

STATE OF ALABAMA
DEPARTMENT OF REVENUE

PROPERTY TAX DIVISION

SPECIFICATIONS FOR PROPERTY OWNERSHIP MAPS
GIS/COMPUTER ASSISTED PROPERTY TAX MAPPING

AND

AERIAL PHOTOGRAPHY

ADV-25

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1 PROPERTY OWNERSHIP MAPPING

1.1 INTRODUCTION

To assess real estate correctly, the assessor must have complete maps of all property in the jurisdiction, updated regularly to show changes in parcel boundaries or other physical characteristics.

Tax maps are an essential tool in the development and maintenance of an equitable assessment system. They are indispensable in inventorying all properties in the county and assuring their inclusion on the tax roll. They are essential for the location and identification of properties to be assessed, and are a requisite for determination of dimensions and area necessary in calculating land valuations.

A tax map, as defined in *The Glossary for Property Appraisal and Assessment*, is “A scale map displaying property ownership boundaries and showing the dimensions of each parcel with related identifiers, survey lines and easements.”

1.2 LAWS AND REGULATIONS

Section 40-7-27 of the 1975 Code of Alabama requires the tax assessor to complete the assessments of property not later than the last Monday in February. For this schedule to be met, the following mapping and appraisal schedule must be complied with:

1. All mapping including name changes, splits, and new subdivisions must be maintained in a current up-to-date status.
2. Deeds and other vesting instruments, including wills and recorded subdivision plats, filed in the probate office should be completely mapped and ready for field review within 30 days after the date the instrument was filed in the probate office or made available to the tax assessor’s office.
3. Mapping for instruments executed between October 1 and September 30 will therefore be completed by October 30. The date of the instrument, that determines the tax year, is the date of signing and not the date it is filed in the Probate Office. In most cases inking can be done in conjunction with the mapping, but in the worst case not later than December 31.
4. The field review and appraisal should begin as soon as the mapping of each vesting instrument is completed. All fieldwork and appraisals should be completed by January 15 for mapping of vesting instruments through the previous September 30.
5. All items, materials and supplies and work products shall be the property of the county governing body. No item, material, data acquired or produced shall be used for any purpose other than fulfillment of mapping requirements unless authorized by the county governing body in writing.

1.3 PARCEL OWNERSHIP

This section describes the method to be utilized for the determination of parcel ownership and boundaries.

1.3.1 Record Research

The cartographer will obtain and use the following materials or documents as required in the maintenance and updating of the ownership maps:

- a. All recorded and unrecorded (when available) vesting instruments that sell, transfer or convey ownership of real property or ownership including wills and trusts.
- b. All newly recorded and unrecorded (when available) subdivisions or re-subdivisions of existing subdivisions and all local surveys.
- c. All right-of-way plans for new roads, railroads, and changes of existing rights-of-ways for all federal, state, county and city streets. During the year the cartographer should contact all the agencies involved to make sure all right-of-way changes and new right-of-way plans have been obtained.
- d. Plats, deeds or aerial photography should be used to map all new rights-of-ways or easements for major transmission lines (oil, gas or electric).
- e. New city annexation information should be obtained and mapped, as it becomes available for the appropriate tax year.

1.3.2 Uniform Parcel Numbering System

The parcel numbering system shall contain seven sets of numbers, each set designed to locate the parcel geographically as well as by ownership map sheet. The numbering system identifies the county, township, area, section, quarter section and/or block in which the parcel is located. The system is completely numerical rather than alphanumeric to facilitate data processing. It is also designed as a system for numbering the ownership map. The description of the seven sets of numbers is as follows:

- a. The County Number is to be the same as that assigned for automobile tags. For example, Autauga County would be 04, Montgomery County would be 03 and Pike County would be 55.
- b. The Township Number is to be the township normally consisting of 36 sections (01-36) in which the parcel is located. Each township within a county will be assigned a number; that is, each township shall be assigned a new number rather than their present reference to township and range. The townships shall be numbered sequentially from east to west and west to east in a serpentine manner within each tier so the easternmost township in the most

northerly tier would be 01. If a township is less or larger than normal size, it is nevertheless numbered in its proper sequence.

- c. The Area Number is the four section area within each township that would comprise a 1" = 400' ownership map sheet. Each township will be broken down into four section areas, two sections high (north-south) by two sections wide (east-west). Normally, there would be nine areas to a township. The areas will be numbered sequentially from east to west and west to east in a serpentine manner as the township above, grouped in four section blocks along tiers two sections high (north-south). The northeasterly group of four sections with a normal 36-section township would be numbered 01 and the southwesterly 09. If a township is less than normal in size or cut by a county boundary, the area will contain the same number that would be normally assigned to it in its location within a 36-section township.
- d. The Section Number is to be the land section in which the parcel is located. Section numbers below 10 should have a "0" in front of the Section number. For example, Section 4 would be shown as 04.
- e. The Quarter Section Number is to be the quarter section in which the parcel is located. These numbers run in a counter-clockwise manner with the northeast quarter being Number 1, northwest quarter Number 2, southwest quarter Number 3, and southeast quarter Number 4. Since there are no numbers in this set higher than four, it is not necessary to use "0" in front of the Quarter Section Number. Quarter Section numbers are to be used only on 1" = 100' and 1" = 50' maps.

