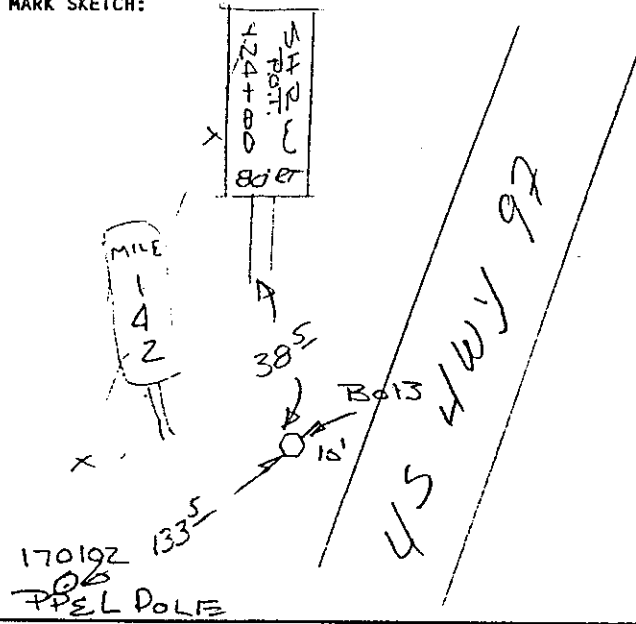
**MARK DESCRIPTION:**

TO REACH THE MARK FROM THE INTERSECTION OF HWY. 97 (3 RD STREET) & HWY. 20 (GREENWOOD AVE.) PROCEED SOUTH ON HWY. 97 FOR 3.64 MI. TO THE MARK ON THE RIGHT.

THE MARK IS A STANDARD OREGON STATE HIGHWAY REFERENCE BRASS CAP MARKED "GPS B013" SET 1 FT. BELOW GROUND LEVEL IN A 6" STEEL PIPE IN CONCRETE.

6 FT. WEST OF WEST EDGE OF HWY. 97  
133.5 FT. NORTHERLY FROM A POWER POLE.

**MARK SKETCH:**



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1991-1992

FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

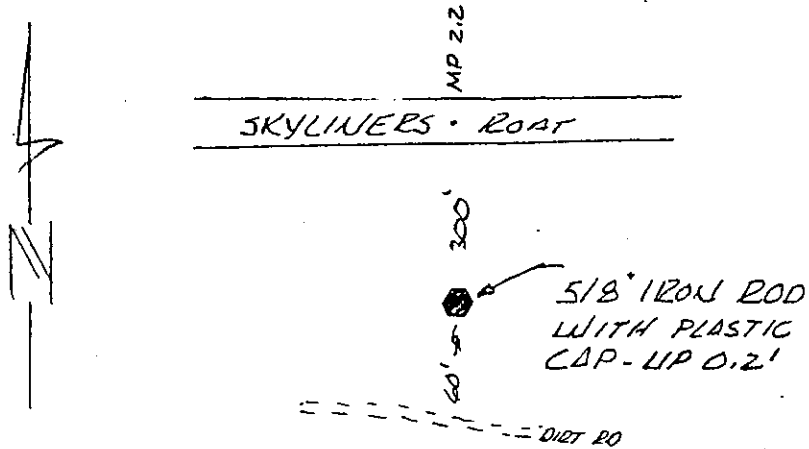
**GEODETIC AND MAPPING COORDINATES**

|      |                    | ONE SIGMA<br>ERROR           |
|------|--------------------|------------------------------|
| B013 | Latitude           | N 44°00'38.581111"           |
|      | Longitude          | W 121°19'19.550405"          |
|      | Scale Factor       | 1.000160118816               |
|      | Convergence        | -0°01'36.9586"               |
|      | Northing(y)        | 368477.5970 0.010992F        |
|      | Easting (x)        | 3289799.7025 0.010564F       |
|      | Ellipsoid Height   | 3770.6373 1149.293 0.012537F |
|      | OrthoMetric Height | 3834.5894 0.018080F          |
|      | Geoid Height       | -63.9521 0.013027F           |

## CONTROL MARK DATA

NAME OF MARK: 17113504 COUNTY: DESCHUTES  
 MARK SET BY: LS 1678 GARY HICKMAN STATE: OREGON  
 DATE OF MARK: 12/04/90 COUNTRY: U.S.A.  
 LOCATION: SECTION 35 TOWNSHIP 17 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR 2178

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1992-1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODITIC AND MAPPING COORDINATES

MARK: 17113504 HORIZONTAL ORDER: FIRST

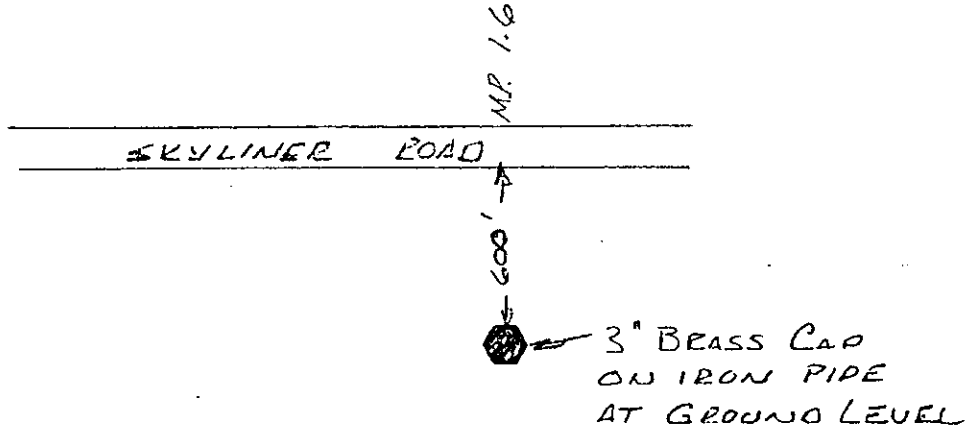
|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 44°03'05.533787"  | ONE SIGMA ERROR |
| Longitude:          | 121°22'25.178717" |                 |
| Northing:           | 383371.3316       | 0.020           |
| Easting:            | 3276247.6945      | 0.017           |
| Convergence:        | -0°03'46.0985"    |                 |
| Scale Factor:       | 1.000160644252    |                 |
| Ellipsoid Height:   | 3785.9334         | 0.028           |
| Orthometric Height: | 3850.1586         | 0.031           |
| Geoid Height:       | -64.2252          |                 |

*1153.955*

## CONTROL MARK DATA

NAME OF MARK: 17113600 COUNTY: DESCHUTES  
 MARK SET BY: LS 1068 DAVID BATEMAN STATE: OREGON  
 DATE OF MARK: 2/21/90 COUNTRY: U.S.A.  
 LOCATION: SECTION 36 TOWNSHIP 17 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR 1033

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1992-1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODITIC AND MAPPING COORDINATES

MARK: 17113600 HORIZONTAL ORDER: FIRST

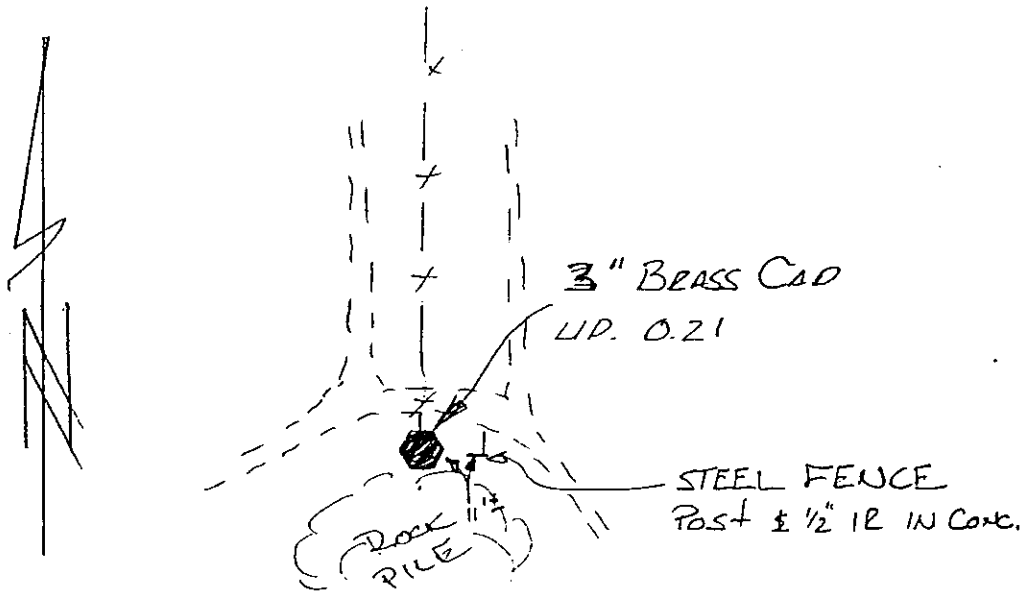
|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 44°03'05.643087"  | ONE   |
| Longitude:          | 121°21'48.764521" | SIGMA |
| Northing:           | 383379.6489       | ERROR |
| Easting:            | 3278907.5384      | 0.017 |
| Convergence:        | -0°03'20.7796"    | 0.015 |
| Scale Factor:       | 1.000160508041    |       |
| Ellipsoid Height:   | 3728.8591         | 0.025 |
| Orthometric Height: | 3793.1077         | 0.028 |
| Geoid Height:       | -64.2485          |       |

*1136-57*

### CONTROL MARK DATA

NAME OF MARK: 17123100 COUNTY: DESCHUTES  
MARK SET BY: LS 1046 MICHAEL TYE STATE: OREGON  
DATE OF MARK: 3/10/78 COUNTRY: U.S.A.  
LOCATION: SECTION 31 TOWNSHIP 17 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
REFERENCE NUMBER: OCRR 359

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1992-1993  
FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS  
DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

#### GEODITIC AND MAPPING COORDINATES

MARK: 17123100 HORIZONTAL ORDER: FIRST

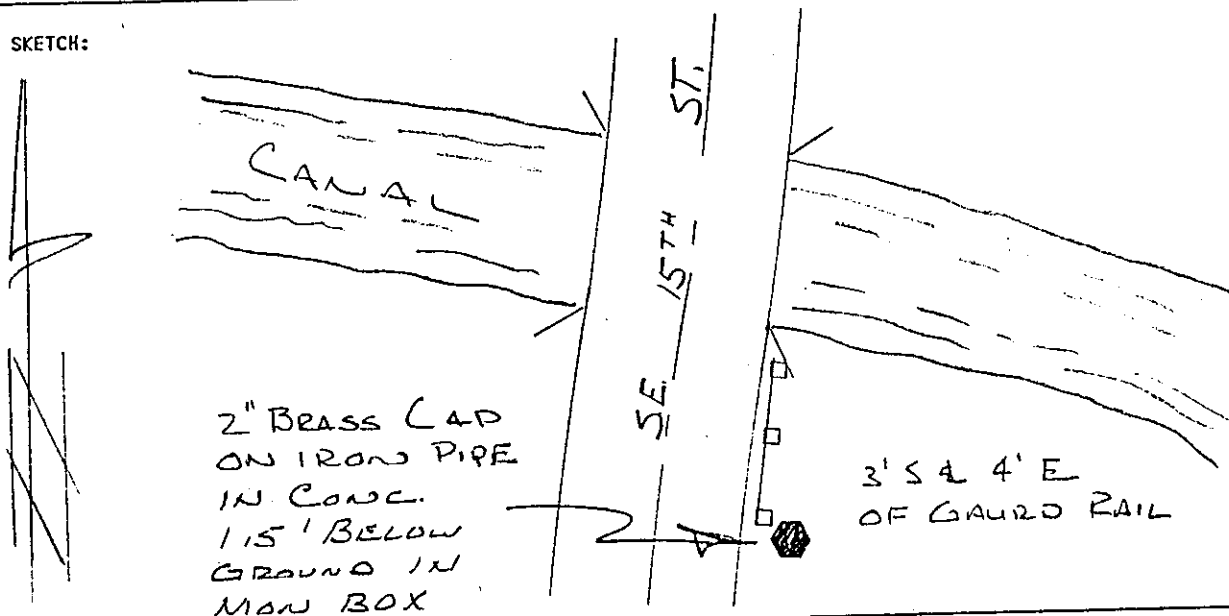
|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 44°03'05.488468"  | ONE SIGMA ERROR |
| Longitude:          | 121°20'36.333985" |                 |
| Northing:           | 383359.4853       | 0.012           |
| Easting:            | 3284198.1295      | 0.011           |
| Convergence:        | -0°02'30.4181"    |                 |
| Scale Factor:       | 1.000160285142    |                 |
| Ellipsoid Height:   | 3756.0684         | 0.020           |
| Orthometric Height: | 3820.3519         | 0.023           |
| Geoid Height:       | -64.2835          |                 |

1144.522

## CONTROL MARK DATA

NAME OF MARK: 18121000 COUNTY: DESCHUTES  
 MARK SET BY: LS 1031 W. C. KAUFFMAN STATE: OREGON  
 DATE OF MARK: 1981 COUNTRY: U.S.A.  
 LOCATION: SECTION 10 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR 0411

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

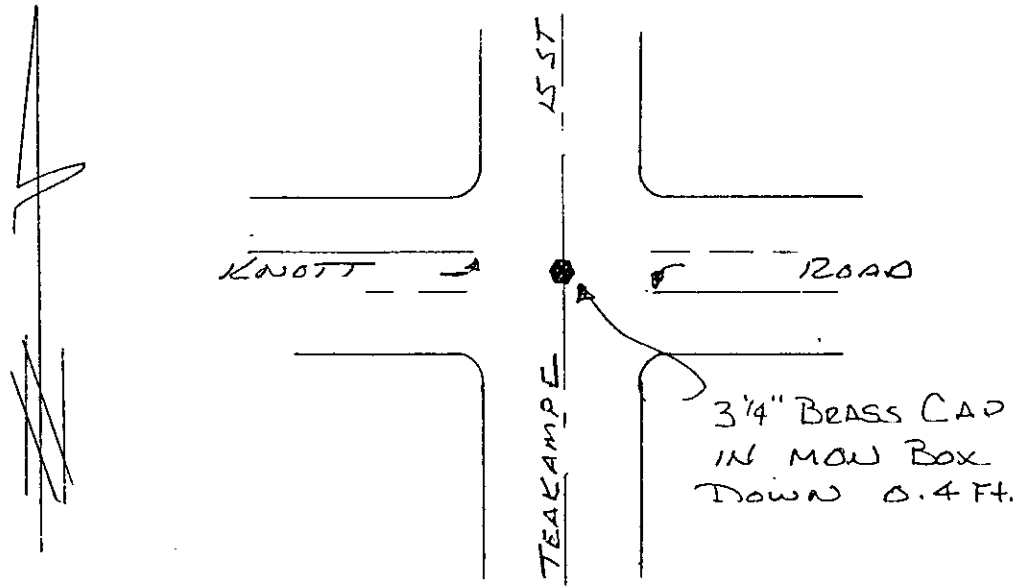
### GEODITIC AND MAPPING COORDINATES

|                       |                                |                 |
|-----------------------|--------------------------------|-----------------|
| <u>MARK: 18121000</u> | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:             | 44°01'20.859699"               | ONE SIGMA ERROR |
| Longitude:            | 121°17'02.840025"              |                 |
| Northing:             | 372757.0921                    | 0.007           |
| Easting:              | 3299792.4522                   | 0.007           |
| Convergence:          | -0°00'01.9736"                 |                 |
| Scale Factor:         | 1.000160000049                 |                 |
| Ellipsoid Height:     | 3654.1208                      | 0.012           |
| Orthometric Height:   | 3718.1609                      | 0.014           |
| Geoid Height:         | -64.0401                       |                 |

## CONTROL MARK DATA

NAME OF MARK: 18121500 COUNTY: DESCHUTES  
 MARK SET BY: LS 2282 KENNETH L. GRANTHAM STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 15 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR N/A

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODITIC AND MAPPING COORDINATES

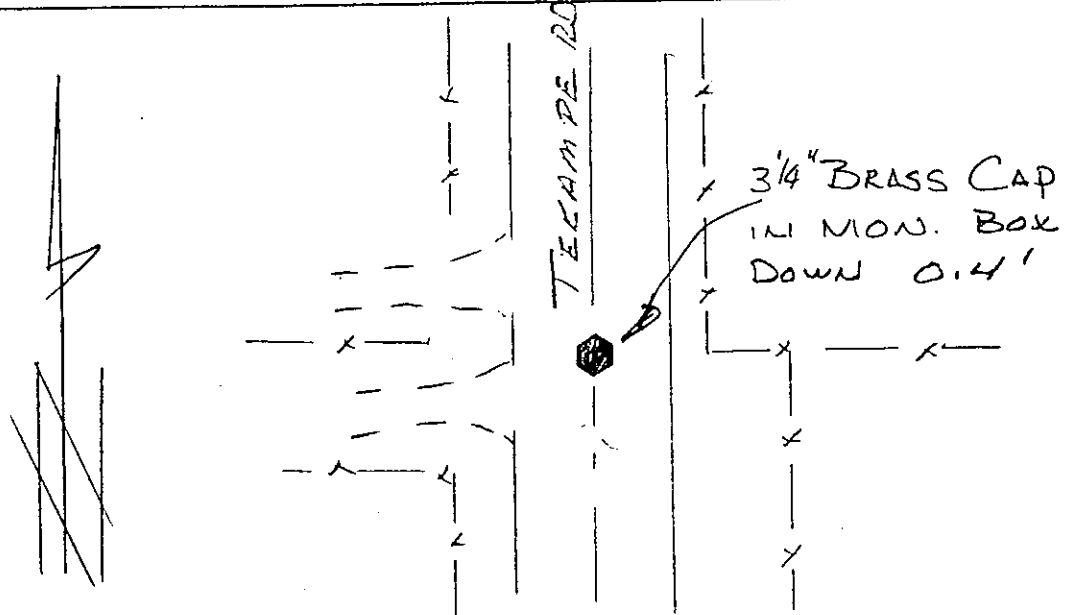
|                       |                                |                 |
|-----------------------|--------------------------------|-----------------|
| MARK: <u>18121500</u> | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:             | <u>44°00'28.678273"</u>        | ONE SIGMA ERROR |
| Longitude:            | <u>121°17'02.748228"</u>       |                 |
| Northing:             | <u>367472.262</u>              | <u>0.010</u>    |
| Easting:              | <u>3299799.1117</u>            | <u>0.010</u>    |
| Convergence:          | <u>-0°00'01.9094"</u>          |                 |
| Scale Factor:         | <u>1.000160000046</u>          |                 |
| Ellipsoid Height:     | <u>3689.48</u>                 | <u>0.015</u>    |
| Orthometric Height:   | <u>3753.397</u>                | <u>0.017</u>    |
| Geoid Height:         | <u>-63.909</u>                 |                 |



## CONTROL MARK DATA

NAME OF MARK: 18122200 COUNTY: DESCHUTES  
 MARK SET BY: LS 2282 KENNETH L. GRANTHAM STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 22 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR ~~174~~ 1238

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

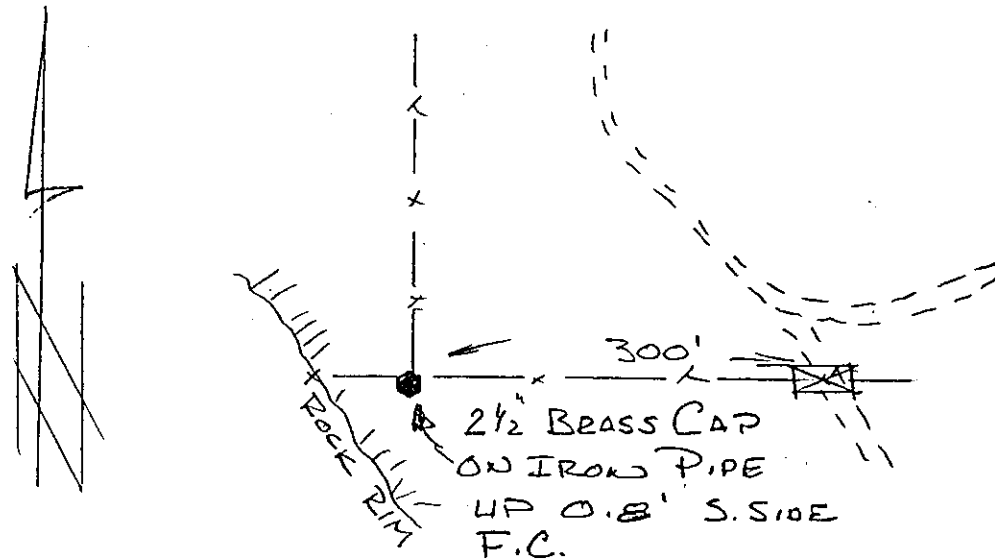
### GEODITIC AND MAPPING COORDINATES

|                       |                                |                 |
|-----------------------|--------------------------------|-----------------|
| <u>MARK: 18122200</u> | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:             | <u>43°59'36.481086"</u>        | ONE SIGMA ERROR |
| Longitude:            | <u>121°17'03.104191"</u>       |                 |
| Northing:             | <u>362185.8493</u>             | <u>0.008</u>    |
| Easting:              | <u>3299773.0365</u>            | <u>0.008</u>    |
| Convergence:          | <u>-0°00'02.1561"</u>          |                 |
| Scale Factor:         | <u>1.000160000059</u>          |                 |
| Ellipsoid Height:     | <u>3782.5632</u>               | <u>0.012</u>    |
| Orthometric Height:   | <u>3846.336</u>                | <u>0.016</u>    |
| Geoid Height:         | <u>-63.7728</u>                |                 |