In those instances where the Quarter Section Number is not used, the space in the Uniform Parcel Number System will contain one zero.

- f. Map Block For convenience in numbering, each map sheet may be broken into blocks bounded by geographical features such as, roads, streams, railroads, etc.

The block number will be a three-digit number. The first digit shall always remain "0" and block numbers may be assigned up to 099. The exception to this will be when the block number is used to identify improvements on leased property. (See section g.2. on page 10)

The procedure for blocking on the 1" = 50' maps is as follows. The perimeter of the 50' mapping should be bounded by geographical features as in other scales. There is no sub-blocking at this scale. Each map sheet at this scale will constitute a map block. For the 50' sheets within a quarter section, the first digit will be the number assigned to that quarter section. For an example the NE quarter of a section would be 1. As another example, the SE quarter would be 4. The second number would be 0. The third digit in any 50' block number would be the 1/4 section number. In any case, there should be no more than one quarter/quarter section shown on any 50' map sheet.

Regardless of the mapping scale, each map block will contain less than 1,000 parcels. Map blocking will be required on all 200' and 100' scale maps.

Map block numbers, where used, become a part of the Uniform Parcel Number System. All

1" to 200' maps should have the block number in the Uniform Parcel Number. (See parcel-numbering example below) In those instances where map blocking is not used, the space in the Uniform Parcel Number System will contain three zeros.

Example:	Scale	Parcel Number Examples
	400'	43-01-02-10-0-000-001.000
	200'	43-01-02-10-0-001-001.000
	100'	43-01-02-10-2-000-001.000
	50'	43-01-02-10-3-301-001.000

Whenever map blocks are not clear by the use of geographical features, block limits should be used. A recommended method to identify map block limits is by the use of tick limits to outline map block. Another method of identifying map block limits is by the use of a dashed line. For examples and correct line weights to use see Drafting Specifications in Appendix C. Whichever method of identifying map block limits is used it must be identified in legend section of map.

- g. The Parcel Number is the number assigned to the particular parcel. This series identifies individual parcels within a block, quarter section map sheet, or section sheet. The parcel number will be a six-digit number for computer purposes. However, due to lack of space on maps only the digits necessary before the decimal and three digits behind the decimal will be shown on map.

Example:	Computer	Map
	001.000	<u>1</u>
	001.001	<u>1.001</u>
	010.000	<u>10</u>
	010.001	<u>10.001</u>

The parcel number on the map will be underlined. See Appendix M for examples of uniform parcel numbers.

“Splits”/Sell-offs - Where the map has an established parcel number and the owner sells a part of the parcel to another person, the "split" will be assigned the original parcel number from which the land was sold plus the addition of a 3 digit decimal number to identify the split.

Example: Mr. A owns a tract of land and is identified on the ownership map as parcel no. 022.000. He sells ten acres of the parcel to Mr. B. The parcel number assigned to Mr. B to identify the split will be 022.001. The splits of an established mapping parcel will be in numerical sequence.

Condominiums - The tract of land or lot on which a condominium is located will be assigned a basic parcel number. Each condominium owner will be assigned a decimal parcel number in the same manner as a split stated above.

Example: The parcel on which the land and condominium improvement is located will be assigned parcel no. 020.000. Each condominium owner will be assigned a parcel number indicating a split of the parcel. Mr. A, one of the owners of the condominium, will be assigned parcel 020.001 and Mr. B will be assigned parcel no. 020.002 and continued in numerical sequence as stated above.

Improvements on Leased Land - For ease in identifying and locating improvements on leased land the following system is suggested. The uniform parcel number may be modified to a unique system for each improvement located on a parcel. By using the parent parcel number and inserting a different 3-digit number in the 3-digit block space, such as 900, would indicate that this is an improvement on leased property. The 6-digit parcel number would also be changed the same as if the improvement were a split or sell-off. The PRC with the improvement could then be filed in the same numerical order. By using this type system those counties on computer systems would be able to have the computer print out a listing of improvements on leased property.

County Locator - The county boundary map will be shown under the space designed for county locator. The map will show all townships within the county and the number of such township assigned under these specifications. The actual geographical townships and range numbers will be shown outside the perimeter of the county boundary map.

Ownership Map Numbering System - Map numbering system as follows: The map number will follow identical with the uniform parcel numbering system. For example, the map number for the area involving 1" = 400' mapping will be the County Number, the Township Number and the Area Number. The map number for the area covered at 1" = 200' will be the County Number, the Township Number, the Area Number and the Section Number. The map covering the area mapped at 1" = 100' will be numbered as the County Number, Township Number, Area Number, Section Number and Quarter Section Number. The map covering 1" = 50' will be numbered in the same manner involving the County Number, Township Number, Area Number, Section Number, Quarter Section Number and Block Number.