## CONTROL MARK DATA

NAME OF MARK: 18122740 COUNTY: DESCHUTES  
 MARK SET BY: LS 0706 BRUCE W. A. ROGERS STATE: OREGON  
 DATE OF MARK: 1975 COUNTRY: U.S.A.  
 LOCATION: SECTION 27 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR 0415

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

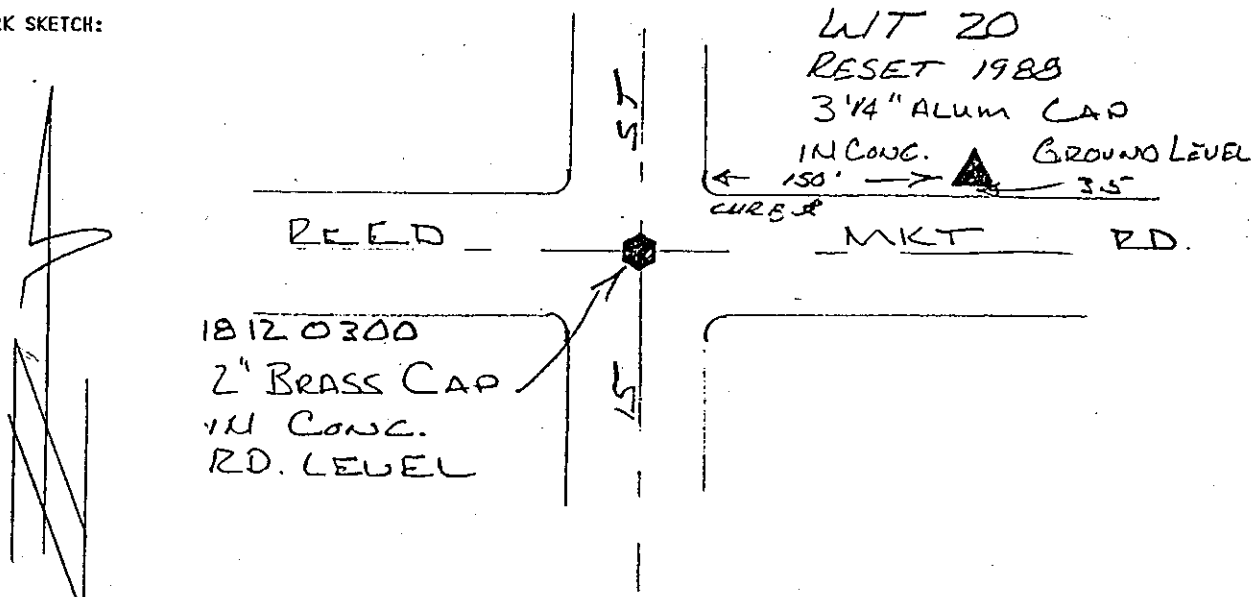
### GEODITIC AND MAPPING COORDINATES

|                       |                                |                 |
|-----------------------|--------------------------------|-----------------|
| MARK: <u>18122740</u> | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:             | <u>43°59'10.451134"</u>        | ONE SIGMA ERROR |
| Longitude:            | <u>121°17'03.395307"</u>       |                 |
| Northing:             | <u>359549.6000</u>             | <u>0.016</u>    |
| Easting:              | <u>3299751.7213</u>            | <u>0.016</u>    |
| Convergence:          | <u>-0°00'02.3580"</u>          |                 |
| Scale Factor:         | <u>1.000160000070</u>          |                 |
| Ellipsoid Height:     | <u>3855.7521</u>               | <u>0.028</u>    |
| Orthometric Height:   | <u>3919.4567</u>               | <u>0.030</u>    |
| Geoid Height:         | <u>-63.7046</u>                |                 |

### CONTROL MARK DATA

NAME OF MARK: WT20 RESET 1988 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. PUBLIC WORKS STATE: OREGON  
 DATE OF MARK: 1988 COUNTRY: U.S.A.  
 LOCATION: SECTION 3 TOWNSHIP 18S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 1

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993

FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

#### GEODITIC AND MAPPING COORDINATES

MARK: WT20 HORIZONTAL ORDER: FIRST

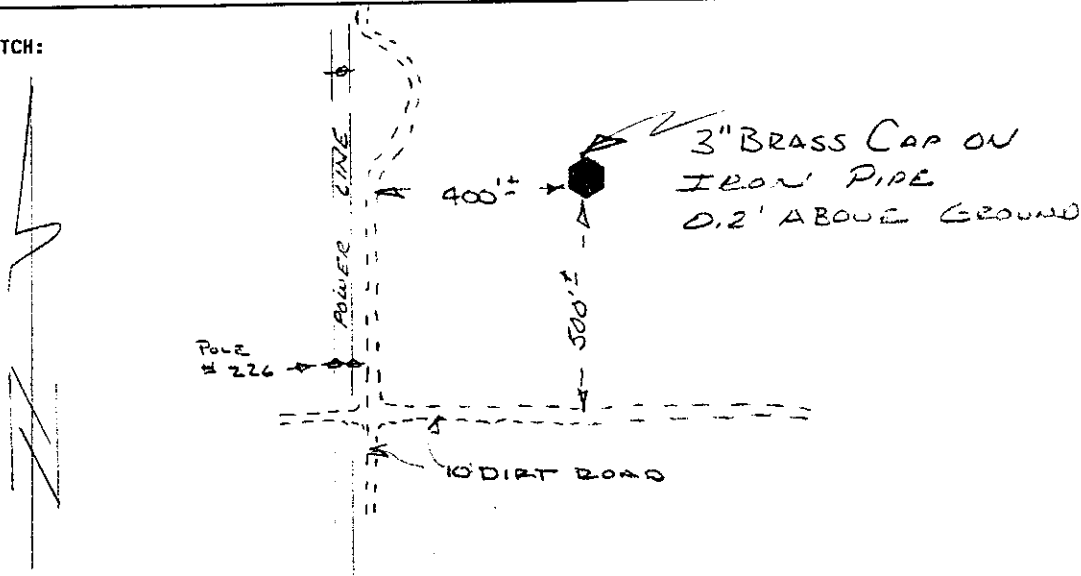
|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 44°02'13.299191"  | ONE SIGMA ERROR |
| Longitude:          | 121°16'59.277056" |                 |
| Northing:           | 378068.0713       | 0.008           |
| Easting:            | 3300052.8195      | 0.008           |
| Convergence:        | +0°00'00.5025"    |                 |
| Scale Factor:       | 1.000160000003    |                 |
| Ellipsoid Height:   | 3668.32           | 0.018           |
| Orthometric Height: | 3732.4847         | 0.020           |
| Geoid Height:       | -64.1647          |                 |

**ADJUSTED  
SURVEY POINTS  
IN  
DESCHUTES COUNTY  
PLANE COORDINATES**

## CONTROL MARK DATA

NAME OF MARK: 18110100 COUNTY: DESCHUTES  
 MARK SET BY: LS 1068 DAVID BATEMAN STATE: OREGON  
 DATE OF MARK: 1991 COUNTRY: U.S.A.  
 LOCATION: SECTION 1 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 3360

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

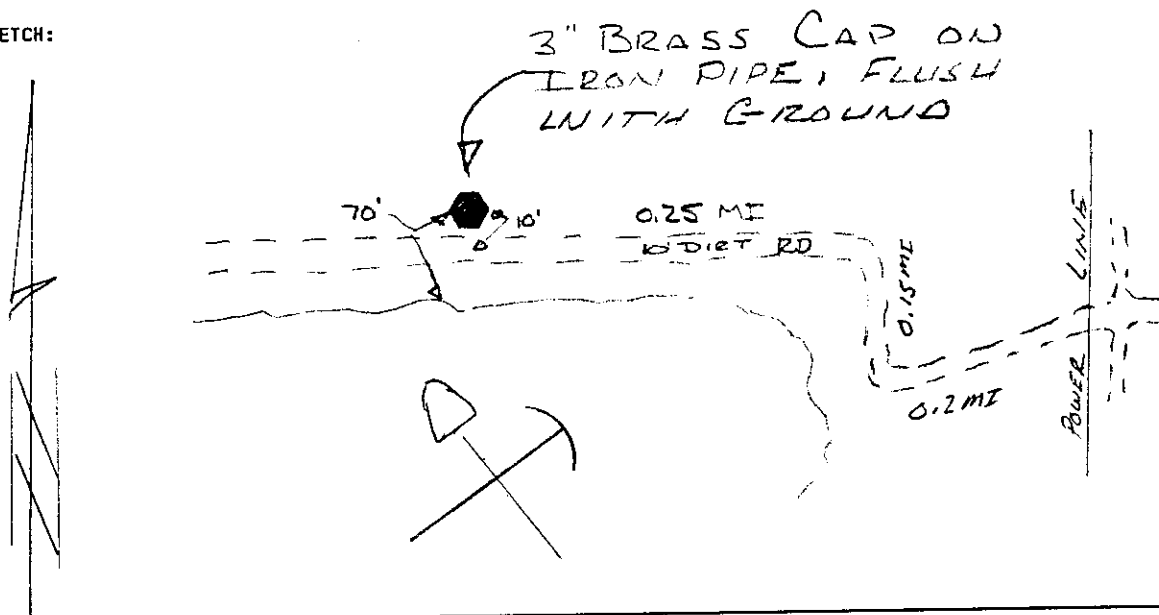
MARK: 18110100 HORIZONTAL ORDER: FIRST

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 44°02'13.302176"  | ONE   |
| Longitude:          | 121°21'49.490804" | SIGMA |
| Northing:           | 378078.6908       | ERROR |
| Easting:            | 3278849.3156      | 0.007 |
| Convergence:        | -0°03'21.2318"    | 0.007 |
| Scale Factor:       | 1.000160510852    |       |
| Ellipsoid Height:   | 3700.6412         | 0.017 |
| Orthometric Height: | 3764.7662         | 0.021 |
| Geoid Height:       | -64.125           |       |

## CONTROL MARK DATA

NAME OF MARK: 18110204 COUNTY: DESCHUTES  
 MARK SET BY: LS 1068 DAVID BATEMAN STATE: OREGON  
 DATE OF MARK: 1989 COUNTRY: U.S.A.  
 LOCATION: SECTION 2 TOWNSHIP 18S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR 1037

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETTIC AND MAPPING COORDINATES

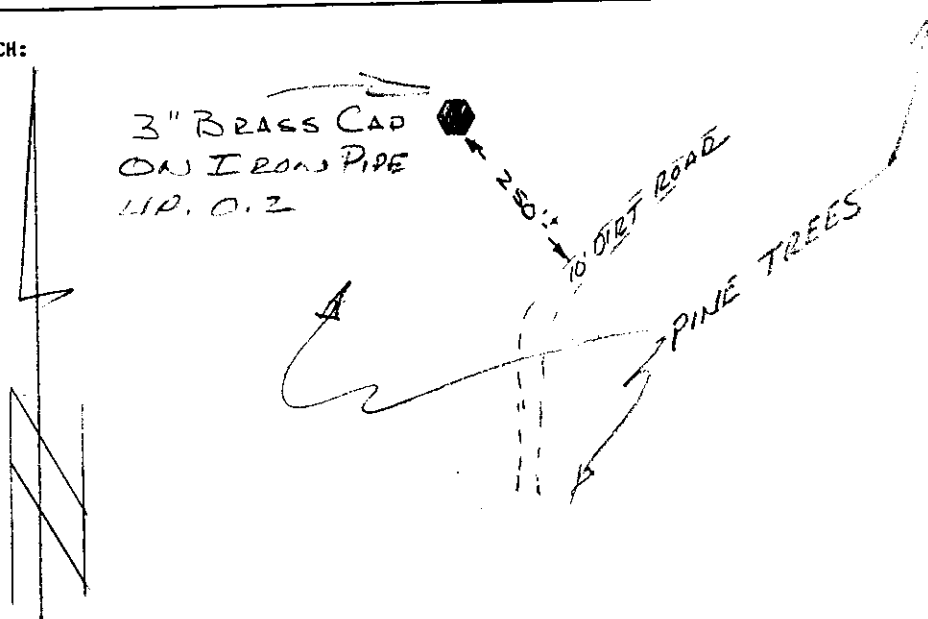
MARK: 18110204 HORIZONTAL ORDER: FIRST

|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 44°02'12.743529"  | ONE SIGMA ERROR |
| Longitude:          | 121°22'25.893528" |                 |
| Northing:           | 378024.8699       | 0.008           |
| Easting:            | 3276189.6092      | 0.009           |
| Convergence:        | -0°03'46.5356"    |                 |
| Scale Factor:       | 1.000160647409    |                 |
| Ellipsoid Height:   | 3788.9759         | 0.018           |
| Orthometric Height: | 3853.0714         | 0.022           |
| Geoid Height:       | -64.0955          |                 |

## CONTROL MARK DATA

NAME OF MARK: 18111100 COUNTY: DESCHUTES  
 MARK SET BY: U.S. DEPT. INT. ( B L M ) STATE: OREGON  
 DATE OF MARK: 1983 COUNTRY: U.S.A.  
 LOCATION: SECTION 11 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR 1038

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS  
 DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

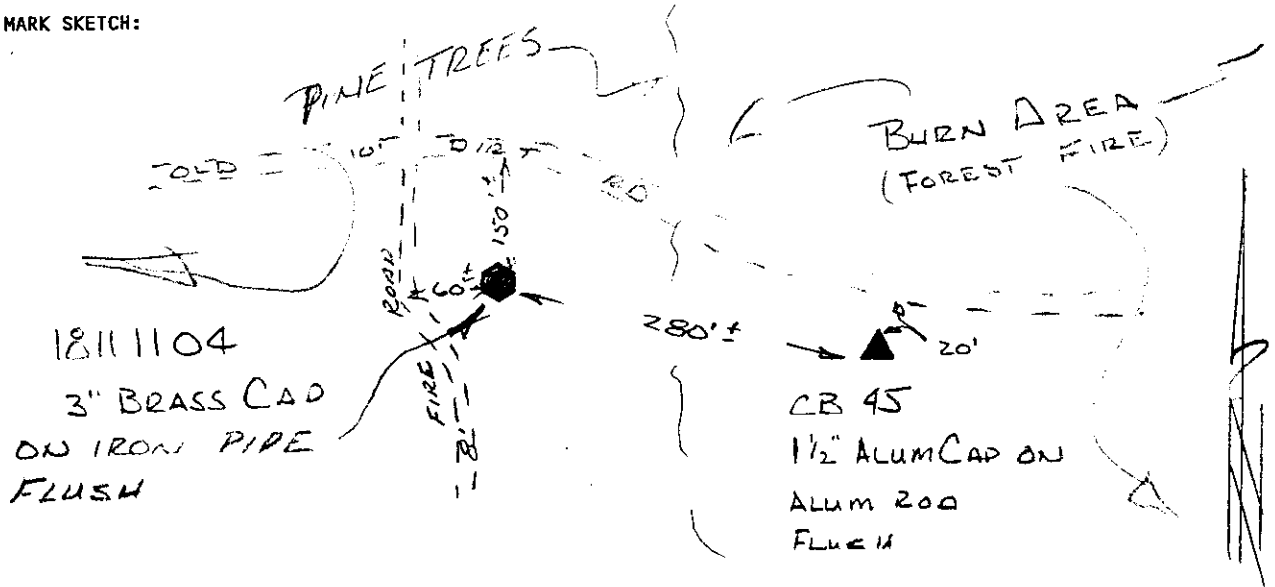
MARK: 18111100 HORIZONTAL ORDER: FIRST

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 44°01'20.723886"  | ONE   |
| Longitude:          | 121°23'02.846440" | SIGMA |
| Northing:           | 372759.5445       | ERROR |
| Easting:            | 3273483.3187      | 0.017 |
| Convergence:        | -0°04'12.1566"    | 0.013 |
| Scale Factor:       | 1.000160802945    |       |
| Ellipsoid Height:   | 3939.0642         | 0.034 |
| Orthometric Height: | 4003.0148         | 0.036 |
| Geoid Height:       | -63.9506          |       |

## CONTROL MARK DATA

NAME OF MARK: 18111104 COUNTY: DESCHUTES  
 MARK SET BY: U.S. DEPT. INT. (BLM) STATE: OREGON  
 DATE OF MARK: 1983 COUNTRY: U.S.A.  
 LOCATION: SECTION 11 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

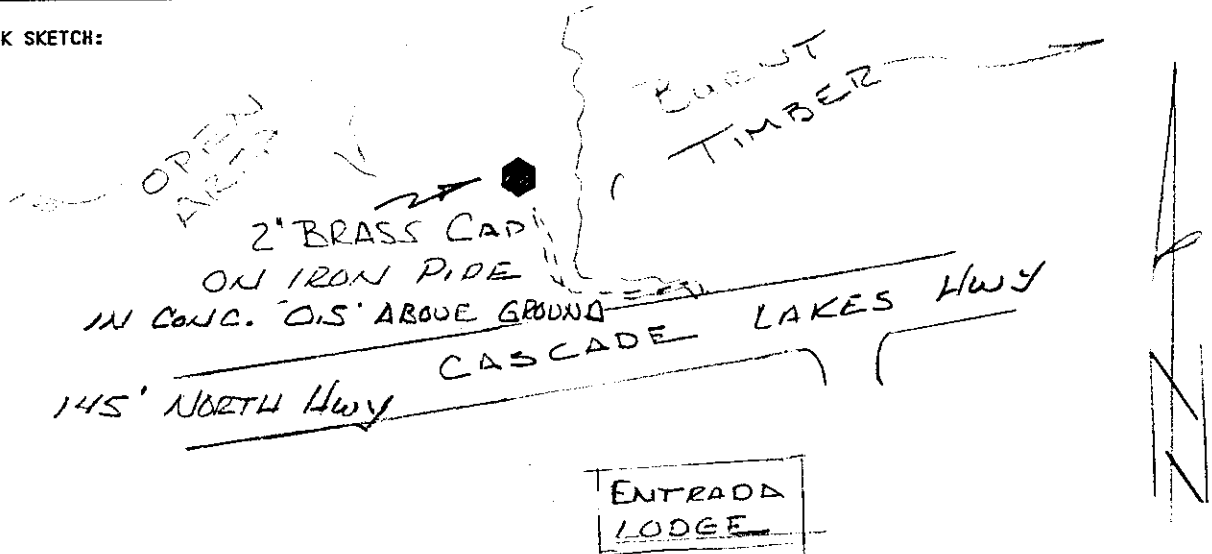
|                       |                                 |                 |
|-----------------------|---------------------------------|-----------------|
| MARK: <u>18111104</u> | HORIZONTAL ORDER: <u>SECOND</u> |                 |
| Latitude:             | 44°01'20.897575"                | ONE SIGMA ERROR |
| Longitude:            | 121°22'26.536627"               |                 |
| Northing:             | 372774.0538                     | 0.016           |
| Easting:              | 3276136.8456                    | 0.016           |
| Convergence:          | -0°03'46.9235"                  |                 |
| Scale Factor:         | 1.000160650283                  |                 |
| Ellipsoid Height:     | 3909.0262                       | 0.022           |
| Orthometric Height:   | 3973.0092                       | 0.023           |
| Geoid Height:         | -63.983                         |                 |



### CONTROL MARK DATA

NAME OF MARK: 18111200 COUNTY: DESCHUTES  
 MARK SET BY: LS 0654 NORMAN NEWTON STATE: OREGON  
 DATE OF MARK: 1970 COUNTRY: U.S.A.  
 LOCATION: SECTION 12 TOWNSHIP 18S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 3380

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

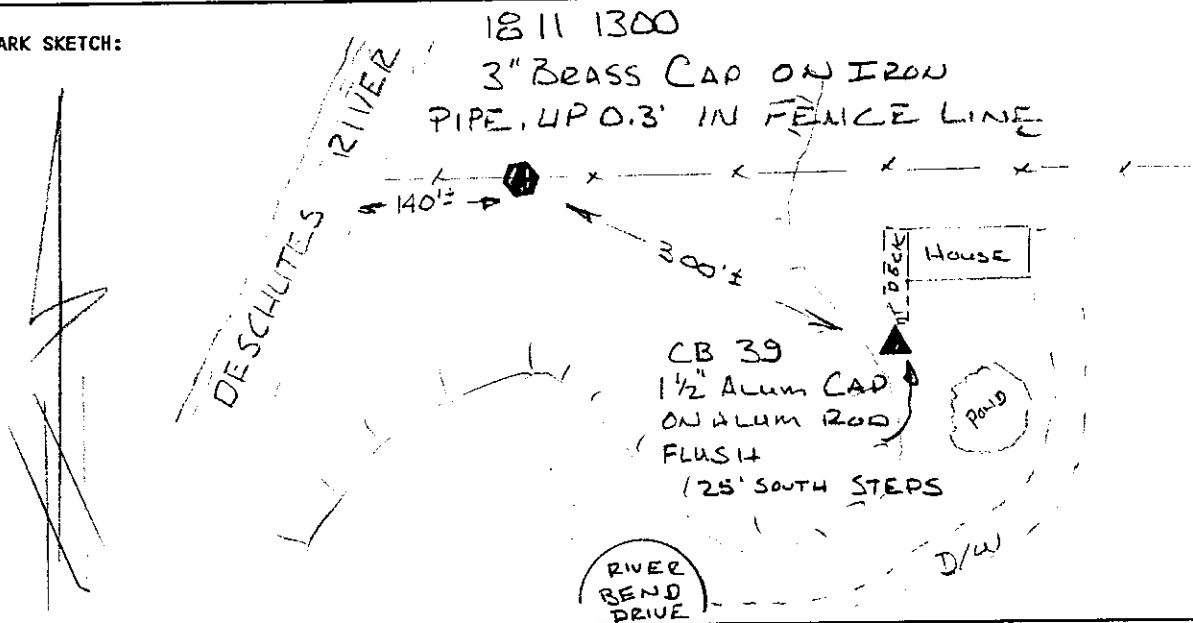
#### GEODETTIC AND MAPPING COORDINATES

|                       |                                |                 |
|-----------------------|--------------------------------|-----------------|
| MARK: <u>18111200</u> | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:             | 44°01'21.074004"               | ONE SIGMA ERROR |
| Longitude:            | 121°21'50.230946"              |                 |
| Northing:             | 372789.1655                    | 0.007           |
| Easting:              | 3278790.0665                   | 0.007           |
| Convergence:          | -0°03'21.6935"                 |                 |
| Scale Factor:         | 1.000160513719                 |                 |
| Ellipsoid Height:     | 3806.1556                      | 0.015           |
| Orthometric Height:   | 3870.1669                      | 0.017           |
| Geoid Height:         | -64.0112                       |                 |