Uniform Ownership Map Number

	CO.#	TWP.#	AREA#	SEC.#	1/4SEC.#	BLK.#
1" = 400'	43 -	01 -	02 -			
1" = 200'	43 -	01 -	02 -	10 -		
1" = 100'	43 -	01 -	02 -	10 -	2-	
1" = 50'	43 -	01 -	02 -	10 -	2-	201

1.4 OWNERSHIP MAPPING

Minimum Map Inclusions: As a minimum, the final ownership maps will depict only the major detail from the planimetric manuscript with at least the following detail shown:

- a. Each established parcel and its boundaries
- b. Township, Range and Section boundaries and numbers
- c. U. S., state, county, municipal, private or non-public, etc., highway, roads, streets and name or number
- d. Subdivisions
- e. County boundaries
- f. Municipal boundaries
- g. Government Lot Numbers
- h. Subdivision names, block and lot numbers, plat book and page numbers or other designations
- i. Canals, rivers, creeks, etc.
- j. Railroad right-of-way (with track layout)
- k. Major utility lines as shown on planimetric manuscripts
- l. Churches, schools, cemeteries, airports, government lands, etc. are to be identified on the ownership map by name and appropriate symbol.

1.5 ENLARGEMENT OF ORIGINAL BASE MANUSCRIPTS/OWNERSHIP MAPS

For the purpose of maintaining ownership maps, enlargements of original base manuscripts to a larger scale i.e., 1" = 400' to 1" = 200' or 1" = 200' to 1" = 100' may be made in order to properly portray subdivisions, small properties and/or areas with congested details; providing that the enlargements of the manuscripts/ownership maps are done with extreme care.

Enlargements of manuscripts/ownership maps will be accomplished through photographic methods using precise processing cameras either by projecting negatives caused from the original manuscripts/ownership maps, or by contacting of negatives enlarged from the original pencil manuscripts. If intermediate copied negatives are used in the process of enlarging the pencil manuscripts, the negatives will be produced on film .004" or equivalent. The enlarged copy of the base manuscripts is to be printed on reproducible stable base polyester material, matte two sides, with a minimum thickness of .004" Cronaflex or equivalent.

In the enlargements of the pencil manuscripts, grids measured on the enlarged copy cannot vary more than .005" from their true dimensions and all grid lines must be uniformly at right angles. Checks made across the diagonals of the enlarged grid squares should not vary more than .005". To maintain parallelism of enlarged grids and perpendicularly enlargements of the base, manuscripts must be performed in small sections not to exceed the outside dimensions of an individual final map sheet.

Enlargements of the pencil manuscripts will be in accordance with the modular structure of the original map sheets; for example, the area covered by one 400' sheet can be enlarged and broken up

into four 1" = 200' sheets, similarly, the area covered by one 1" = 200' sheets could be blown up to four 1" = 100'. In the event, that the area covered by one of the modular sheets straddles the tie between two manuscripts both shall be enlarged and no effort is to be made to join or otherwise splice the manuscripts either in the original form or in the enlarged negative stage, so as to avoid any deviations in scale caused by the splicing together of manuscripts or enlarged negatives.

1.6 VESTING INSTRUMENTS

A deed is a written agreement, in proper legal form, which conveys title to or an interest in realty and when properly signed and delivered, gives evidence of the location, title or transfer of an interest in realty. The purpose of a deed is to describe by words the exact location, geometric shape, and size of the land intended to be conveyed, and to identify the land for title purposes as a protection to the grantee.

1.7 PARTS OF A DEED

1. Names of Parties Grantor (giving), Grantee (receiving)
2. Consideration Value Exchange
3. Granting Clause A clause containing words of conveyance such as grants, transfer, or convey.
4. Habendum Clause A clause which recites, "to have and to hold to said grantee, his heirs, successors, and assigns".
5. Description Description of property being conveyed.
6. Testimony Clause The concluding clause beginning "In witness whereof".
7. Signature Signature of granting party.
8. Witness Signature of those witnessing the signing.
9. Date Date of deliverance and acceptance.

1.8 PLOTTING AND DRAFTING METHODS

Angles - In order to accomplish plotting, a thorough understanding of angles is necessary. The basic idea in angles is that any line always has direction as well as length and the angles are used to show this direction. Angles generally may be divided into three classes:

1. Bearings
2. Azimuths
3. Field Angles

The first two use a grid or a magnetic meridian, whereas the last relates back to the preceding course of the description or traverse.

1.8.1 Bearings

Bearings are the most common method of designating the direction of lines. Bearings are angles measured from either north or south toward either the east or the west. Consequently, a bearing never exceeds 90 degrees and always indicates the quadrant in which it falls. For example, S 40 degrees W means that with the vertex at a point previously described, an angle must be turned from the south toward the west 40 degrees. Therefore, the pairs of letters, N-E, N-W, S-E, and S-W describe the quadrant in which the angle is measured. Furthermore, the angle is always measured from the first direction toward the second.