## CONTROL MARK DATA

NAME OF MARK: 18111300 COUNTY: DESCHUTES  
 MARK SET BY: U.S. DEPT. INT. (BLM) STATE: OREGON  
 DATE OF MARK: 1983 COUNTRY: U.S.A.  
 LOCATION: SECTION 13 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

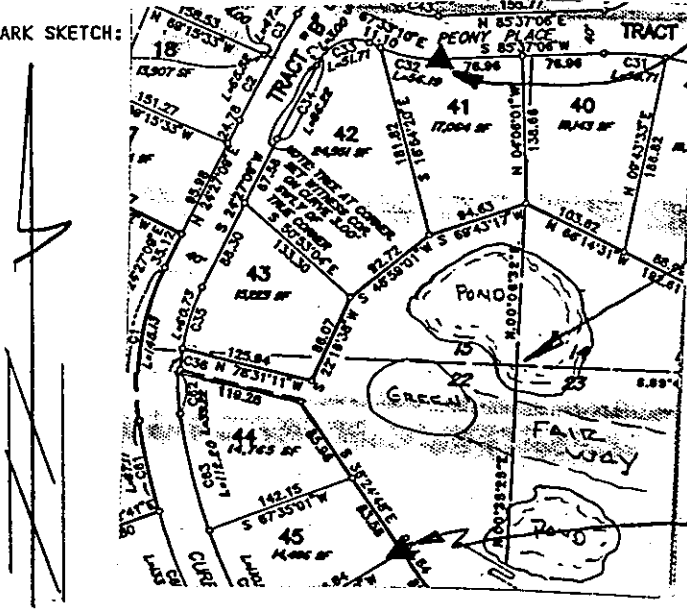
### GEODETIC AND MAPPING COORDINATES

|                       |                                 |                 |
|-----------------------|---------------------------------|-----------------|
| MARK: <u>18111300</u> | HORIZONTAL ORDER: <u>SECOND</u> |                 |
| Latitude:             | 44°00'28.305870"                | ONE SIGMA ERROR |
| Longitude:            | 121°21'51.314233"               |                 |
| Northing:             | 367444.9921                     | 0.017           |
| Easting:              | 3278705.6558                    | 0.016           |
| Convergence:          | -0°03'22.3927"                  |                 |
| Scale Factor:         | 1.000160517818                  |                 |
| Ellipsoid Height:     | 3759.9773                       | 0.026           |
| Orthometric Height:   | 3823.8709                       | 0.029           |
| Geoid Height:         | -63.8936                        |                 |

## CONTROL MARK DATA

NAME OF MARK: 18111400 COUNTY: DESCHUTES  
 MARK SET BY: U.S. DEPT. INT. (BLM) STATE: OREGON  
 DATE OF MARK: 1983 COUNTRY: U.S.A.  
 LOCATION: SECTION 14 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: Computed From Subdivision Coord.

MARK SKETCH:



CB 42 5/8" IRON ROD W/ PLASTIC CAP - UP 0.1 FT - CURVE POINT R/W

18111400 - Comp. Coord.  
 FROM POINT COOR. DATA FOR SUBDIVISION FROM CHECK PLAT FILE. ROTATE/TRANSLATE & SCALED CARLSON COOR TO COUNTY GRID.

CB 43 5/8" IRON ROD W/ PLASTIC CAP UP 0.2 FT. - Lot Cor BET 46+45

DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

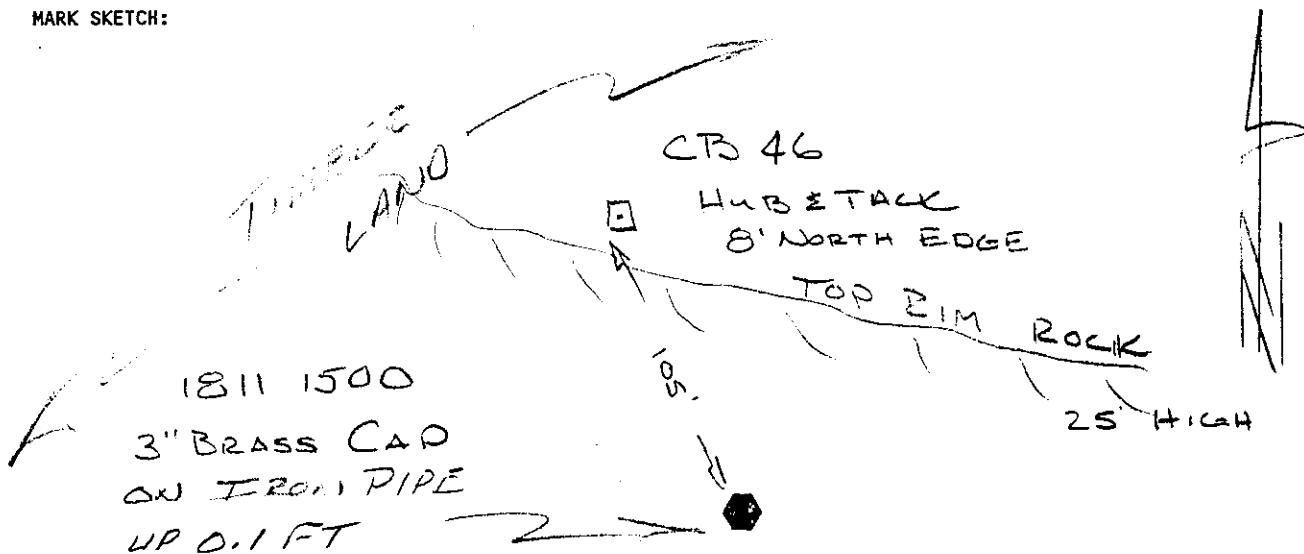
### GEODETIC AND MAPPING COORDINATES

MARK: 18111400 HORIZONTAL ORDER: THIRD  
 Latitude: 44°00'28.492286" ONE SIGMA ERROR  
 Longitude: 121°23'03.432571"  
 Northing: 367469.685 0.100  
 Easting: 3273434.008 0.100  
 Convergence: -0°04'12.4977"  
 Scale Factor: 1.000160805937  
 Ellipsoid Height:  
 Orthometric Height:  
 Geoid Height:

## CONTROL MARK DATA

NAME OF MARK: 18111500 COUNTY: DESCHUTES  
 MARK SET BY: U.S. DEPT. INT. (BLM) STATE: OREGON  
 DATE OF MARK: 1983 COUNTRY: U.S.A.  
 LOCATION: SECTION 15 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

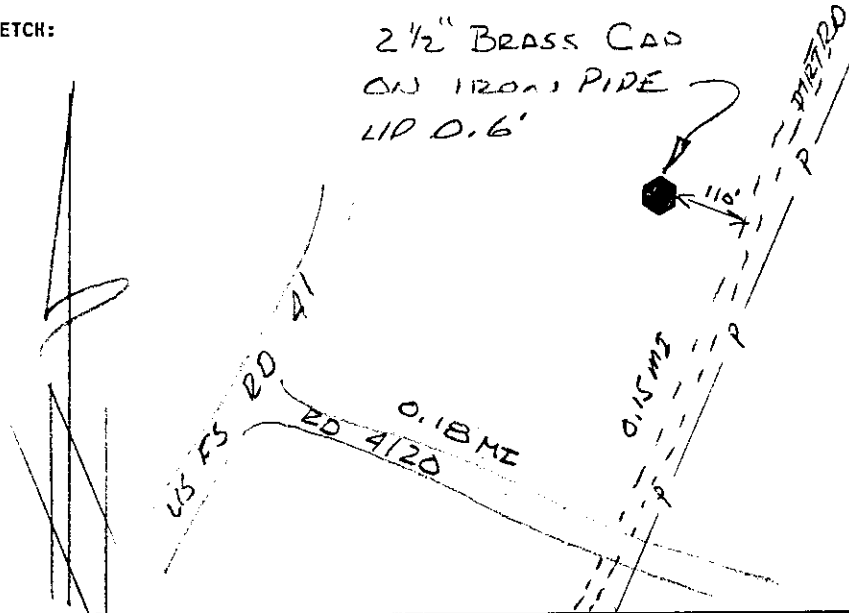
MARK: 18111500 HORIZONTAL ORDER: SECOND

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 44°00'28.472552"  | ONE   |
| Longitude:          | 121°24'16.544951" | SIGMA |
| Northing:           | 367474.8866       | ERROR |
| Easting:            | 3268089.6767      | 0.018 |
| Convergence:        | -0°05'03.2932"    | 0.017 |
| Scale Factor:       | 1.000161162817    |       |
| Ellipsoid Height:   | 4009.145          | 0.029 |
| Orthometric Height: | 4072.8888         | 0.035 |
| Geoid Height:       | -63.7438          |       |

## CONTROL MARK DATA

NAME OF MARK: 18112200 COUNTY: DESCHUTES  
 MARK SET BY: U.S. DEPT. INT. (BLM) STATE: OREGON  
 DATE OF MARK: 1932 COUNTRY: U.S.A.  
 LOCATION: SECTION 22 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR 0403

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

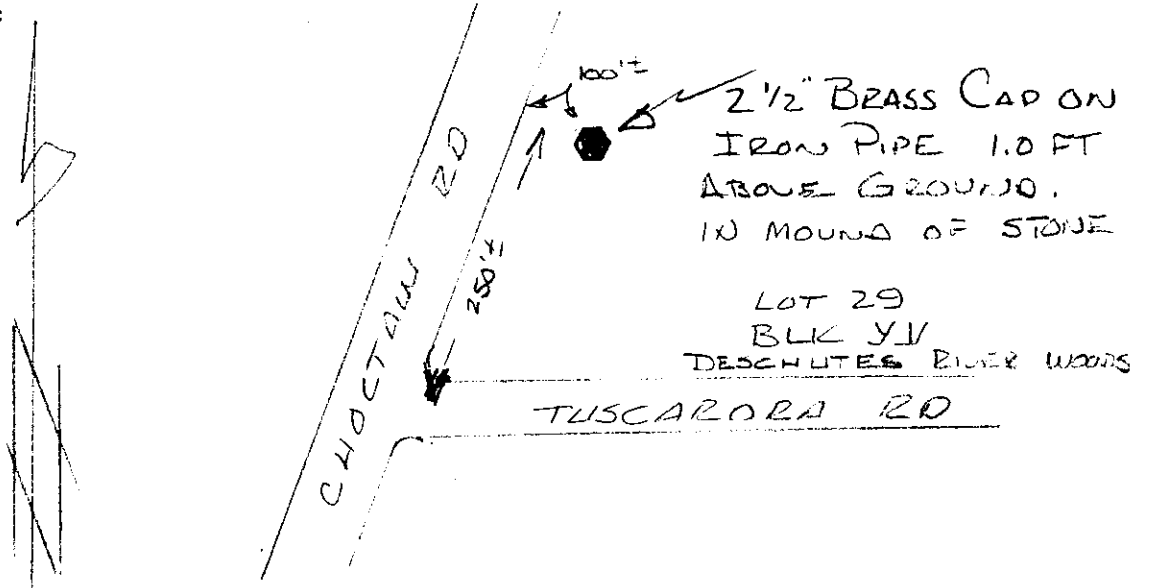
MARK: 18112200 HORIZONTAL ORDER: FIRST

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 43°59'36.309211"  | ONE   |
| Longitude:          | 121°24'17.215993" | SIGMA |
|                     |                   | ERROR |
| Northing:           | 362191.9733       | 0.013 |
| Easting:            | 3268032.8462      | 0.010 |
| Convergence:        | -0°05'03.6799"    |       |
| Scale Factor:       | 1.000161166967    |       |
| Ellipsoid Height:   | 3947.6983         | 0.028 |
| Orthometric Height: | 4011.3393         | 0.035 |
| Geoid Height:       | -63.641           |       |

# CONTROL MARK DATA

NAME OF MARK: 18112300 COUNTY: DESCHUTES  
MARK SET BY: U.S. DEPT. INT. (BLM) STATE: OREGON  
DATE OF MARK: 1932 COUNTRY: U.S.A.  
LOCATION: SECTION 23 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
REFERENCE NUMBER: NONE

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

## GEODETIC AND MAPPING COORDINATES

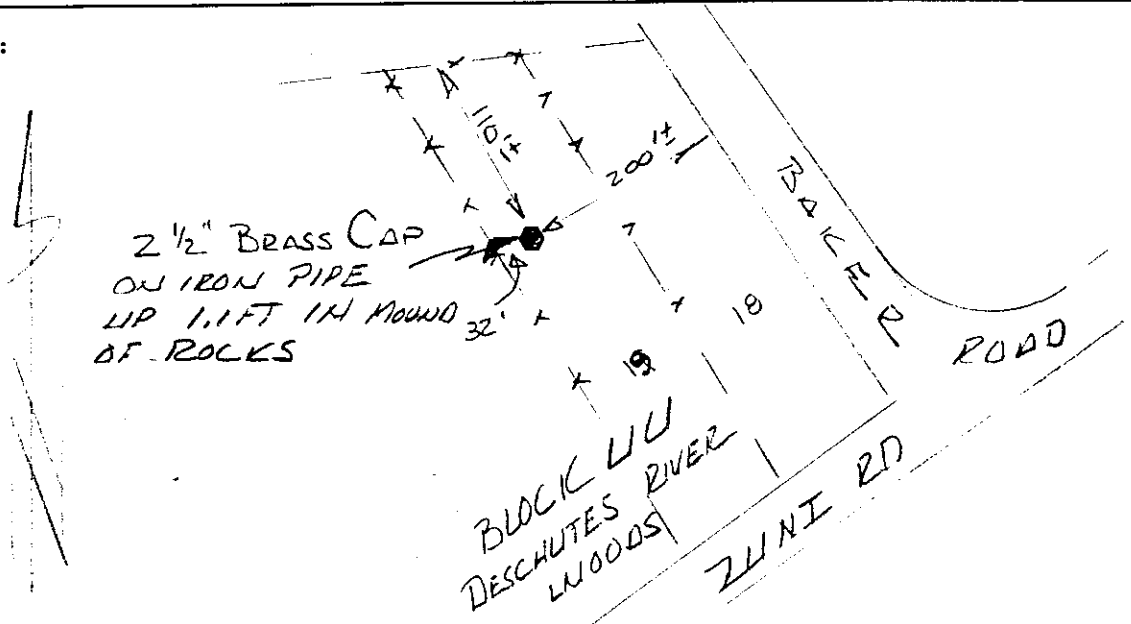
MARK: 18112300 HORIZONTAL ORDER: FIRST

|                     |                   |                       |
|---------------------|-------------------|-----------------------|
| Latitude:           | 43°59'36.428511"  | ONE<br>SIGMA<br>ERROR |
| Longitude:          | 121°23'03.873697" |                       |
| Northing:           | 362196.8229       | 0.015                 |
| Easting:            | 3273395.3011      | 0.011                 |
| Convergence:        | -0°04'12.7381"    |                       |
| Scale Factor:       | 1.000160808290    |                       |
| Ellipsoid Height:   | 3884.0694         | 0.033                 |
| Orthometric Height: | 3947.7965         | 0.038                 |
| Geoid Height:       | -63.7271          |                       |

## CONTROL MARK DATA

NAME OF MARK: 18112304 COUNTY: DESCHUTES  
 MARK SET BY: U.S. DEPT. INT. (B I M) STATE: OREGON  
 DATE OF MARK: 1932 COUNTRY: U.S.A.  
 LOCATION: SECTION 23 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

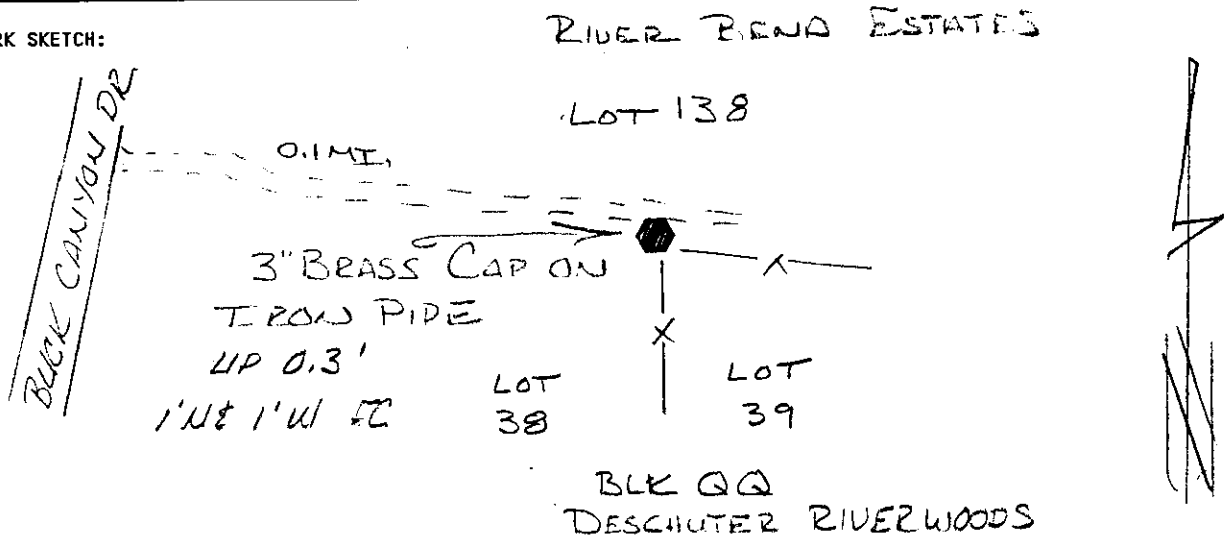
### GEODETIC AND MAPPING COORDINATES

|                       |                                |                 |
|-----------------------|--------------------------------|-----------------|
| MARK: <u>18112304</u> | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:             | 43°59'36.435052"               | ONE SIGMA ERROR |
| Longitude:            | 121°22'27.695666"              |                 |
| Northing:             | 362194.4054                    | 0.017           |
| Easting:              | 3276040.4659                   | 0.013           |
| Convergence:          | -0°03'47.6097"                 |                 |
| Scale Factor:         | 1.000160655552                 |                 |
| Ellipsoid Height:     | 3872.4934                      | 0.033           |
| Orthometric Height:   | 3936.2486                      | 0.037           |
| Geoid Height:         | -63.7551                       |                 |

## CONTROL MARK DATA

NAME OF MARK: 18112440 COUNTY: DESCHUTES  
 MARK SET BY: U.S. DEPT. INT. (B.L.M.) STATE: OREGON  
 DATE OF MARK: 1983 COUNTRY: U.S.A.  
 LOCATION: SECTION 24 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

MARK: 18112440 HORIZONTAL ORDER: FIRST

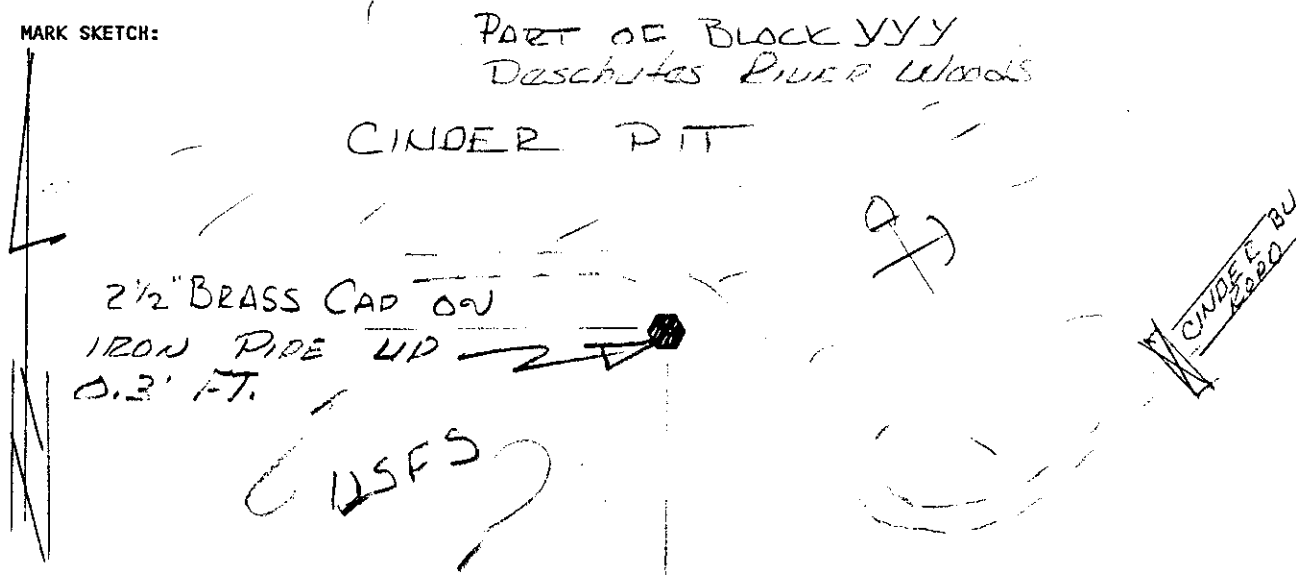
|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 44°00'02.328644"  | ONE SIGMA ERROR |
| Longitude:          | 121°21'51.117599" |                 |
| Northing:           | 364814.0617       | 0.013           |
| Easting:            | 3278717.4496      | 0.014           |
| Convergence:        | -0°03'22.2297"    |                 |
| Scale Factor:       | 1.000160517246    |                 |
| Ellipsoid Height:   | 3828.9318         | 0.031           |
| Orthometric Height: | 3892.7696         | 0.034           |
| Geoid Height:       | -63.8378          |                 |