When a series of bearings is used, it would look like this:

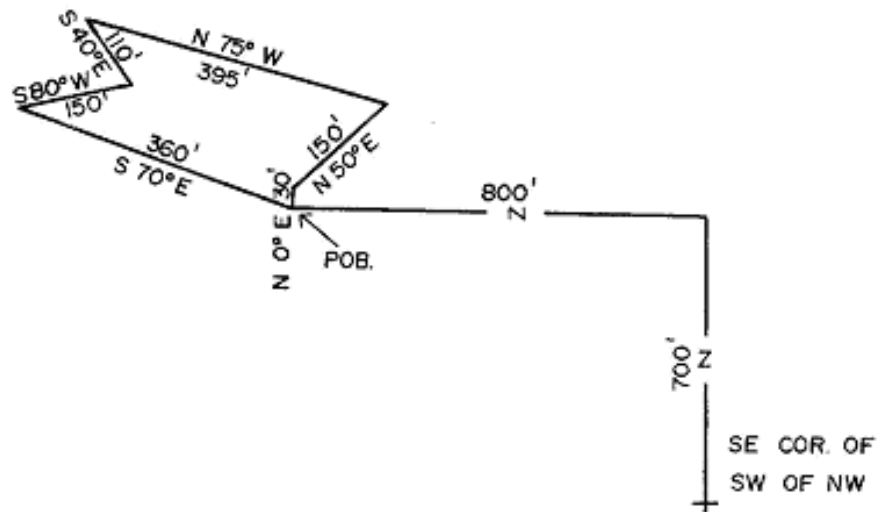


Fig. 1

The description of the above parcel would read:

“Beginning at a point, said point being 700 feet north and 800 feet west of the southeast corner of the southwest quarter (SW ¼) of the northwest quarter (NW ¼), thence from said POB run N 0 degrees E 30' to a point thence run N 50 degrees E 150' to a concrete monument. Thence run N 75 degrees W 395' to the easterly line of the Jones property thence S 40 degrees E 110' to a fence corner along said easterly line of the Jones property; thence run along the southerly line of the Jones property S 80 degrees W 150' to a stake run; thence S 70 degrees E 360' along the north side of the county road to the said point of beginning.”

1.8.2 Azimuths

Azimuths are another method by which the direction of a line may be described. Azimuths are angles also, but, unlike bearings, they are measured from one point only and always in clockwise direction. Thus, these azimuths may be anywhere from 0 degrees to 360 degrees, and the point from

which these angles are measured is usually north. However, some military maps use south as the reference point. Also, a “back azimuth” may be turned from the previous station in a clockwise direction – this is actually a field angle and is illustrated in that section.

AZIMUTHS/BACK AZIMUTH

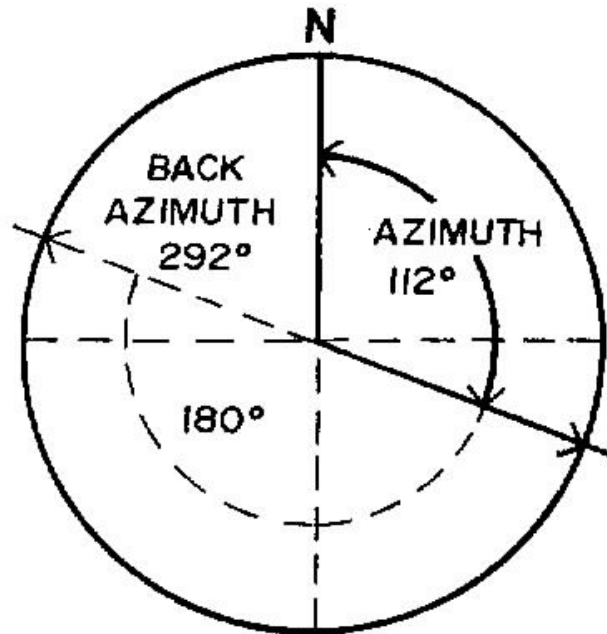


Fig. 2

Interior and Exterior

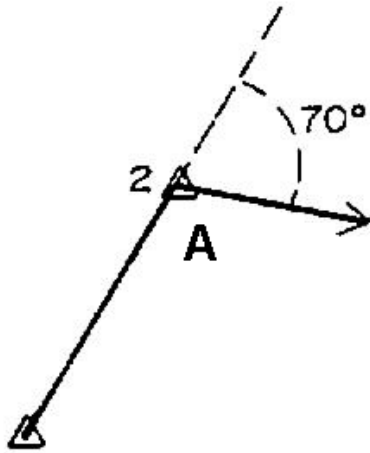
The interior angles are always on the inside of the property being described whereas the exterior angles lie on the outside.

1.8.3 Field Angles

A field angle is one that refers back to the preceding course rather than to one reference point, such as north or south. In dealing with this kind of angle, it is important to know just which angle is being referred to. Some of the words used to describe the angles are: deflection, interior, exterior, clockwise, counter-clockwise, to the right, and to the left. In the diagrams, which follow, stations and traverse are designated as in the legend:

Arrows indicate direction of traverse

An angle to the right of 70 degree



An angle to the left of 70 degree

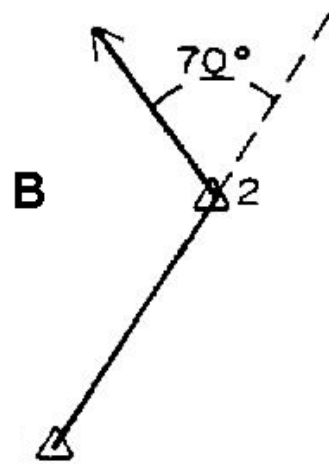


Fig. 3

A deflection angle to the right of 70 degree

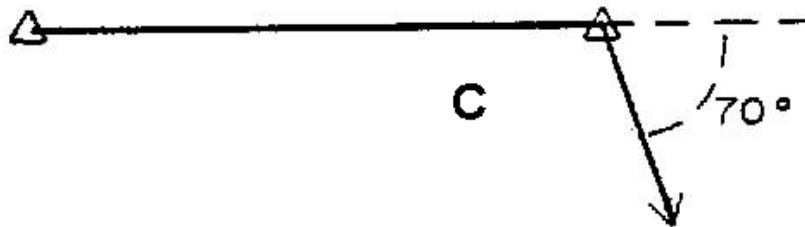


Fig. 4

A deflection angle to the left of 70 degree

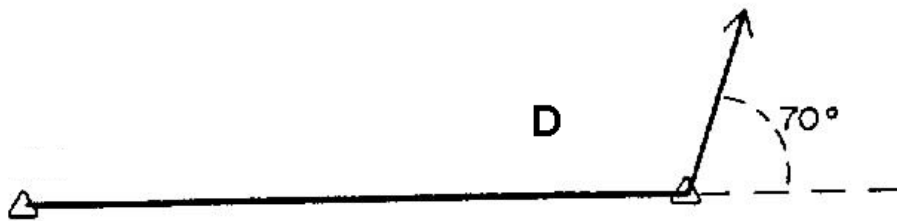


Fig. 5

1.9 CURVES

Curves are frequently encountered in plotting out a description or a traverse. It is often a problem to plot up to the curve, then along the curve to the next course. There are four basic methods to plot around a curve: first through the P.I. (point of intersection), second along the Ch. (long chord), third through the center, and fourth along the curve itself. The discussion will follow this same order, as they are listed in their order of importance. Three basic things must be remembered:

1. Tangent distances (T) of a curve are **ALWAYS** equal.
2. Radii **ALWAYS** form a right angle with the tangents - thus, the curve is tangent to the P. C. and P. T. (see angles A, B, C, and D in figures 3,4, and 5 above)
3. Radii of the same curve are **ALWAYS** equal.

1.9.1 To Plot through the Point of Intersection (P.I.)

Information needed:

Tangent Distance (*This may be given in the curve data as "T" or may be found in some cases by subtracting the P. station from the P. I. station = 1,200'*)
Delta Angle

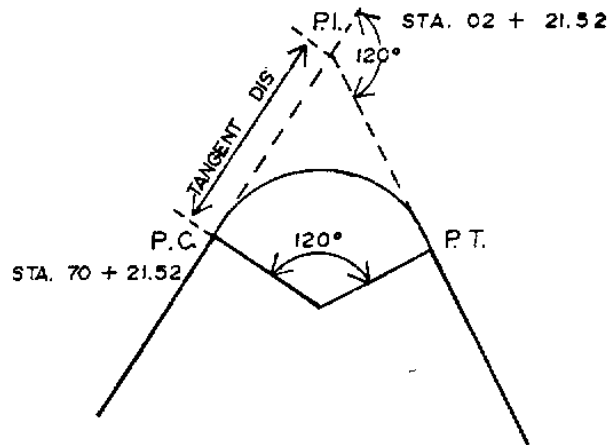


Fig. 6

To Plot: The description will give a distance to the P. C., which is the beginning of the curve. From this point continue on the same course for the tangent distance and thus establish the P. I. At the P. I. turn a deflection angle in the proper direction that is equal to the delta angle; or if the bearing of the next tangent is given, turn this bearing. Thence continue in this direction distance to P. T.; thence continue in a straight line to the next course. Use curve to draw in arc tangent at P. C. and P. T.

1.9.2 To Plot along the Long Chord (LC)

Information needed: Delta angle (or chord bearing) = 120°
Chord distance = 1,200'

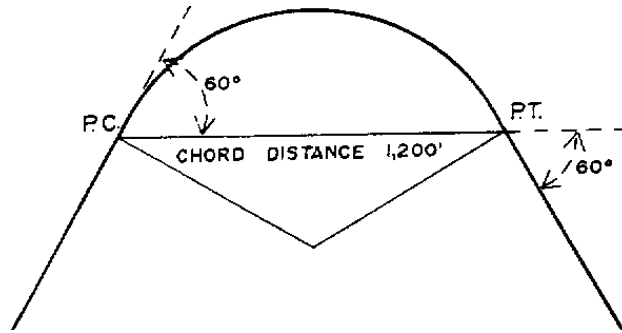


Fig. 7

To Plot: The description will give a distance to P. C., which is the beginning of the circle. At this point turn a deflection angle in the proper direction, which is equal to $1/2$ of the delta angle; or if chord bearing is given, turn this bearing. Continue along this for the chord distance to establish the P. T. At the P. T. turn a deflection angle in the same direction of the same size to establish the next course. Use curve to draw an arc tangent at P. C. and P. T.