**CONTROL MARK DATA**

NAME OF MARK: 18112500 COUNTY: DESCHUTES  
 MARK SET BY: U.S. DEPT. INT. (B.L.M.) STATE: OREGON  
 DATE OF MARK: 1932 COUNTRY: U.S.A.  
 LOCATION: SECTION 25 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

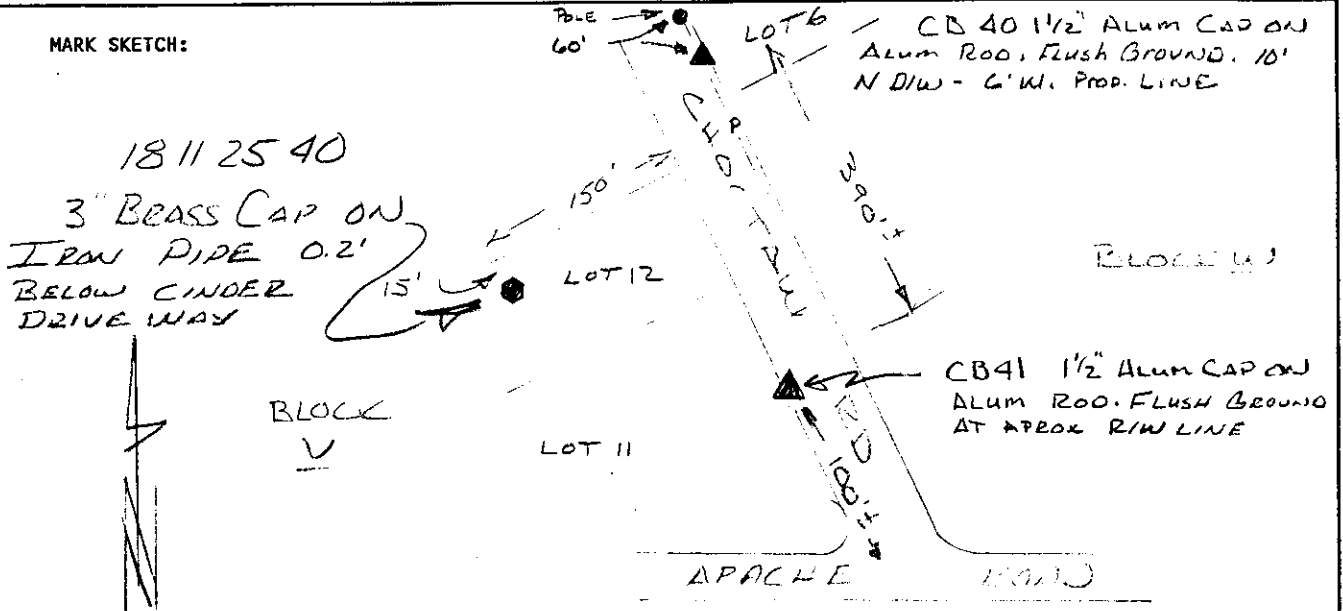
GEODETTIC AND MAPPING COORDINATES

|                       |                                |                 |
|-----------------------|--------------------------------|-----------------|
| MARK: <u>18112500</u> | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:             | 43°58'44.133860"               | ONE SIGMA ERROR |
| Longitude:            | 121°21'52.114727"              |                 |
| Northing:             | 356894.7575                    | 0.010           |
| Easting:              | 3278636.7638                   | 0.013           |
| Convergence:          | -0°03'22.8427"                 |                 |
| Scale Factor:         | 1.000160521178                 |                 |
| Ellipsoid Height:     | 3983.8172                      | 0.026           |
| Orthometric Height:   | 4047.4838                      | 0.032           |
| Geoid Height:         | -63.6665                       |                 |

## CONTROL MARK DATA

NAME OF MARK: 18112540 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 25 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR 1248

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

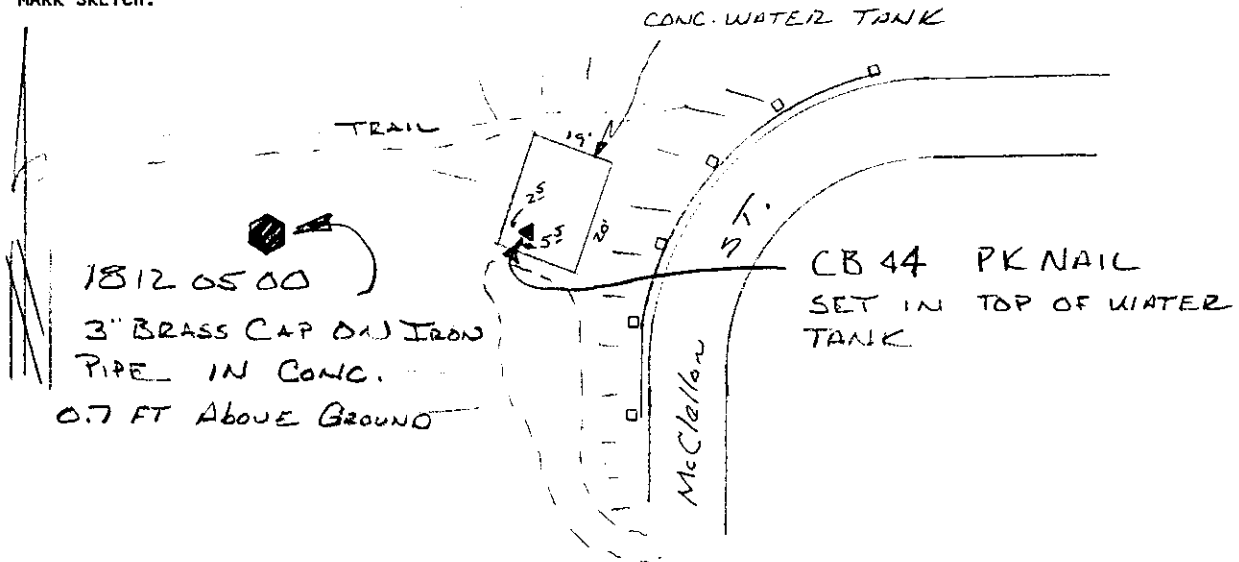
### GEODETIC AND MAPPING COORDINATES

|                       |                                 |                 |
|-----------------------|---------------------------------|-----------------|
| MARK: <u>18112540</u> | HORIZONTAL ORDER: <u>SECOND</u> |                 |
| Latitude:             | 43°59'10.127027"                | ONE SIGMA ERROR |
| Longitude:            | 121°21'51.799143"               |                 |
| Northing:             | 359527.2556                     | 0.019           |
| Easting:              | 3278662.4296                    | 0.021           |
| Convergence:          | -0°03'22.6500"                  |                 |
| Scale Factor:         | 1.000160519925                  |                 |
| Ellipsoid Height:     | 3869.7543                       | 0.032           |
| Orthometric Height:   | 3933.4829                       | 0.036           |
| Geoid Height:         | -63.7286                        |                 |

## CONTROL MARK DATA

NAME OF MARK: 18120500 COUNTY: DESCHUTES  
 MARK SET BY: LS 0540 GEORGE COOK STATE: OREGON  
 DATE OF MARK: 1973 COUNTRY: U.S.A.  
 LOCATION: SECTION 5 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 3721

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

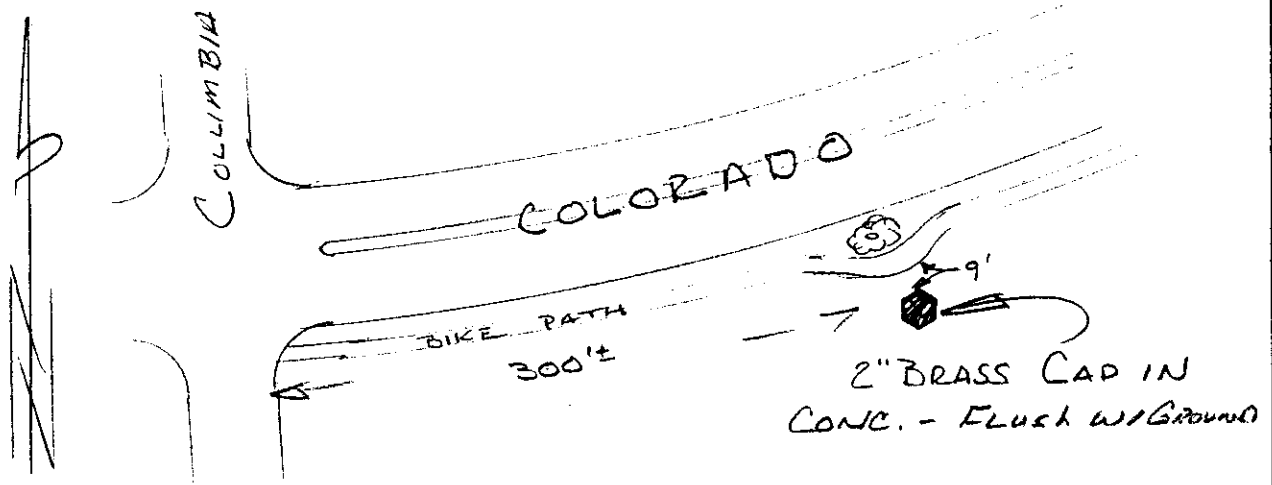
MARK: 18120500 HORIZONTAL ORDER: SECOND

|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 44°02'13.081130"  | ONE SIGMA ERROR |
| Longitude:          | 121°19'24.649351" |                 |
| Northing:           | 378048.5324       | 0.016           |
| Easting:            | 3289431.6646      | 0.016           |
| Convergence:        | -0°01'40.5490"    |                 |
| Scale Factor:       | 1.000160127544    |                 |
| Ellipsoid Height:   | 3582.3986         | 0.024           |
| Orthometric Height: | 3646.5708         | 0.026           |
| Geoid Height:       | -64.1722          |                 |

# CONTROL MARK DATA

NAME OF MARK: 18120540 COUNTY: DESCHUTES  
MARK SET BY: LS 1031 W. C. KAUFFMAN STATE: OREGON  
DATE OF MARK: 1984 COUNTRY: U.S.A.  
LOCATION: SECTION 5 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
REFERENCE NUMBER: CS 3743

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

## GEODETTIC AND MAPPING COORDINATES

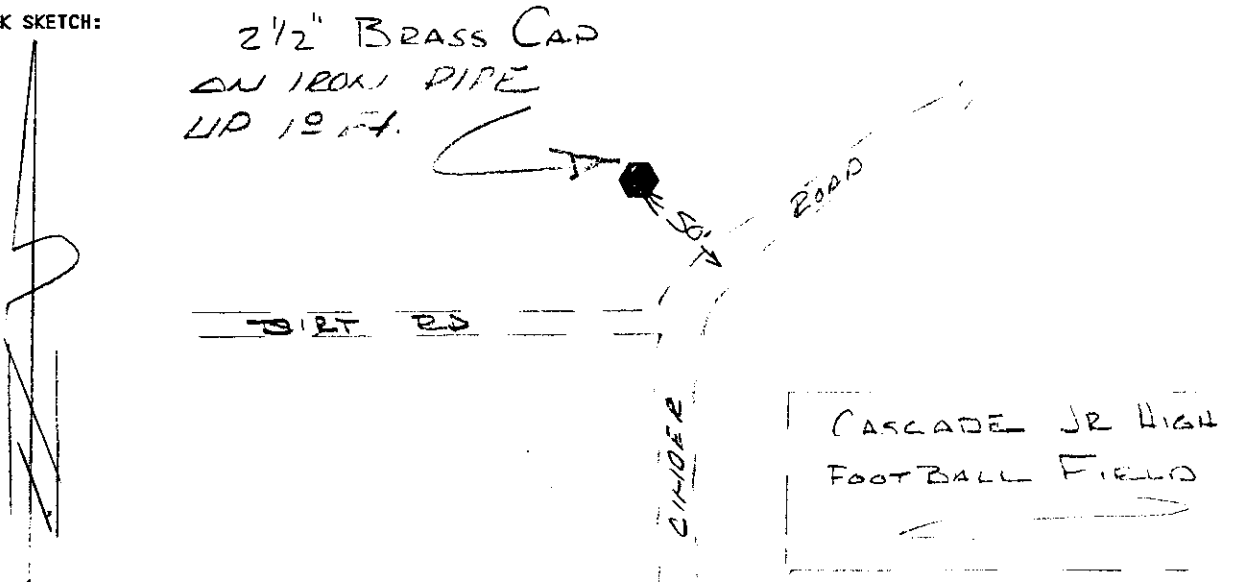
MARK: 18120540 HORIZONTAL ORDER: FIRST

|                     |                          |       |
|---------------------|--------------------------|-------|
| Latitude:           | <u>44°02'39.048207"</u>  | ONE   |
| Longitude:          | <u>121°19'26.127244"</u> | SIGMA |
| Northing:           | <u>380678.5204</u>       | ERROR |
| Easting:            | <u>3289324.9824</u>      | 0.010 |
| Convergence:        | <u>-0°01'41.5895"</u>    | 0.009 |
| Scale Factor:       | <u>1.000160130131</u>    |       |
| Ellipsoid Height:   | <u>3594.9845</u>         | 0.012 |
| Orthometric Height: | <u>3659.2192</u>         | 0.012 |
| Geoid Height:       | <u>-64.2347</u>          |       |

## CONTROL MARK DATA

NAME OF MARK: 18120600 COUNTY: DESCHUTES  
 MARK SET BY: LS 0981 LEON KENNEDY STATE: OREGON  
 DATE OF MARK: 1979 COUNTRY: U.S.A.  
 LOCATION: SECTION 6 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 10536

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

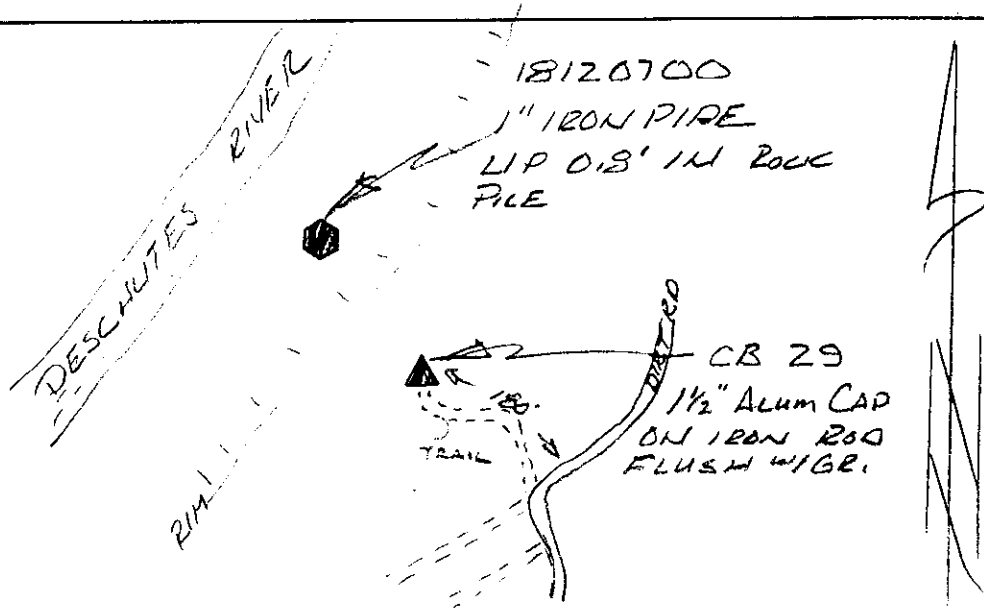
### GEODETTIC AND MAPPING COORDINATES

|                              |                                |                 |
|------------------------------|--------------------------------|-----------------|
| <u>MARK:</u> <u>18120600</u> | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:                    | 44°02'13.282434"               | ONE SIGMA ERROR |
| Longitude:                   | 121°20'37.046603"              |                 |
| Northing:                    | 378072.1738                    | 0.011           |
| Easting:                     | 3284142.2092                   | 0.009           |
| Convergence:                 | -0°02'30.8741"                 |                 |
| Scale Factor:                | 1.000160287165                 |                 |
| Ellipsoid Height:            | 3687.5415                      | 0.027           |
| Orthometric Height:          | 3751.7036                      | 0.030           |
| Geoid Height:                | -64.1621                       |                 |

## CONTROL MARK DATA

NAME OF MARK: 18120700 COUNTY: DESCHUTES  
 MARK SET BY: LS 0010 AL MANSFIELD STATE: OREGON  
 DATE OF MARK: 1964 COUNTRY: U.S.A.  
 LOCATION: SECTION 7 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 3375

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

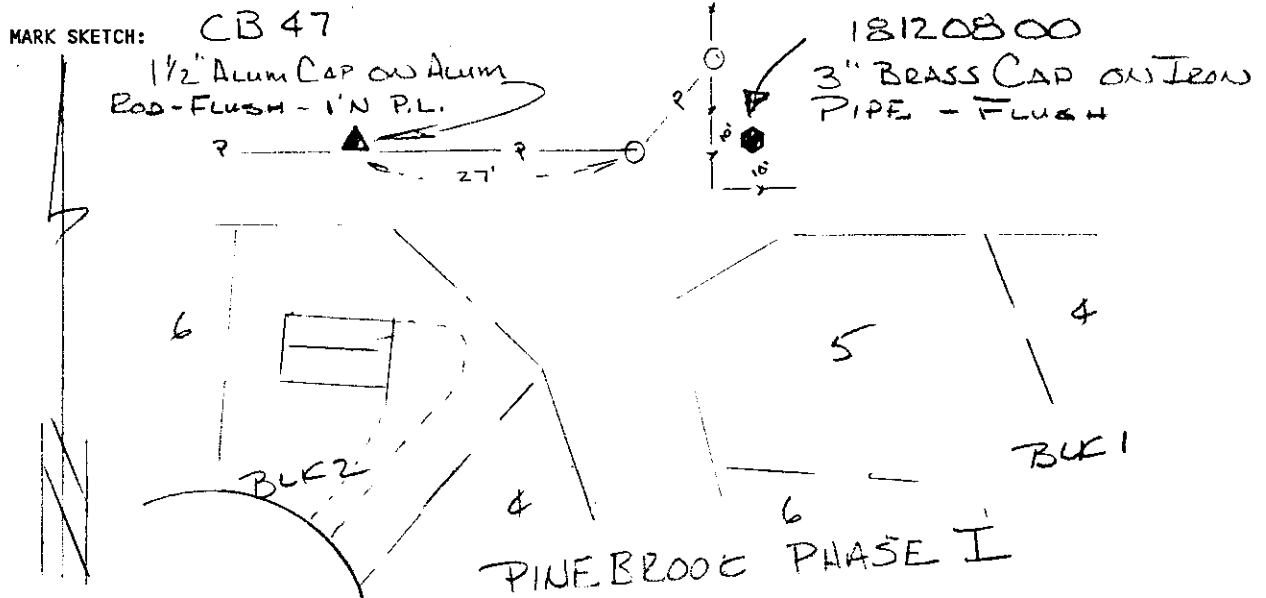
### GEODETIC AND MAPPING COORDINATES

MARK: 18120700 HORIZONTAL ORDER: SECOND

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 44°01'20.844132"  | ONE   |
| Longitude:          | 121°20'37.778224" | SIGMA |
| Northing:           | 372761.3533       | ERROR |
| Easting:            | 3284084.8585      | 0.021 |
| Convergence:        | -0°02'31.3429"    | 0.021 |
| Scale Factor:       | 1.000160289247    |       |
| Ellipsoid Height:   | 3712.0427         | 0.028 |
| Orthometric Height: | 3776.0861         | 0.031 |
| Geoid Height:       | -64.0434          |       |

## CONTROL MARK DATA

NAME OF MARK: 18120800 COUNTY: DESCHUTES  
 MARK SET BY: LS 0540 GEORGE COOK STATE: OREGON  
 DATE OF MARK: 1974 COUNTRY: U.S.A.  
 LOCATION: SECTION 8 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 8895



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETTIC AND MAPPING COORDINATES