1.9.3 To Plot through the Center

Information needed: Radius distance = 840'
Delta angle or = 120°
Chord length = 1,435'

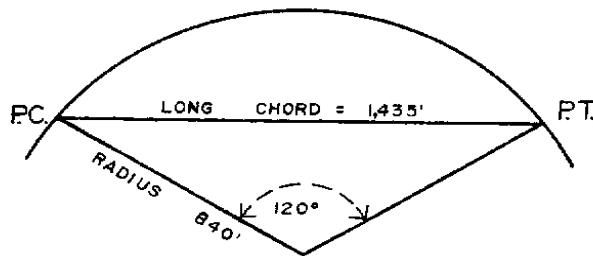


Fig. 8

To Plot: The description will bring you up to the P. C., which is the beginning of the circle. At this point turn a right angle in the same direction as the curve and measure the radius along this line to establish the center. Then measure the delta angle to establish the second radius and thus the P.T., at the P. T. turn a right angle to establish the tangent. The arc may then be put in with a compass or curves. In case the chord length is given instead of the delta angle, the arc must be drawn first with a compass and then the chord of the proper length drawn to intersect the arc, thus establishing the P. T. and a right angle turned to establish the tangent. One thing to remember here is that the accuracy of this method varies inversely with the length of the radii.

1.9.4 To Plot along the Curve

Information needed: Degree of curvature (D) = 5°

Length of arc = 1,475'

Length of chord = 1,390'

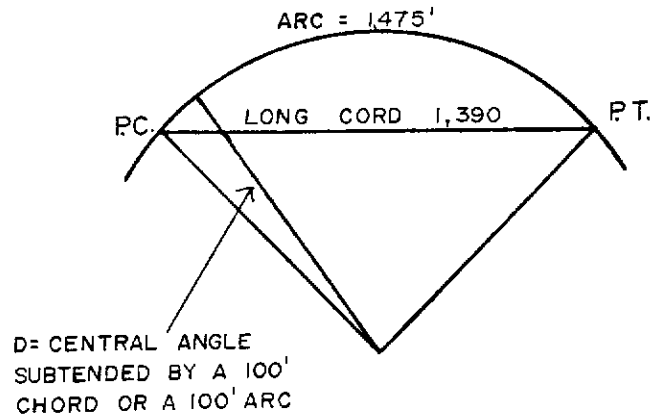


Fig. 9

To Plot: In order to use this method of plotting, it is necessary to understand the workings of highway curves. These curves come in a set and are graduated by degrees at a scale of 1" = 100'. If a person were working on a drawing scale of 1" = 100' and needed a 2° curve, he could easily find it. However, if the drawing were at a 1" = 200' the curve wanted would be a 4° curve, and at a 1" = 400' it would be an 8° curve, thus to find the proper curve it is necessary to use the following formula:

$$D \text{ (of curve at } 1'' = 100') \times (\text{scale of map}) = 100 \text{ degree of highway curve.}$$

Once the P. C. has been established and the proper curve chosen, the arc can be drawn. Then either the arc distance or the chord distance may be sealed in to establish the P. T.

1.10 DESCRIPTIONS

1.10.1 Subdivision

When a parcel is described as a certain lot of a certain block in a certain subdivision, it is easy enough to trace the description. However, when a split occurs, it becomes more involved, and care and caution must be exercised.

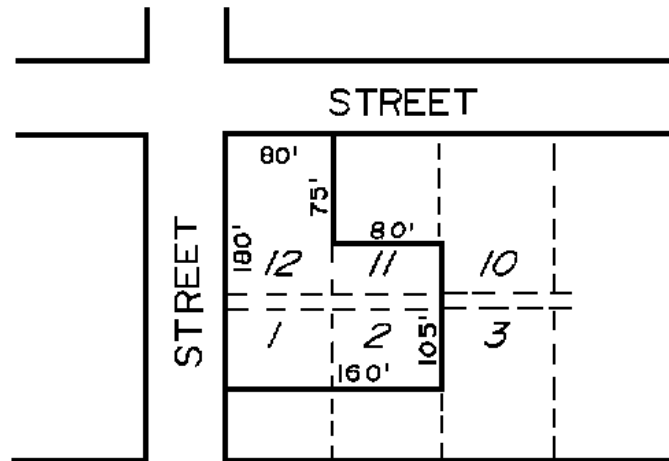


Fig. 10

The description for the above could read "the North half of the Lots 1 and 2, all of Lots 11 and 12, less the North 75' of Lot 11." On a tax roll this would probably be abbreviated as "N ½ of Lt 1 & 2, all Lt 11 & 12, less N 75' Lt 11."

Another possibility that occurs in subdivisions is where the lots are large or the blocks undivided and descriptions are run by courses with the block or lot.