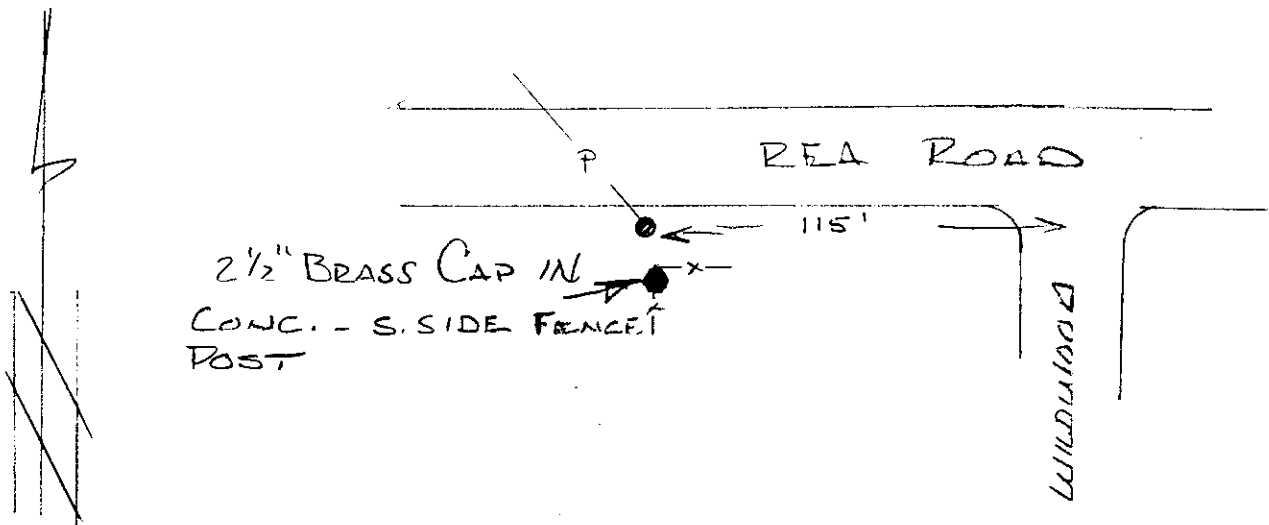
MARK: 18120800 HORIZONTAL ORDER: SECOND

|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 44°01'20.980443"  | ONE SIGMA ERROR |
| Longitude:          | 121°19'24.716864" |                 |
| Northing:           | 372771.8981       | 0.015           |
| Easting:            | 3289424.1589      | 0.015           |
| Convergence:        | -0°01'40.5697"    |                 |
| Scale Factor:       | 1.000160127725    |                 |
| Ellipsoid Height:   | 3750.9716         | 0.021           |
| Orthometric Height: | 3815.0219         | 0.022           |
| Geoid Height:       | -64.0502          |                 |

## CONTROL MARK DATA

NAME OF MARK: 18120900 COUNTY: DESCHUTES  
 MARK SET BY: LS 0980 ED GRAVES STATE: OREGON  
 DATE OF MARK: 1978 COUNTRY: U.S.A.  
 LOCATION: SECTION 9 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 5091

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

MARK: 18120900 HORIZONTAL ORDER: FIRST

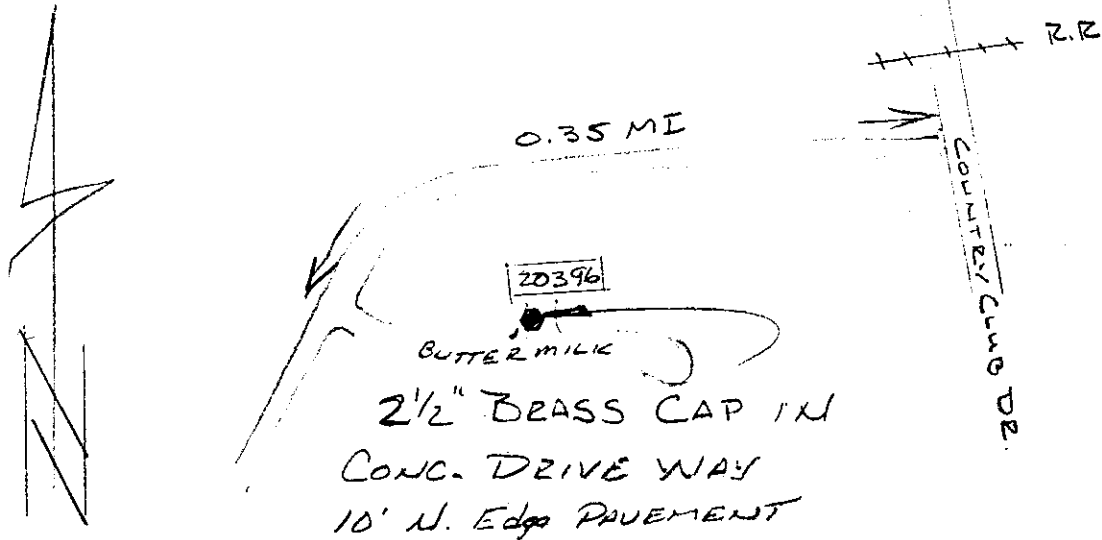
|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 44°01'20.902620"  | ONE SIGMA ERROR |
| Longitude:          | 121°18'13.657123" |                 |
| Northing:           | 372762.106        | 0.008           |
| Easting:            | 3294617.1698      | 0.006           |
| Convergence:        | -0°00'51.1873"    |                 |
| Scale Factor:       | 1.000160033088    |                 |
| Ellipsoid Height:   | 3696.2801         | 0.017           |
| Orthometric Height: | 3760.3282         | 0.020           |
| Geoid Height:       | -64.0481          |                 |



## CONTROL MARK DATA

NAME OF MARK: 18121600 COUNTY: DESCHUTES  
 MARK SET BY: LS 1081 JEFFERY KERN STATE: OREGON  
 DATE OF MARK: 1992 COUNTRY: U.S.A.  
 LOCATION: SECTION 16 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR 1145

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETTIC AND MAPPING COORDINATES

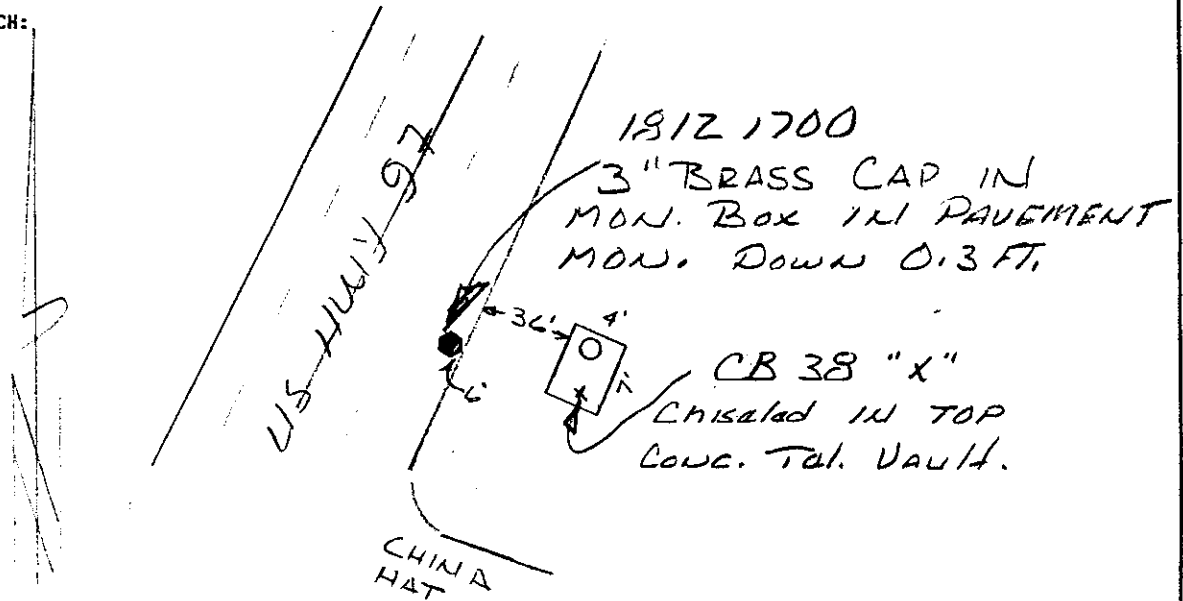
MARK: 18121600 HORIZONTAL ORDER: FIRST

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 44°00'28.230768"  | ONE   |
| Longitude:          | 121°18'14.284326" | SIGMA |
|                     |                   | ERROR |
| Northing:           | 367427.618        | 0.012 |
| Easting:            | 3294569.9991      | 0.011 |
| Convergence:        | -0°00'51.6095"    |       |
| Scale Factor:       | 1.000160033670    |       |
| Ellipsoid Height:   | 3777.0884         | 0.028 |
| Orthometric Height: | 3841.0103         | 0.030 |
| Geoid Height:       | -63.9219          |       |

## CONTROL MARK DATA

NAME OF MARK: 18121700 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 17 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: OCRR N/A

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

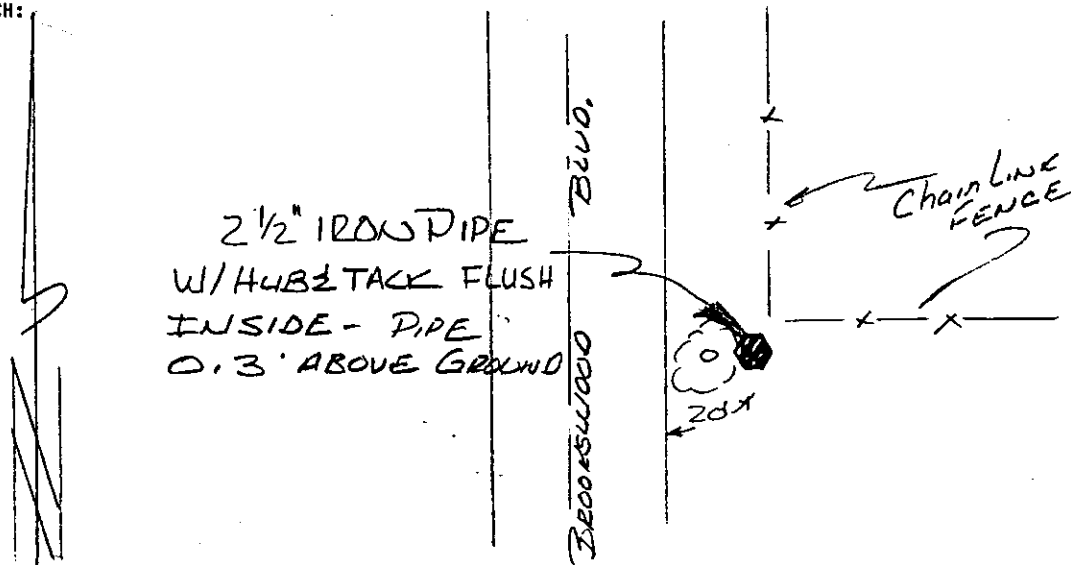
### GEODETTIC AND MAPPING COORDINATES

|                     |                   |                   |               |
|---------------------|-------------------|-------------------|---------------|
| MARK:               | <u>18121700</u>   | HORIZONTAL ORDER: | <u>SECOND</u> |
| Latitude:           | 44°00'28.820040"  | ONE               |               |
| Longitude:          | 121°19'25.270999" | SIGMA             |               |
| Northing:           | 367489.2169       | ERROR             |               |
| Easting:            | 3289381.0777      | 0.015             |               |
| Convergence:        | -0°01'40.9283"    | 0.015             |               |
| Scale Factor:       | 1.000160128768    |                   |               |
| Ellipsoid Height:   | 3784.3175         | 0.019             |               |
| Orthometric Height: | 3848.2474         | 0.020             |               |
| Geoid Height:       | -63.9298          |                   |               |

## CONTROL MARK DATA

NAME OF MARK: 18121800 COUNTY: DESCHUTES  
 MARK SET BY: PE 3700 EMILE BACHAND STATE: OREGON  
 DATE OF MARK: 1968 COUNTRY: U.S.A.  
 LOCATION: SECTION 18 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 10411

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETTIC AND MAPPING COORDINATES

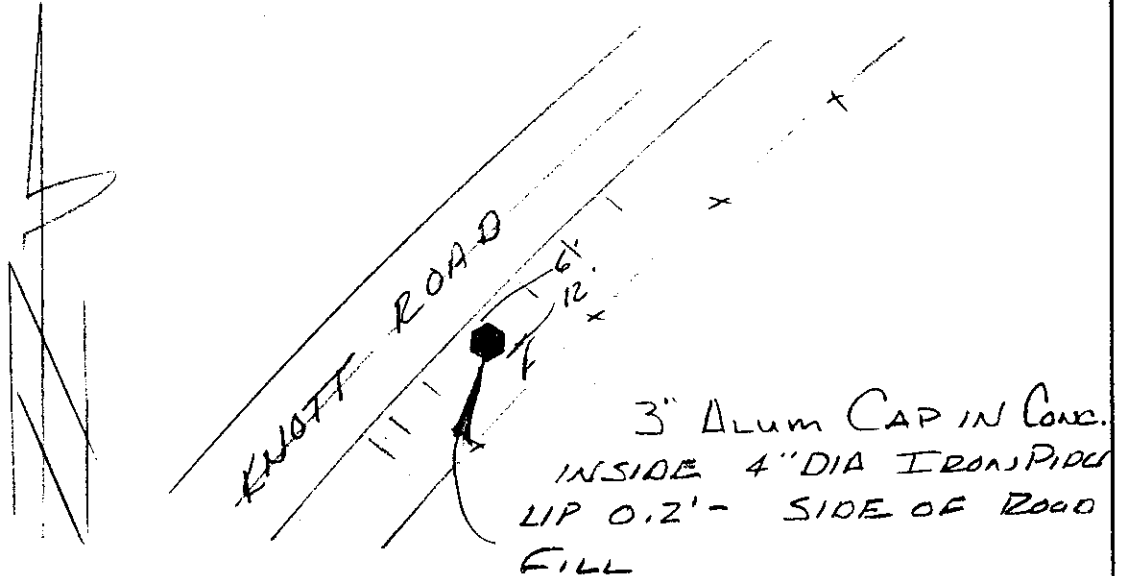
MARK: 18121800 HORIZONTAL ORDER: FIRST

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 44°00'28.450926"  | ONE   |
| Longitude:          | 121°20'38.484268" | SIGMA |
| Northing:           | 367455.1124       | ERROR |
| Easting:            | 3284029.3556      | 0.009 |
| Convergence:        | -0°02'31.7936"    | 0.009 |
| Scale Factor:       | 1.000160291269    |       |
| Ellipsoid Height:   | 3787.5375         | 0.022 |
| Orthometric Height: | 3851.469          | 0.026 |
| Geoid Height:       | -63.9315          |       |

## CONTROL MARK DATA

NAME OF MARK: 18122000 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 20 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC N/A

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETTIC AND MAPPING COORDINATES

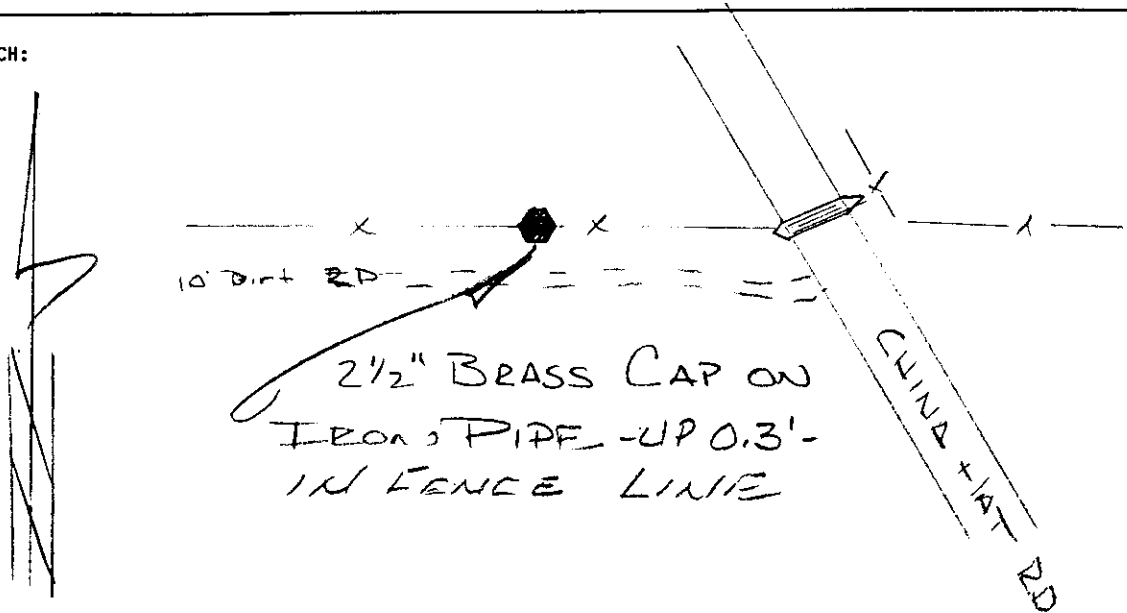
MARK: 18122000 HORIZONTAL ORDER: FIRST

|                     |                   | ONE<br>SIGMA<br>ERROR |
|---------------------|-------------------|-----------------------|
| Latitude:           | 43°59'36.676778"  |                       |
| Longitude:          | 121°19'26.512976" |                       |
| Northing:           | 362208.3099       | 0.007                 |
| Easting:            | 3289287.6867      | 0.007                 |
| Convergence:        | -0°01'41.7646"    |                       |
| Scale Factor:       | 1.000160131044    |                       |
| Ellipsoid Height:   | 3844.8504         | 0.015                 |
| Orthometric Height: | 3908.6636         | 0.017                 |
| Geoid Height:       | -63.8131          |                       |

# CONTROL MARK DATA

NAME OF MARK: 18122840 COUNTY: DESCHUTES  
MARK SET BY: LS 0706 BRUCE W. A. ROGERS STATE: OREGON  
DATE OF MARK: 1975 COUNTRY: U.S.A.  
LOCATION: SECTION 28 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
REFERENCE NUMBER: OCRR 418

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

## GEODETIC AND MAPPING COORDINATES

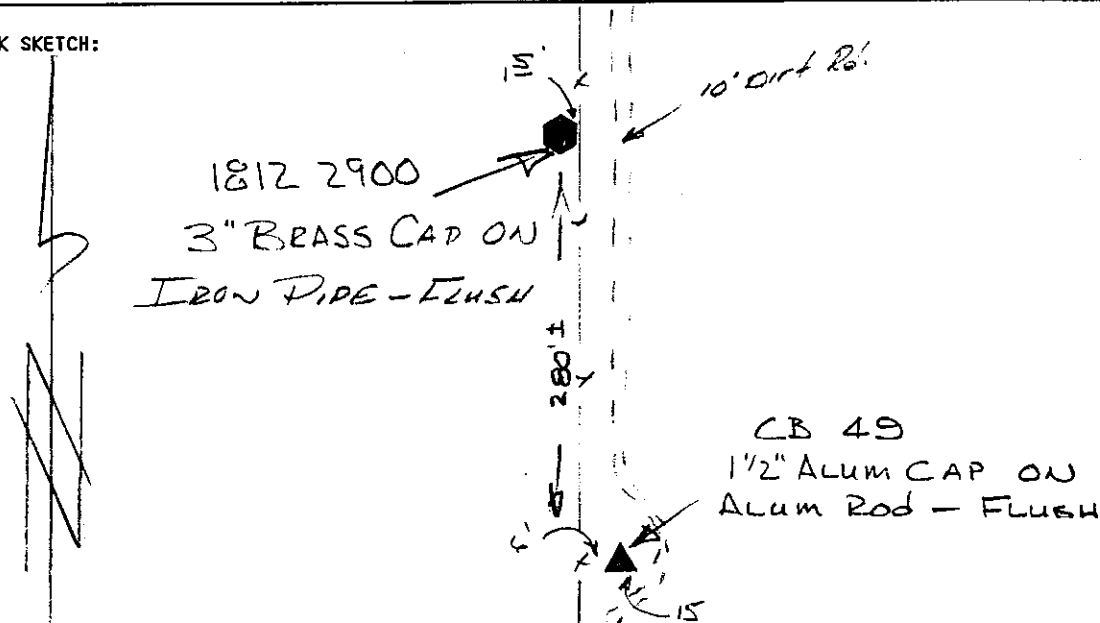
MARK: 18122840 HORIZONTAL ORDER: FIRST

|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 43°59'10.339545"  | ONE SIGMA ERROR |
| Longitude:          | 121°18'15.256349" |                 |
| Northing:           | 359538.9943       | 0.011           |
| Easting:            | 3294496.9474      | 0.007           |
| Convergence:        | -0°00'52.2644"    |                 |
| Scale Factor:       | 1.000160034583    |                 |
| Ellipsoid Height:   | 3893.7431         | 0.022           |
| Orthometric Height: | 3957.473          | 0.026           |
| Geoid Height:       | -63.7298          |                 |

## CONTROL MARK DATA

NAME OF MARK: 18122900 COUNTY: DESCHUTES  
 MARK SET BY: U.S. DEPT. INT. (B L M) STATE: OREGON  
 DATE OF MARK: 1976 COUNTRY: U.S.A.  
 LOCATION: SECTION 29 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: NONE

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETTIC AND MAPPING COORDINATES

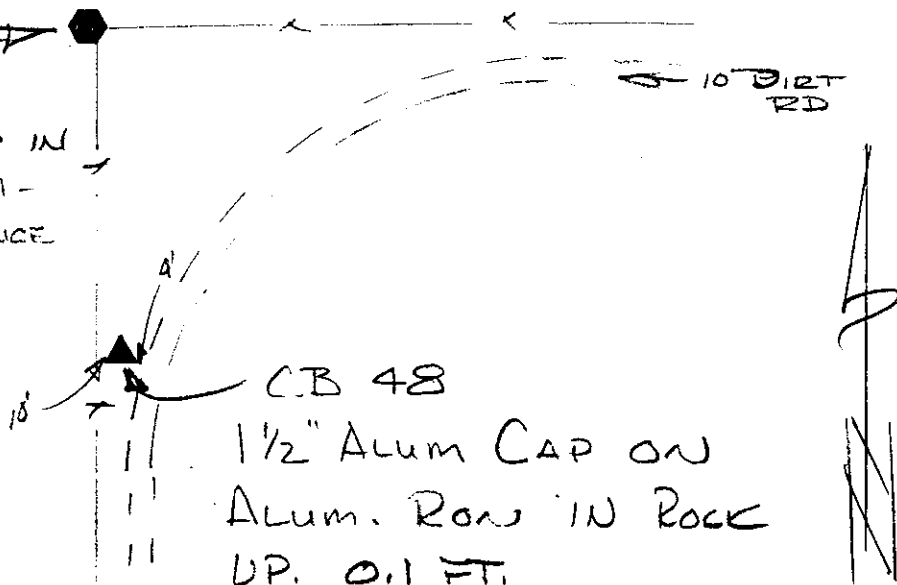
|                       |                                 |                 |
|-----------------------|---------------------------------|-----------------|
| MARK: <u>18122900</u> | HORIZONTAL ORDER: <u>SECOND</u> |                 |
| Latitude:             | 43°58'44.561697"                | ONE SIGMA ERROR |
| Longitude:            | 121°19'27.551295"               |                 |
| Northing:             | 356930.2634                     | 0.015           |
| Easting:              | 3289209.1478                    | 0.016           |
| Convergence:          | -0°01'42.4589"                  |                 |
| Scale Factor:         | 1.000160132973                  |                 |
| Ellipsoid Height:     | 3969.9112                       | 0.025           |
| Orthometric Height:   | 4033.592                        | 0.029           |
| Geoid Height:         | -63.6808                        |                 |

## CONTROL MARK DATA

NAME OF MARK: 18122940 COUNTY: DESCHUTES  
 MARK SET BY: LS 1031 W. C. KAUFFMAN STATE: OREGON  
 DATE OF MARK: 1982 COUNTRY: U.S.A.  
 LOCATION: SECTION 29 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 4062

MARK SKETCH:

1812 2940  
 2" BRASS CAP IN  
 CONK. - FLUSH -  
 0.3' NW FENCE  
 COR.



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

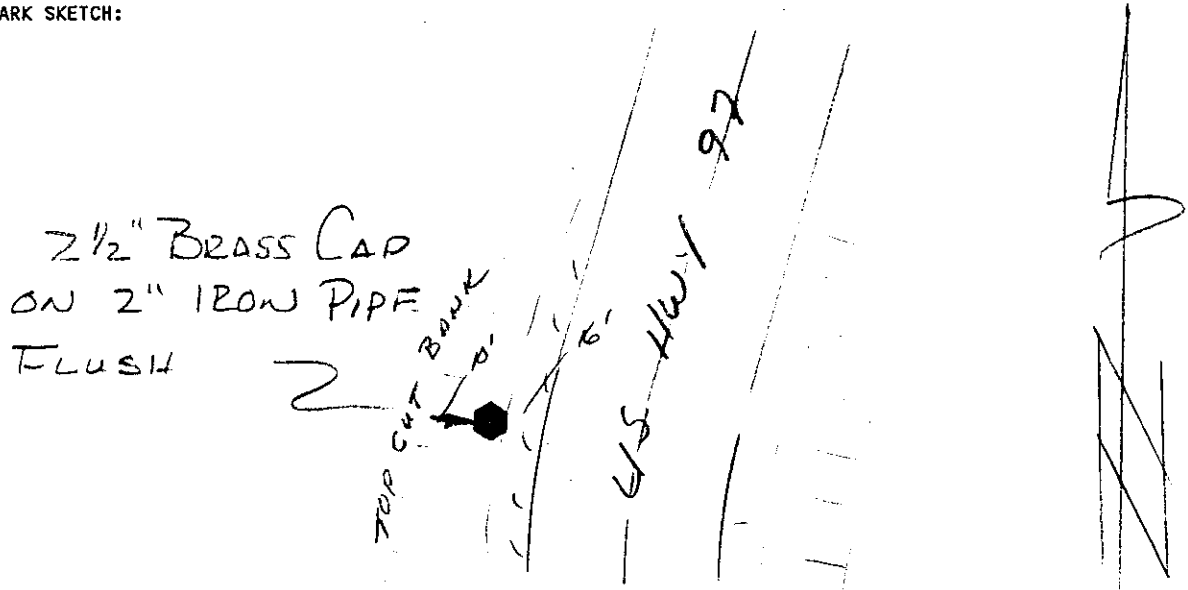
MARK: 18122940 HORIZONTAL ORDER: SECOND

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 43°59'10.635718"  | ONE   |
| Longitude:          | 121°19'27.028983" | SIGMA |
| Northing:           | 359570.954        | ERROR |
| Easting:            | 3289248.6531      | 0.015 |
| Convergence:        | -0°01'42.1096"    | 0.015 |
| Scale Factor:       | 1.000160132001    |       |
| Ellipsoid Height:   | 3900.946          | 0.021 |
| Orthometric Height: | 3964.692          | 0.023 |
| Geoid Height:       | -63.746           |       |

## CONTROL MARK DATA

NAME OF MARK: 18123000 COUNTY: DESCHUTES  
 MARK SET BY: LS 1642 ROBERT KARL STATE: OREGON  
 DATE OF MARK: 1981 COUNTRY: U.S.A.  
 LOCATION: SECTION 30 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 4196

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETTIC AND MAPPING COORDINATES

MARK: 18123000 HORIZONTAL ORDER: FIRST

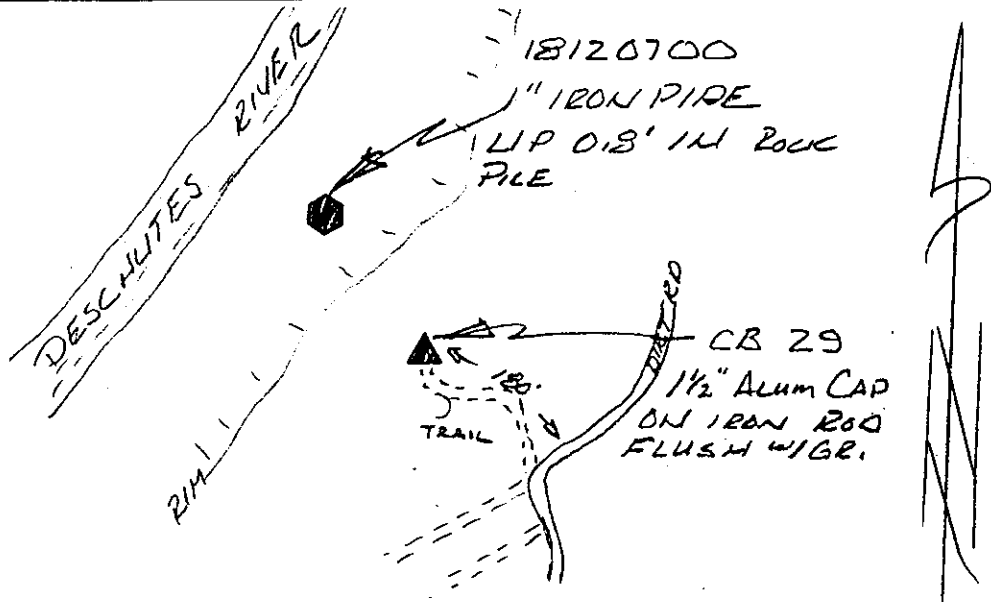
|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 43°58'44.448369"  | ONE   |
| Longitude:          | 121°20'39.750232" | SIGMA |
| Northing:           | 356922.0504       | ERROR |
| Easting:            | 3283929.0225      | 0.008 |
| Convergence:        | -0°02'32.5935"    | 0.009 |
| Scale Factor:       | 1.000160294942    |       |
| Ellipsoid Height:   | 3905.8726         | 0.019 |
| Orthometric Height: | 3969.568          | 0.024 |
| Geoid Height:       | -63.6954          |       |



**CONTROL MARK DATA**

NAME OF MARK: CB29 COUNTY: DESCHUTES  
MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
DATE OF MARK: 1993 COUNTRY: U.S.A.  
LOCATION: SECTION 13 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

**GEODETIC AND MAPPING COORDINATES**

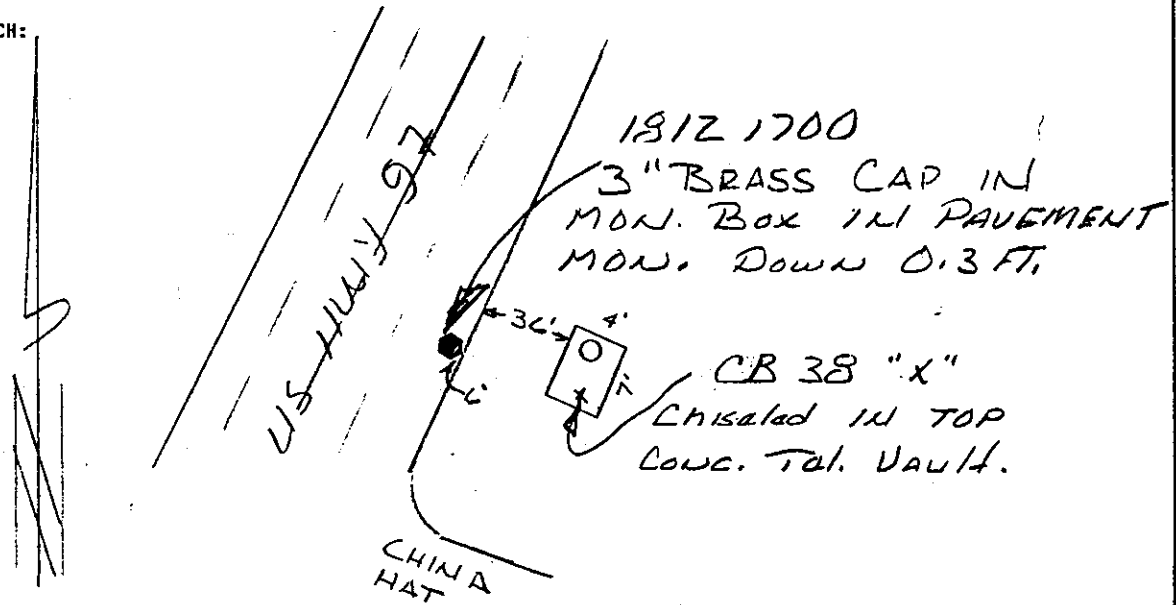
MARK: CB29 HORIZONTAL ORDER: FIRST

|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 44°01'18.816799"  | ONE SIGMA ERROR |
| Longitude:          | 121°20'37.976093" |                 |
| Northing:           | 372556.0394       | 0.008           |
| Easting:            | 3284070.2475      | 0.008           |
| Convergence:        | -0°02'31.4789"    |                 |
| Scale Factor:       | 1.000160289778    |                 |
| Ellipsoid Height:   | 3784.9741         | 0.020           |
| Orthometric Height: | 3849.0172         | 0.023           |
| Geoid Height:       | -64.0431          |                 |

## CONTROL MARK DATA

NAME OF MARK: CB38 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 17 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

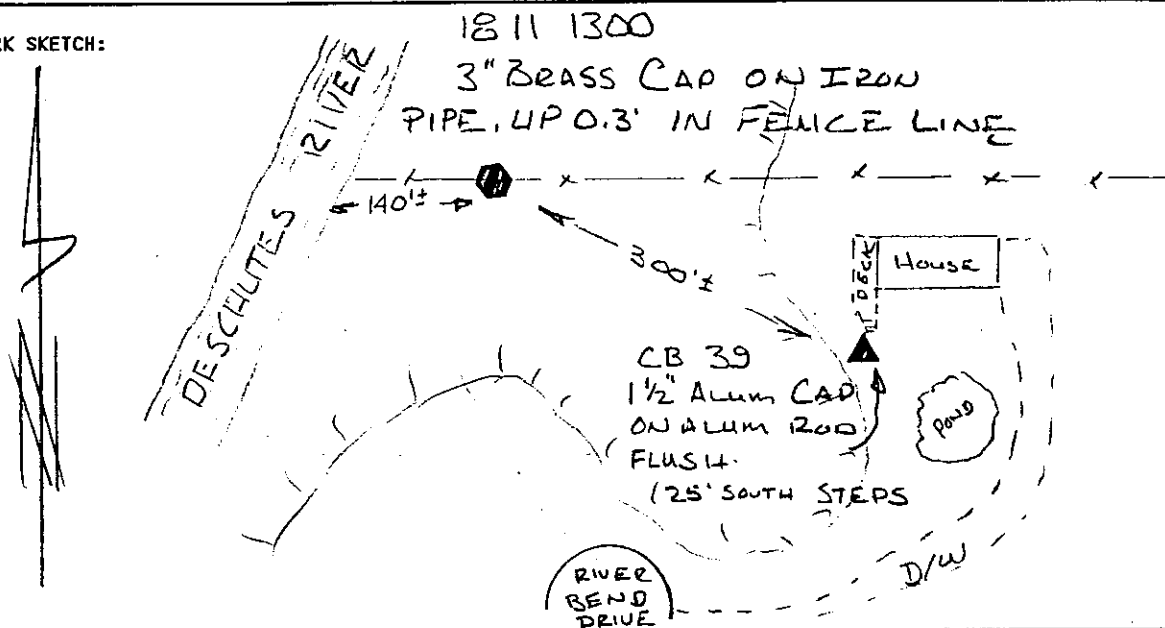
### GEODETIC AND MAPPING COORDINATES

|                          |                                |                 |
|--------------------------|--------------------------------|-----------------|
| <u>MARK:</u> <u>CB38</u> | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:                | 44°00'28.665541"               | ONE SIGMA ERROR |
| Longitude:               | 121°19'24.643072"              |                 |
| Northing:                | 367473.5472                    | 0.006           |
| Easting:                 | 3289426.9699                   | 0.006           |
| Convergence:             | -0°01'40.4920"                 |                 |
| Scale Factor:            | 1.000160127658                 |                 |
| Ellipsoid Height:        | 3783.4821                      | 0.013           |
| Orthometric Height:      | 3847.412                       | 0.015           |
| Geoid Height:            | -63.9299                       |                 |

## CONTROL MARK DATA

NAME OF MARK: CB39 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 13 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

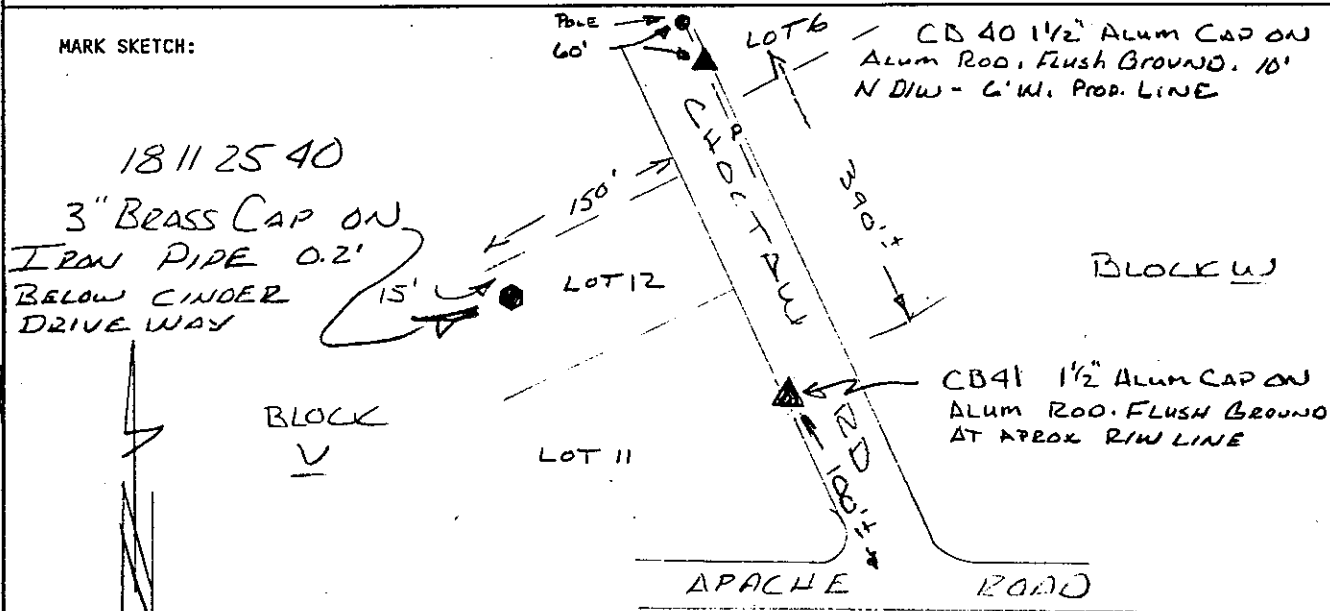
MARK: CB39 HORIZONTAL ORDER: FIRST

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 44°00'27.572706"  | ONE   |
| Longitude:          | 121°21'47.801694" | SIGMA |
| Northing:           | 367370.4884       | ERROR |
| Easting:            | 3278962.3417      | 0.010 |
| Convergence:        | -0°03'19.9516"    | 0.009 |
| Scale Factor:       | 1.000160505410    |       |
| Ellipsoid Height:   | 3819.7915         | 0.022 |
| Orthometric Height: | 3883.6865         | 0.026 |
| Geoid Height:       | -63.895           |       |

## CONTROL MARK DATA

NAME OF MARK: CB40 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 25 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

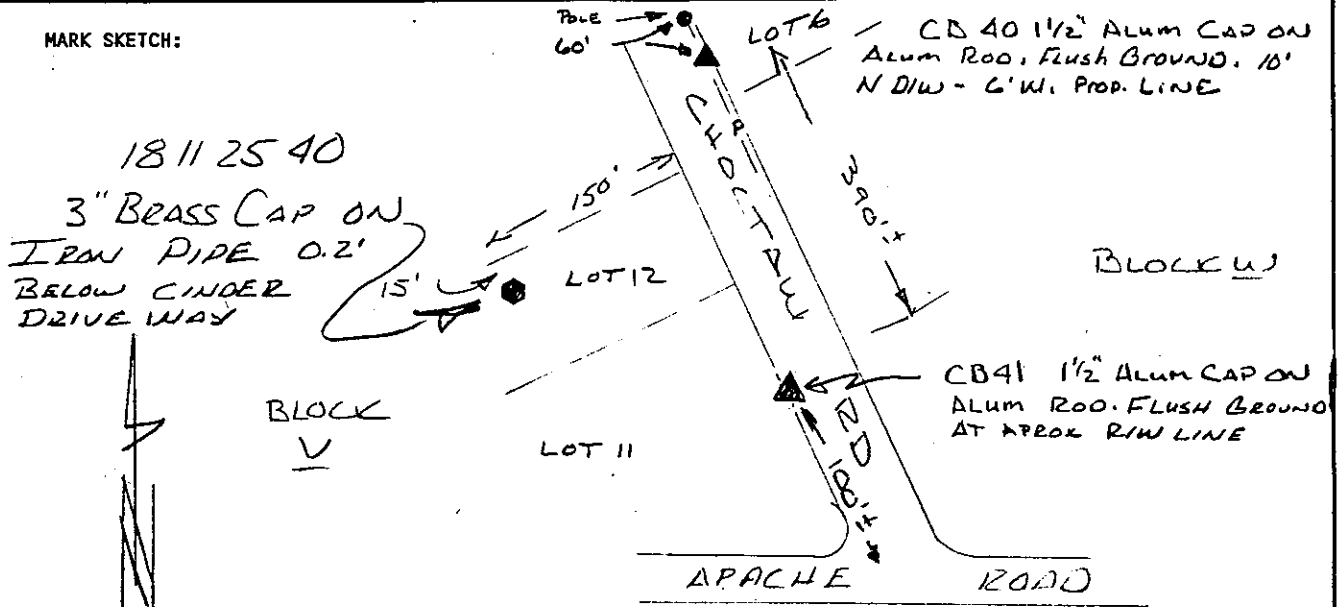
### GEODETTIC AND MAPPING COORDINATES

|                     |                                |                 |
|---------------------|--------------------------------|-----------------|
| MARK: <u>CB40</u>   | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:           | 43°59'12.630765"               | ONE SIGMA ERROR |
| Longitude:          | 121°21'50.455618"              |                 |
| Northing:           | 359780.7316                    | 0.012           |
| Easting:            | 3278760.9217                   | 0.014           |
| Convergence:        | -0°03'21.7195"                 |                 |
| Scale Factor:       | 1.000160515136                 |                 |
| Ellipsoid Height:   | 3864.83                        | 0.029           |
| Orthometric Height: | 3928.5599                      | 0.034           |
| Geoid Height:       | -63.7299                       |                 |

## CONTROL MARK DATA

NAME OF MARK: CB41 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 25 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