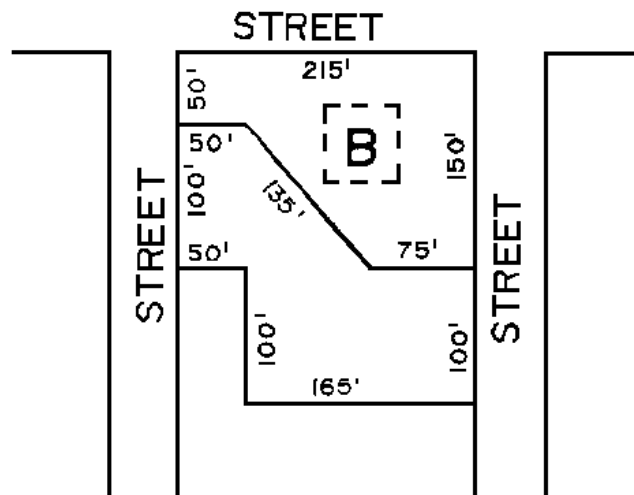


Fig. 11

The description for figure 11 could read: "Begin at a point 50 feet south of the Northwest corner of Block B, thence run south 100 feet, east 50 feet, south 100 feet, east 165 feet, north 100 feet, west 75 feet, northwest 135 feet, west 50 feet to Point of Beginning." On a tax roll this description would probably be abbreviated as: Beg. 50' S of NW cor. Blk. B, S 100', E 50', S 100', E 165', N 100', W 75', NW 135', W 50' to POB. Even though this sounds like a metes and bounds description, it is a subdivision description as it lies within Block B of said subdivision.

A third possible way to treat the block in a way similar to a section thus calling for a quarter of half, etc.; of the area (see section following on reading descriptions in sections).

1.10.2 Metes and Bounds

a. Descriptions that refer to a section or parts of a section by area.

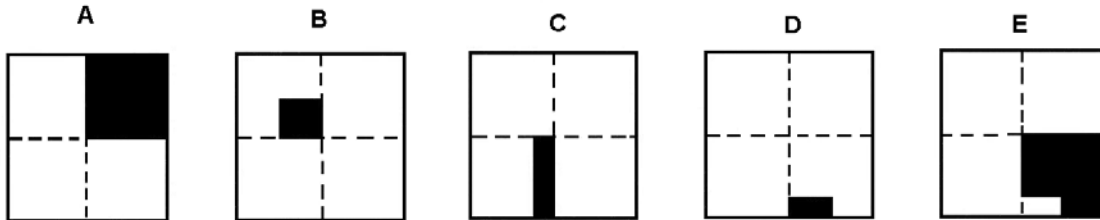


Fig. 12

Each of the above illustrated parcels, A, B, C, D, and E, will be described. In order to trace these descriptions, they should be read backwards, thus the reader starts at the largest division first and works backwards to the smallest division, which is the property described. The written description begins at the piece being described and works through the larger areas to the full section.

Descriptions:

Parcel A - Northeast quarter abbreviated as "NE $\frac{1}{4}$."

Parcel B - The Southeast quarter of the Northwest Quarter. Abbreviated as "SE $\frac{1}{4}$ of NW $\frac{1}{4}$."

Parcel C - East half of the East half of the Southwest quarter. Abbreviated as "E $\frac{1}{2}$ of E $\frac{1}{2}$ of SW $\frac{1}{4}$."

Parcel D - The South half of the Southwest quarter of the Southeast quarter. Abbreviated as "S $\frac{1}{2}$ of SW $\frac{1}{4}$ of SE $\frac{1}{4}$."

Parcel E - The Southeast quarter less the South half of the Southwest quarter of the Southeast quarter. Abbreviated as "SE $\frac{1}{4}$ less S $\frac{1}{2}$ of SW $\frac{1}{4}$ of SE $\frac{1}{4}$."

b. Descriptions that refer to a traverse or a series of courses. In order to be able to trace these out, the following vital parts of a section must be understood and known.

NW of NW	NE of NW	NW of NE	NE of NE
SW of NW	SE of NW	SW of NE	SE of NE
NW of SW	NE of SW	NW of SE	NE of SE
SW of SW	SE of SW	SW of SE	SE of SE

Fig. 13

The material covered previously under "Plotting" is basic to understanding this type of description. Three things that are necessary to a description of this type are: (1) Starting point, (2) Point of beginning and (3) the description ends where it starts.

Sample description:

Commence at the Northwest corner of the Northeast quarter of Section 3, Township 24S, Range 10 W, thence run South 660 feet to a point, thence East 575.5 feet to the point of beginning, thence East 500 feet, thence South 52 degrees 40 minutes East 802 feet to a point, thence South 30 degrees 30 minutes West 610 feet to the beginning of a curve, thence around the arc of said curve to the right having a central angle of 120 degrees and a chord length of 685 feet, thence North 30 degrees 30 minutes West 285 feet, thence North 770 feet to the point of beginning.

The above description might be abbreviated on a tax roll as: "Beg. 660' S & 575.5' E of NW Cor. of NE ¼, th E 500', SE 802', SW 610', to P. C. around curve to rt, ch dist 685' to P.T., th NW 285', N 770' to POB. S3 T24S R10W. NW Cor. of NE ¼"