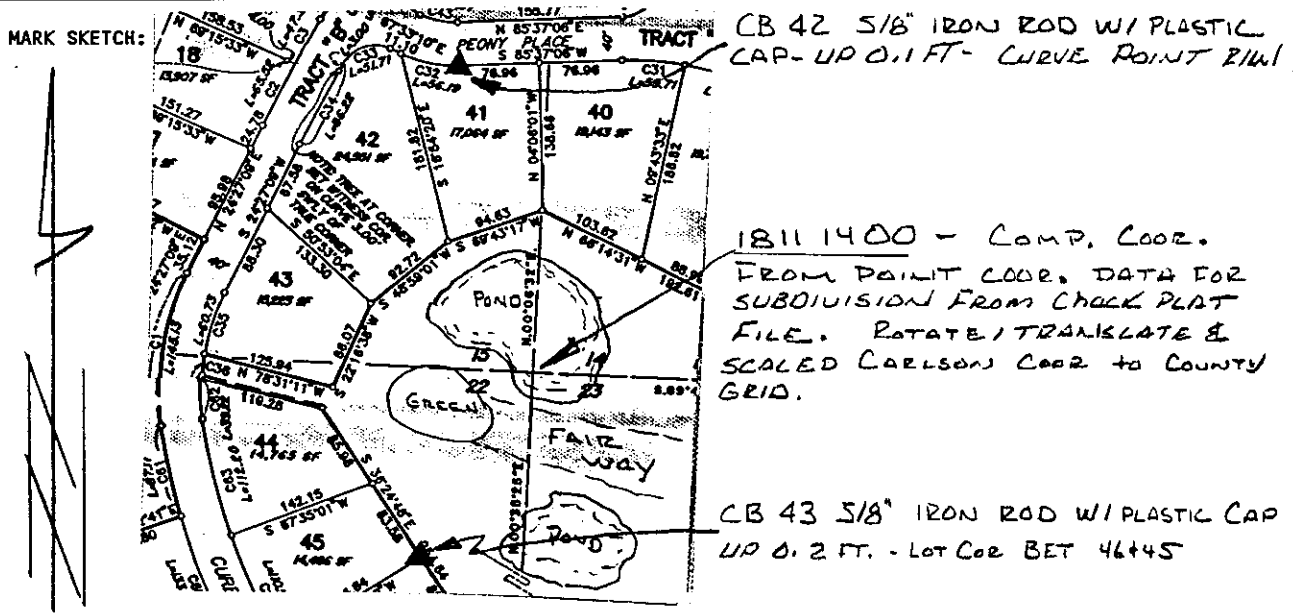
### GEODETIC AND MAPPING COORDINATES

MARK: CB41 HORIZONTAL ORDER: FIRST

|                     |                   |              |
|---------------------|-------------------|--------------|
| Latitude:           | 43°59'08.977761"  | ONE<br>SIGMA |
| Longitude:          | 121°21'48.795621" | ERROR        |
| Northing:           | 359410.6462       | 0.014        |
| Easting:            | 3278881.9464      | 0.016        |
| Convergence:        | -0°03'20.5630"    |              |
| Scale Factor:       | 1.000160509283    |              |
| Ellipsoid Height:   | 3872.0105         | 0.034        |
| Orthometric Height: | 3935.7334         | 0.038        |
| Geoid Height:       | -63.7229          |              |

## CONTROL MARK DATA

NAME OF MARK: CB42 COUNTY: DESCHUTES  
 MARK SET BY: LS 2044 JOHN CARLSON STATE: OREGON  
 DATE OF MARK: 1990 COUNTRY: U.S.A.  
 LOCATION: SECTION 15 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 9717



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993

FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

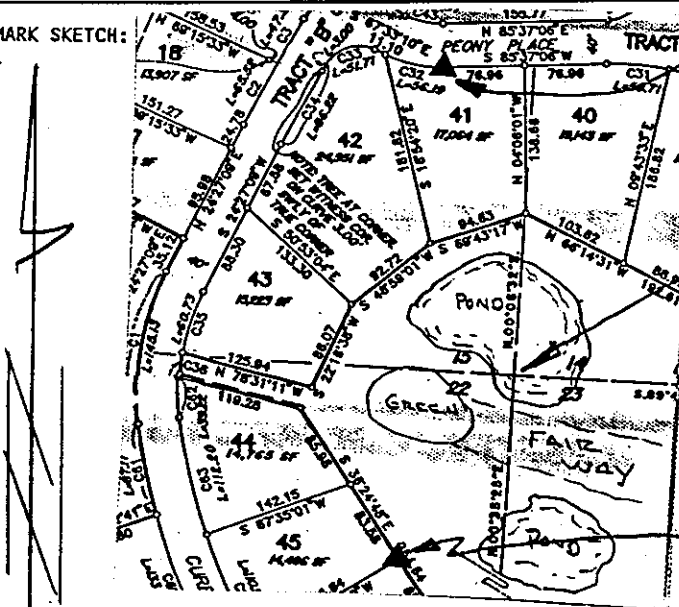
### GEODETIC AND MAPPING COORDINATES

|                          |                                       |                 |
|--------------------------|---------------------------------------|-----------------|
| <u>MARK:</u> <u>CB42</u> | <u>HORIZONTAL ORDER:</u> <u>FIRST</u> |                 |
| Latitude:                | 44°00'31.277731"                      | ONE SIGMA ERROR |
| Longitude:               | 121°23'04.612573"                     |                 |
| Northing:                | 367751.8947                           | 0.013           |
| Easting:                 | 3273348.0994                          | 0.011           |
| Convergence:             | -0°04'13.3211"                        |                 |
| Scale Factor:            | 1.000160811158                        |                 |
| Ellipsoid Height:        | 3868.024                              | 0.027           |
| Orthometric Height:      | 3931.865                              | 0.032           |
| Geoid Height:            | -63.841                               |                 |

## CONTROL MARK DATA

NAME OF MARK: CB43 COUNTY: DESCHUTES  
 MARK SET BY: LS 2044 JOHN CARLSON STATE: OREGON  
 DATE OF MARK: 1990 COUNTRY: U.S.A.  
 LOCATION: SECTION 22 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 9717

MARK SKETCH:



CB 42 5/8" IRON ROD W/ PLASTIC CAP - UP 0.1 FT - CURVE POINT 2141

18111400 - Comp. Coord.  
 FROM PAINT CODE. DATA FOR SUBDIVISION FROM CHECK PLAT FILE. ROTATE / TRANSLATE & SCALED CARLSON COOR TO COUNTY GRID.

CB 43 5/8" IRON ROD W/ PLASTIC CAP UP 0.2 FT. - Lot Cor BET 4645

DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

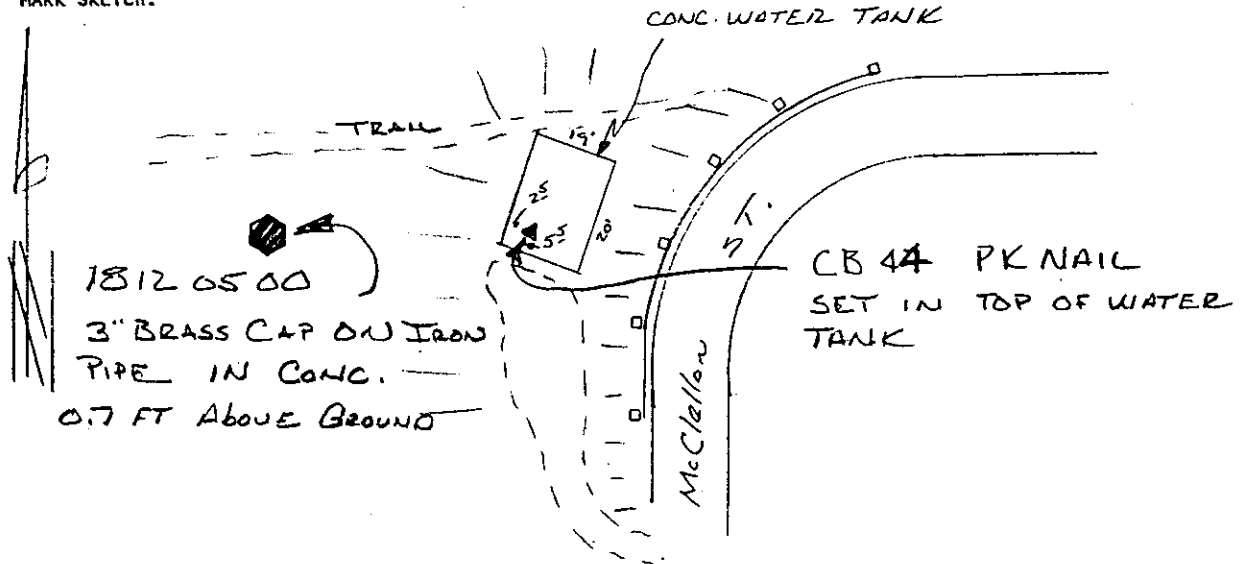
### GEODETTIC AND MAPPING COORDINATES

|                     |                                |                 |
|---------------------|--------------------------------|-----------------|
| MARK: <u>CB43</u>   | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:           | 44°00'26.726387"               | ONE SIGMA ERROR |
| Longitude:          | 121°23'04.772540"              |                 |
| Northing:           | 367290.9586                    | 0.012           |
| Easting:            | 3273335.84                     | 0.010           |
| Convergence:        | -0°04'13.4264"                 |                 |
| Scale Factor:       | 1.000160811904                 |                 |
| Ellipsoid Height:   | 3863.6038                      | 0.025           |
| Orthometric Height: | 3927.4349                      | 0.030           |
| Geoid Height:       | -63.8311                       |                 |

## CONTROL MARK DATA

NAME OF MARK: CB44 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 5 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

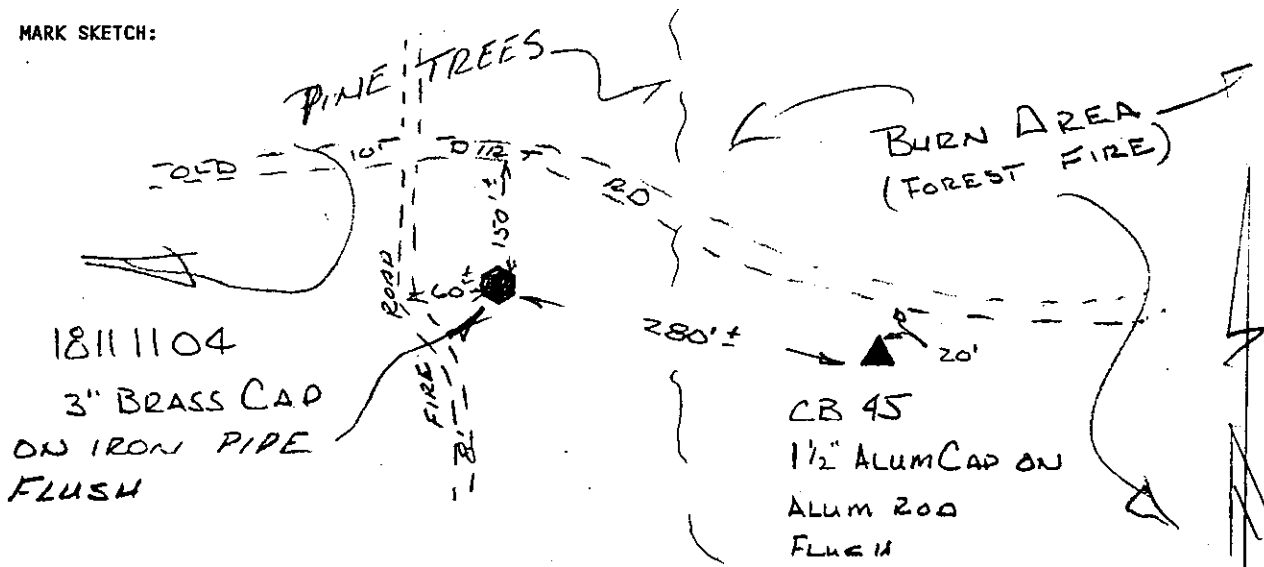
|                     |                                |                 |
|---------------------|--------------------------------|-----------------|
| MARK: <u>CB44</u>   | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:           | 44°02'13.033464"               | ONE SIGMA ERROR |
| Longitude:          | 121°19'23.360251"              |                 |
| Northing:           | 378043.6891                    | 0.008           |
| Easting:            | 3289525.8462                   | 0.008           |
| Convergence:        | -0°01'39.6529"                 |                 |
| Scale Factor:       | 1.000160125281                 |                 |
| Ellipsoid Height:   | 3626.15                        | 0.020           |
| Orthometric Height: | 3690.3227                      | 0.022           |
| Geoid Height:       | -64.1726                       |                 |



## CONTROL MARK DATA

NAME OF MARK: CB45 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 14 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

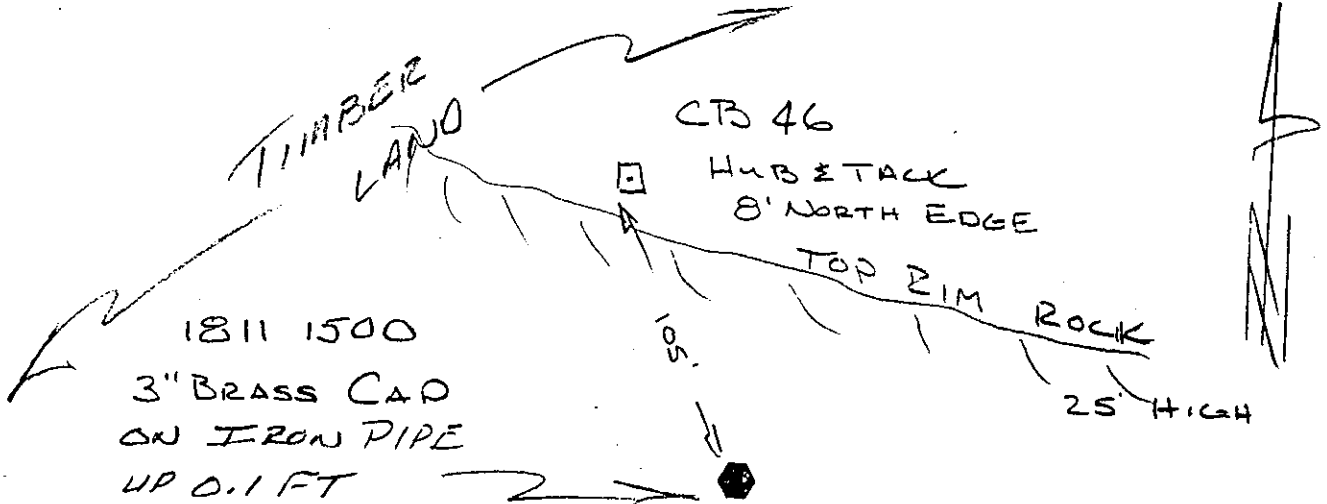
### GEODETIC AND MAPPING COORDINATES

|                     |                                |       |
|---------------------|--------------------------------|-------|
| <u>MARK: CB45</u>   | <u>HORIZONTAL ORDER: FIRST</u> |       |
| Latitude:           | 44°01'20.641245"               | ONE   |
| Longitude:          | 121°22'22.728739"              | SIGMA |
| Northing:           | 372747.7888                    | ERROR |
| Easting:            | 3276415.0962                   | 0.008 |
| Convergence:        | -0°03'44.2771"                 | 0.008 |
| Scale Factor:       | 1.000160635207                 |       |
| Ellipsoid Height:   | 3905.7669                      | 0.017 |
| Orthometric Height: | 3969.7517                      | 0.018 |
| Geoid Height:       | -63.9848                       |       |

## CONTROL MARK DATA

NAME OF MARK: CB46 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 15 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

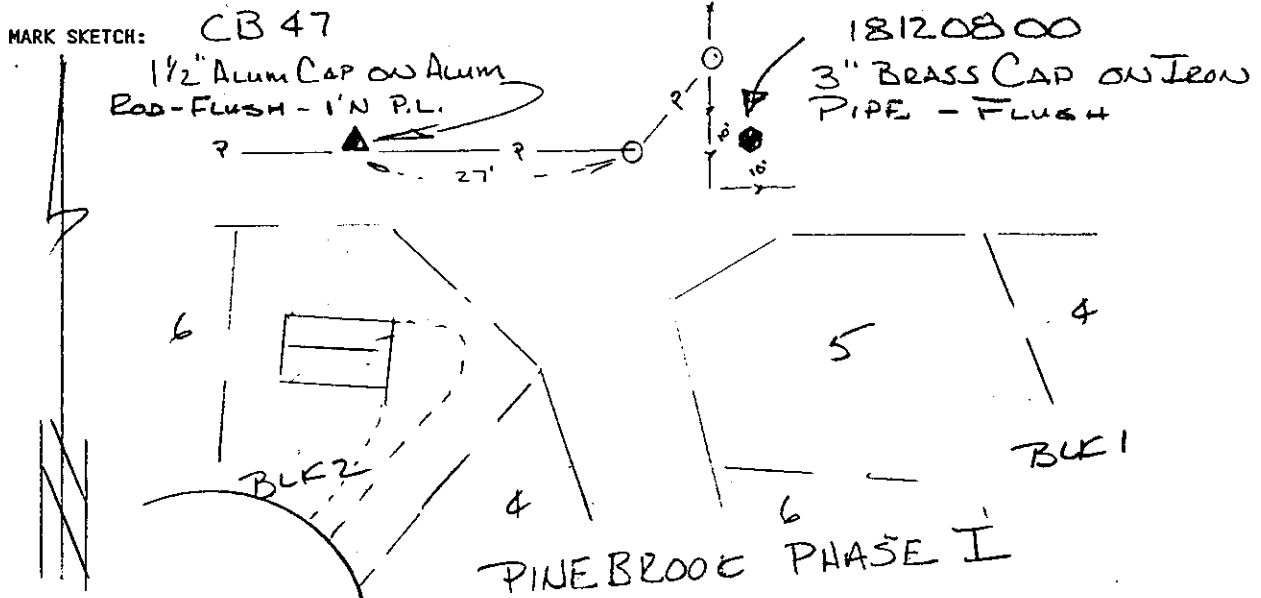
DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETTIC AND MAPPING COORDINATES

|                     |                                |                 |
|---------------------|--------------------------------|-----------------|
| MARK: <u>CB46</u>   | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:           | 44°00'29.469183"               | ONE SIGMA ERROR |
| Longitude:          | 121°24'17.036751"              |                 |
| Northing:           | 367575.8762                    | 0.012           |
| Easting:            | 3268053.876                    | 0.010           |
| Convergence:        | -0°05'03.6364"                 |                 |
| Scale Factor:       | 1.000161165428                 |                 |
| Ellipsoid Height:   | 4049.1786                      | 0.025           |
| Orthometric Height: | 4112.9224                      | 0.032           |
| Geoid Height:       | -63.7439                       |                 |

## CONTROL MARK DATA

NAME OF MARK: CB47 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 7 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

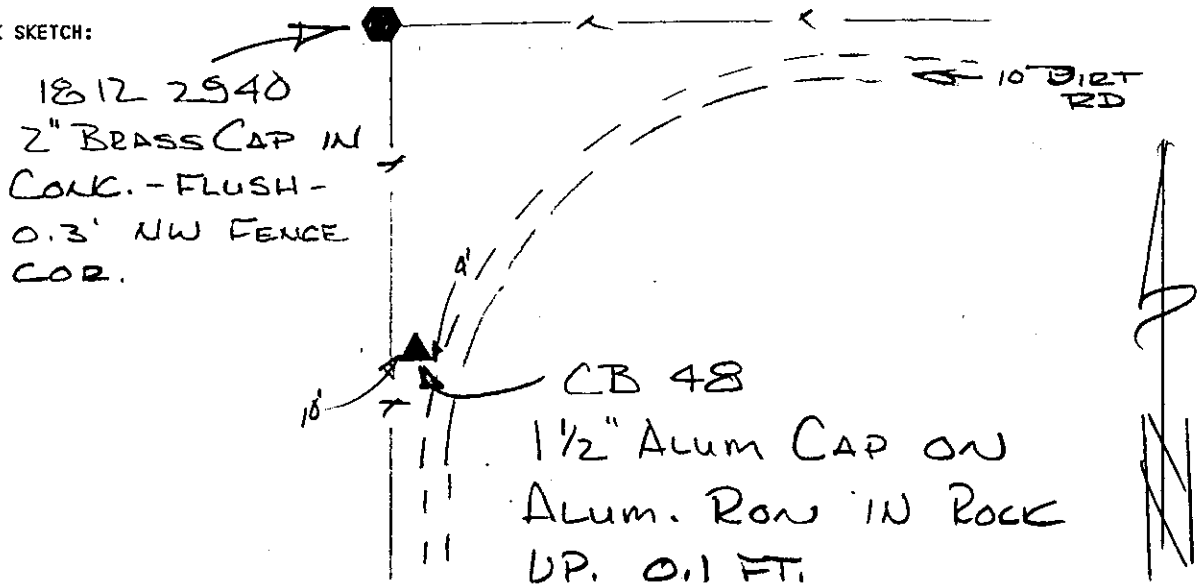
### GEODETTIC AND MAPPING COORDINATES

|                     |                                |                 |
|---------------------|--------------------------------|-----------------|
| MARK: <u>CB47</u>   | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:           | 44°01'20.944760"               | ONE SIGMA ERROR |
| Longitude:          | 121°19'26.159394"              |                 |
| Northing:           | 372768.3359                    | 0.006           |
| Easting:            | 3289318.7377                   | 0.006           |
| Convergence:        | -0°01'41.5721"                 |                 |
| Scale Factor:       | 1.000160130284                 |                 |
| Ellipsoid Height:   | 3756.7667                      | 0.016           |
| Orthometric Height: | 3820.8166                      | 0.018           |
| Geoid Height:       | -64.0499                       |                 |

## CONTROL MARK DATA

NAME OF MARK: CB48 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 29 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

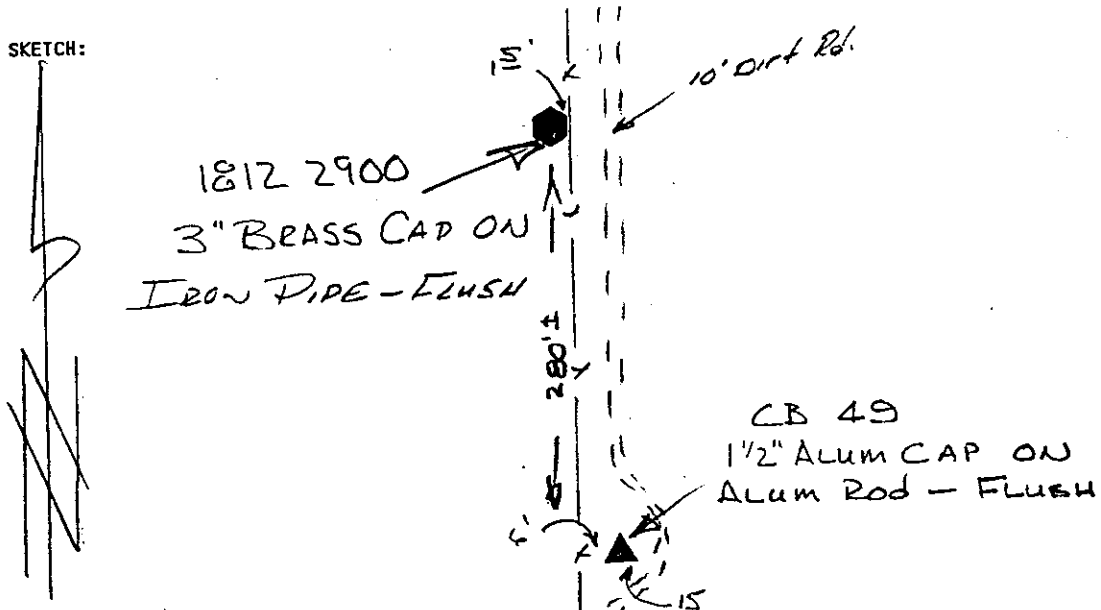
### GEODETTIC AND MAPPING COORDINATES

|                     |                                |                 |
|---------------------|--------------------------------|-----------------|
| MARK: <u>CB48</u>   | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:           | 43°59'08.344113"               | ONE SIGMA ERROR |
| Longitude:          | 121°19'26.965714"              |                 |
| Northing:           | 359338.8636                    | 0.007           |
| Easting:            | 3289253.1648                   | 0.006           |
| Convergence:        | -0°01'42.0645"                 |                 |
| Scale Factor:       | 1.000160131890                 |                 |
| Ellipsoid Height:   | 3911.1237                      | 0.015           |
| Orthometric Height: | 3974.8691                      | 0.019           |
| Geoid Height:       | -63.7454                       |                 |

## CONTROL MARK DATA

NAME OF MARK: CB49 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 32 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETIC AND MAPPING COORDINATES

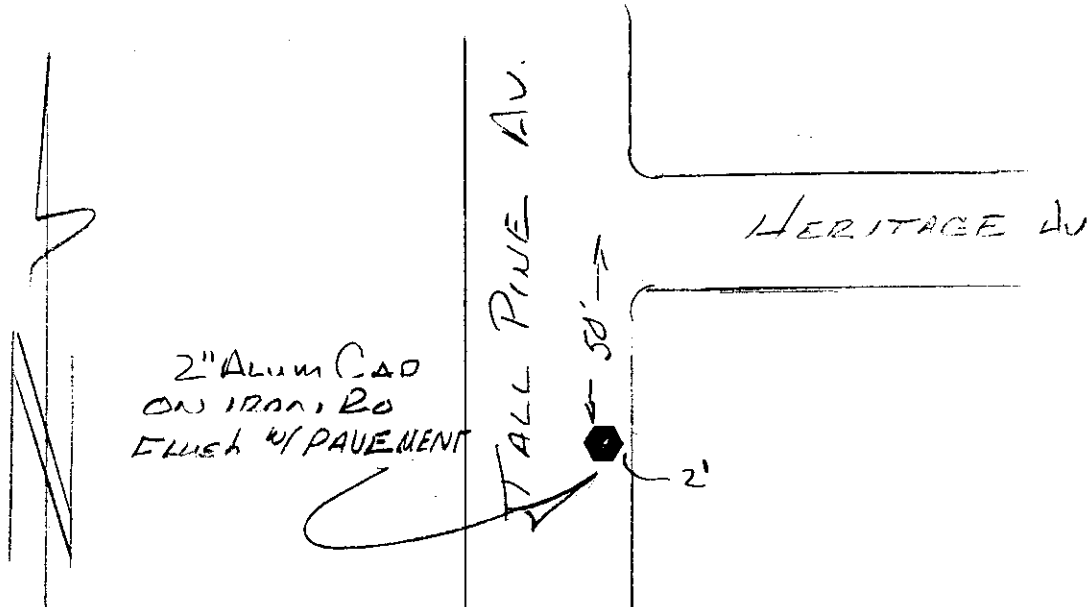
MARK: CB49 HORIZONTAL ORDER: FIRST

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 43°58'41.801850"  | ONE   |
| Longitude:          | 121°19'27.516325" | SIGMA |
| Northing:           | 356650.7522       | ERROR |
| Easting:            | 3289211.5664      | 0.007 |
| Convergence:        | -0°01'42.4332"    | 0.009 |
| Scale Factor:       | 1.000160132913    |       |
| Ellipsoid Height:   | 3985.1973         | 0.021 |
| Orthometric Height: | 4048.8773         | 0.025 |
| Geoid Height:       | -63.68            |       |

**CONTROL MARK DATA**

NAME OF MARK: CB50 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 29 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS  
 DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

**GEODETTIC AND MAPPING COORDINATES**

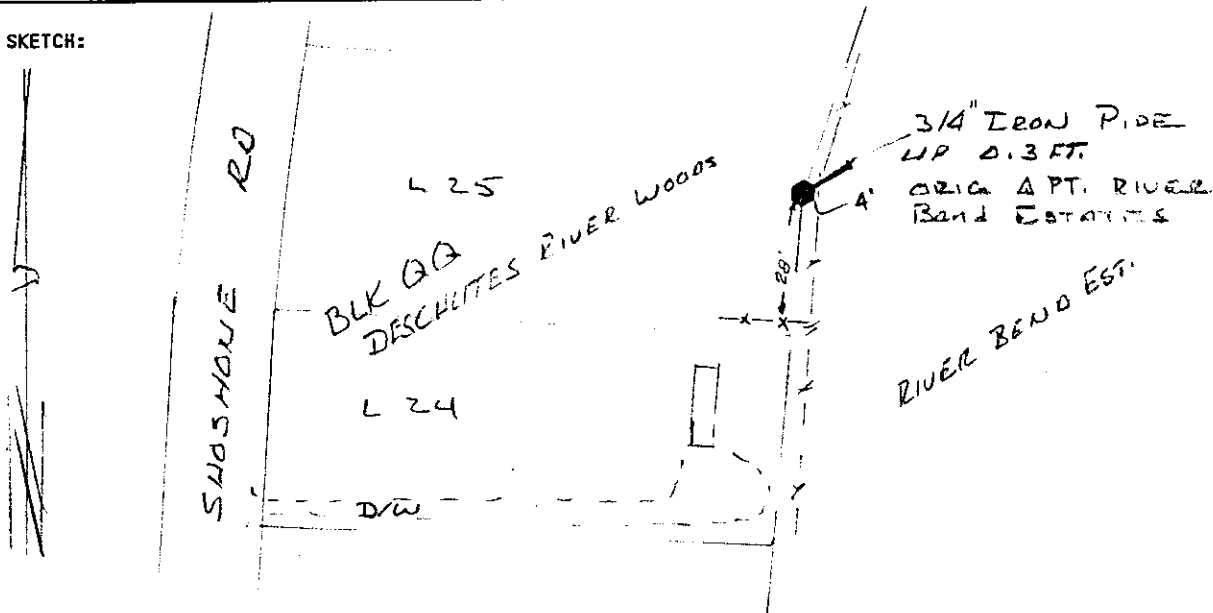
MARK: CB50 HORIZONTAL ORDER: FIRST

|                     |                   |       |
|---------------------|-------------------|-------|
| Latitude:           | 43°59'33.728164"  | ONE   |
| Longitude:          | 121°18'19.101453" | SIGMA |
|                     |                   | ERROR |
| Northing:           | 361907.8091       | 0.008 |
| Easting:            | 3294216.4085      | 0.007 |
| Convergence:        | -0°00'54.9412"    |       |
| Scale Factor:       | 1.000160038198    |       |
| Ellipsoid Height:   | 3885.3674         | 0.017 |
| Orthometric Height: | 3949.1558         | 0.021 |
| Geoid Height:       | -63.7884          |       |

## CONTROL MARK DATA

NAME OF MARK: DRW1 COUNTY: DESCHUTES  
 MARK SET BY: PE 2222 ARTHUR SHERMAN STATE: OREGON  
 DATE OF MARK: 1963 COUNTRY: U.S.A.  
 LOCATION: SECTION 24 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 9305

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

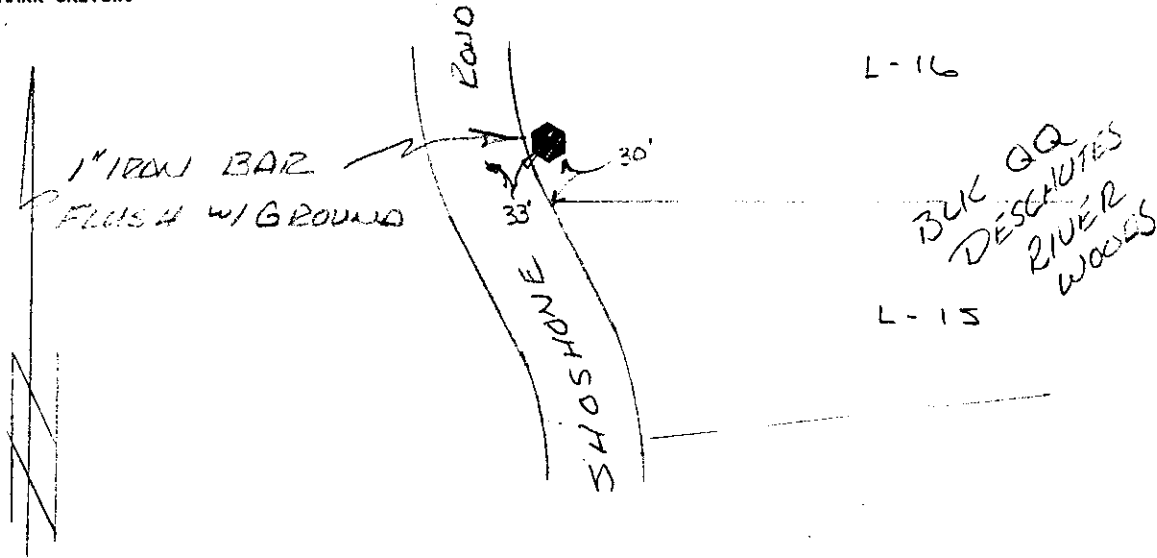
### GEODETIC AND MAPPING COORDINATES

|                     |                                |                 |
|---------------------|--------------------------------|-----------------|
| MARK: <u>DRW1</u>   | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:           | <u>43°59'48.768092"</u>        | ONE SIGMA ERROR |
| Longitude:          | <u>121°21'46.122402"</u>       |                 |
| Northing:           | <u>363440.3251</u>             | <u>0.014</u>    |
| Easting:            | <u>3279081.307</u>             | <u>0.014</u>    |
| Convergence:        | <u>-0°03'18.7462"</u>          |                 |
| Scale Factor:       | <u>1.000160499711</u>          |                 |
| Ellipsoid Height:   | <u>3835.0789</u>               | <u>0.030</u>    |
| Orthometric Height: | <u>3898.8905</u>               | <u>0.034</u>    |
| Geoid Height:       | <u>-63.8116</u>                |                 |

## CONTROL MARK DATA

NAME OF MARK: DRW2 COUNTY: DESCHUTES  
 MARK SET BY: DESCHUTES CO. SURVEYOR STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 1 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: DGMC 11

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

|   |   |
|---|---|
| DATUM: HORIZONTAL= <u>NAD (83-91)</u><br>VERTICAL= <u>NGVD 29</u> | CENTRAL MERIDIAN: <u>W 121°17'00.000000"</u><br>LATITUDE OF ORIGIN: <u>N 43°00'00.000000"</u> |
| COORDINATE SYSTEM: <u>TRANSVERSE MERCATOR</u>                     | ORIGIN NORTHING: <u>0.0000 F</u>  |
| ZONE: <u>DESCHUTES COUNTY</u>                                     | ORIGIN EASTING: <u>3,300,000.0000 F</u>   |
| LINEAR UNITS: <u>INTERNATIONAL FOOT</u>                           | SCALE ALONG MERIDIAN: <u>1.000160000000</u>   |

### GEODETTIC AND MAPPING COORDINATES

MARK: DRW2 HORIZONTAL ORDER: FIRST

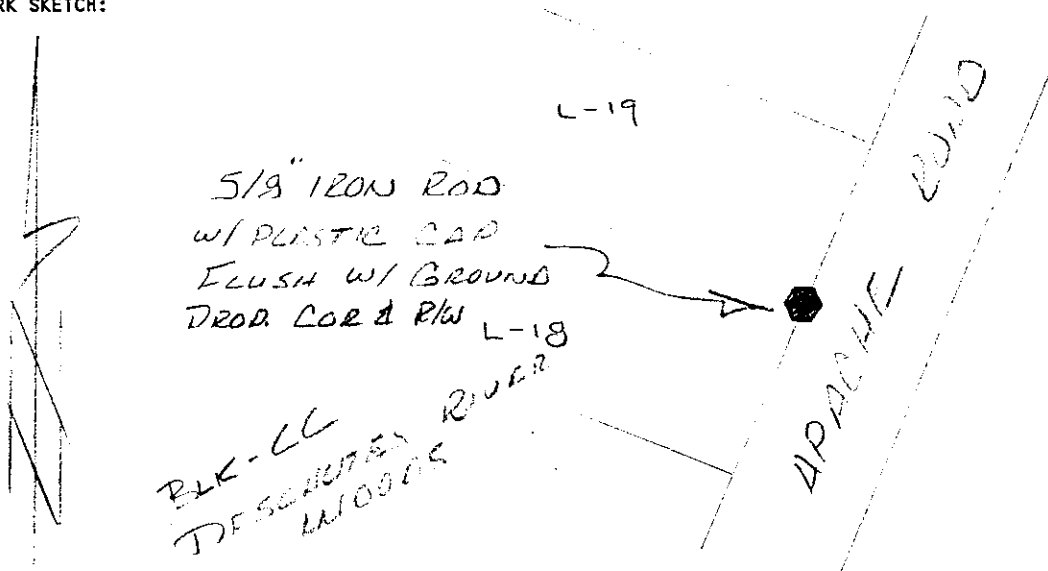
|                     |                   |                 |
|---------------------|-------------------|-----------------|
| Latitude:           | 43°59'40.002878"  | ONE SIGMA ERROR |
| Longitude:          | 121°21'51.987808" |                 |
| Northing:           | 362553.0223       | 0.011           |
| Easting:            | 3278651.6085      | 0.011           |
| Convergence:        | -0°03'22.8115"    |                 |
| Scale Factor:       | 1.000160520452    |                 |
| Ellipsoid Height:   | 3838.3147         | 0.024           |
| Orthometric Height: | 3902.1034         | 0.029           |
| Geoid Height:       | -63.7887          |                 |



## CONTROL MARK DATA

NAME OF MARK: DRW3 COUNTY: DESCHUTES  
 MARK SET BY: LS 2208 GARY DEJARNATT STATE: OREGON  
 DATE OF MARK: 1993 COUNTRY: U.S.A.  
 LOCATION: SECTION 1 TOWNSHIP 18 S. RANGE 11 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 11430

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

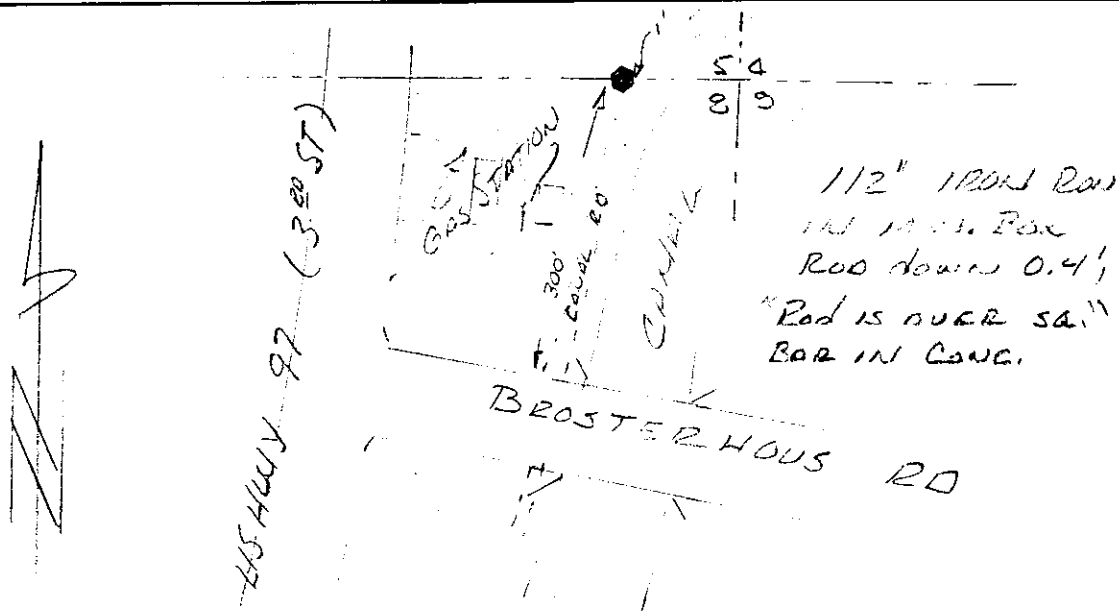
### GEODETIC AND MAPPING COORDINATES

|                     |                                |                 |
|---------------------|--------------------------------|-----------------|
| MARK: <u>DRW3</u>   | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:           | 43°59'36.518877"               | ONE SIGMA ERROR |
| Longitude:          | 121°20'33.276183"              |                 |
| Northing:           | 362195.2751                    | 0.008           |
| Easting:            | 3284406.2755                   | 0.008           |
| Convergence:        | -0°02'28.1366"                 |                 |
| Scale Factor:       | 1.000160277683                 |                 |
| Ellipsoid Height:   | 3867.3087                      | 0.019           |
| Orthometric Height: | 3931.1282                      | 0.022           |
| Geoid Height:       | -63.8195                       |                 |

## CONTROL MARK DATA

NAME OF MARK: JOHN COUNTY: DESCHUTES  
 MARK SET BY: LS 1046 MICHAEL TYE STATE: OREGON  
 DATE OF MARK: 1987 COUNTRY: U.S.A.  
 LOCATION: SECTION 5 TOWNSHIP 18 S. RANGE 12 E. MERIDIAN: WILLAMETTE  
 REFERENCE NUMBER: CS 10335

MARK SKETCH:



DATA COMPUTED BY: DESCHUTES COUNTY SURVEYOR'S OFFICE DATE: 1993  
 FIELD METHOD: GPS FIELD EQUIPMENT: TRIMBLE 4000ST ADJUSTED WITH: TRIMNET PLUS

DATUM: HORIZONTAL= NAD (83-91) CENTRAL MERIDIAN: W 121°17'00.000000"  
 VERTICAL= NGVD 29 LATITUDE OF ORIGIN: N 43°00'00.000000"  
 COORDINATE SYSTEM: TRANSVERSE MERCATOR ORIGIN NORTHING: 0.0000 F  
 ZONE: DESCHUTES COUNTY ORIGIN EASTING: 3,300,000.0000 F  
 LINEAR UNITS: INTERNATIONAL FOOT SCALE ALONG MERIDIAN: 1.000160000000

### GEODETTIC AND MAPPING COORDINATES

|                     |                                |                 |
|---------------------|--------------------------------|-----------------|
| MARK: <u>JOHN</u>   | HORIZONTAL ORDER: <u>FIRST</u> |                 |
| Latitude:           | 44°02'13.316267"               | ONE SIGMA ERROR |
| Longitude:          | 121°18'13.536336"              |                 |
| Northing:           | 378070.4665                    | 0.006           |
| Easting:            | 3294627.3122                   | 0.006           |
| Convergence:        | -0°00'51.1168"                 |                 |
| Scale Factor:       | 1.000160032963                 |                 |
| Ellipsoid Height:   | 3668.6574                      | 0.014           |
| Orthometric Height: | 3732.8355                      | 0.016           |
| Geoid Height:       | -64.1781                       |                 |