NW COR. OF NE 1/4

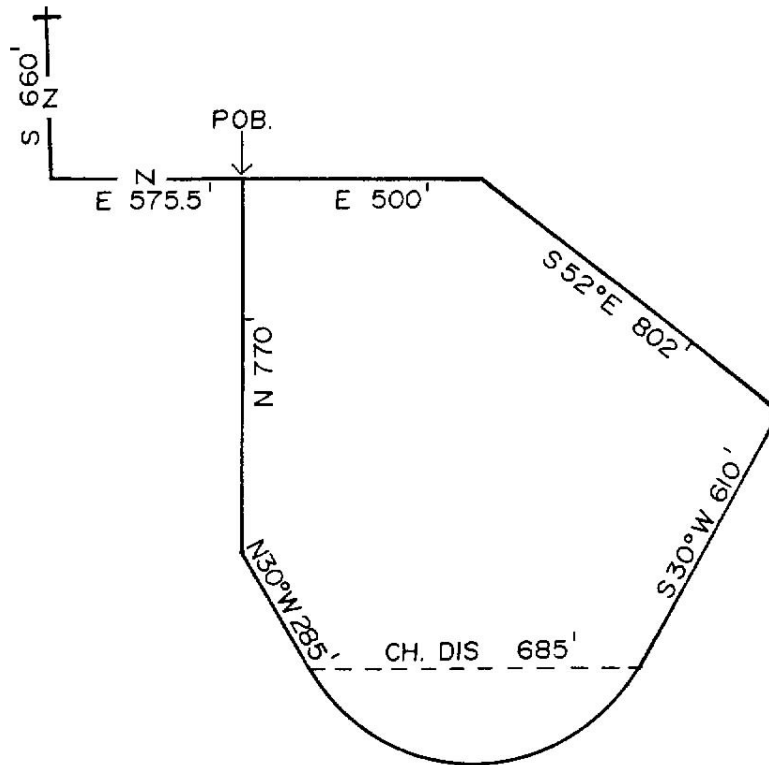


Fig. 14

1.11 MAINTENANCE/UPDATING PROCEDURES

The cartographer is responsible for obtaining copies of all vesting instruments, newly recorded subdivisions or re-subdivision of existing subdivisions, all local surveys, all new right-of-ways, acquisition plans and changes of right-of-ways for all federal, state, county and city roads and all new right-of-ways of major transmission lines, etc. during the updating period. When new photography becomes available, additional or new planimetric features should be added to maps along with checking for accuracy of lines.

The majority of the deeds recorded in the county probate office will be name changes only and may not require services of the county cartographer or changes to the ownership map. It does require preparation of the property change form and entries being posted to the map register and changes to the property record cards, and assessments. The county map clerk can handle this administrative work, but the cartographer will be held responsible for work performed.

1.11.1 Ownership Maps

- a. Documents: All vesting instruments, documents affecting owners or boundaries, new subdivisions, survey maps, etc. will be sorted by map numbers and marked as such. Each transfer will be logged on the Maintenance Mapping Register, RP Form 17, see Appendix D. A property Change Form RP-15 (in duplicate) will be made and the transfer will be attached

to the cartographer's copy and will be filed in numerical order by township. One copy of the Property Change Form will go to the appraiser. Then each transfer or new survey map will be compared with the present ownership map to check the accuracy and completeness of the original mapping. The "card change" procedure will follow this phase of the updating procedure.

NOTE: On the property change form you should show whether the deed is a Joint Survivorship Deed, Quit Claim Deed, Correction Deed, Sales Contract, Deed in Error, etc. under type of deed heading. Some of the abbreviations can be found in the reference section.

- b. Corrections & Updating: Splits, sell-offs and/or map corrections will be indicated on a paper copy of the ownership map. Red-colored pencil should be used for property line changes and dimensions and new parcels. The red pencil, on the paper print, makes the drafting or inking on the originals much easier and more identifiable. The tax assessor or like county official will record any report or information on Parcel Error Change Form, RP-16, which indicates an error in owner or owners or parcel boundaries for review and required corrections as necessary by county cartographer. Maps requiring corrections to the original mapping will be done in the same manner as splits or sell-offs.
- c. Numbering: Numbering of parcels will be done in accordance with Section 1.3.2.
- d. Acreage and Dimensions: All maps will show deed or plat dimensions decimally on all parcels under five acres to the nearest tenth of a foot. All subdivision lots will, regardless of size, show dimensions. Acreage on all parcels under ten acres will be shown to the nearest one-tenth (1/10) acre, and all parcels over ten acres to the nearest acre. The acreage will be calculated on every parcel either by electronic or polar planimeter. On parcels under 5 acres deeded or calculated acreage will be stated only in the description. If a polar planimeter is utilized for this purpose, the computation must be based on the average of three (3) separate readings.

In those cases where differentials exist in the boundary dimensions as stated in the deed of more than 3% the boundary will show both dimensions, designating deed dimensions with a small "d" and scale dimensions with a small "s" after the number. Where the differentials between deed and scale are less than 3% only deed dimensions will be shown. It will not be necessary in those cases for a small "d" to be shown. Where differentials exist in area as stated in the deed of 3% or more the parcel will show both deed and calculated acreage. Deed acreage designated by a small (d) in parenthesis will be directly under the parcel number and calculated acreage designated by a small (c) in parenthesis will be under deed acreage. Where the differentials are less than 3% only deed acreage will be shown and it will not be necessary to designate it by a small (d). In cases where no acreage is defined in the vesting instrument or in cases where parcels must be split, calculated acreage only will be used and will be designated by a small (c) in parenthesis. The differentials in both dimensions and acreage will be shown on the property change form RP-15. When maps are put into a digital format, the parenthesis on scaled and deed dimensions will not be required.

- e. Aerial Photo: Each split, sell-off, or map correction can be checked against the aerial photo covering the area.
- f. Field Edit: In those instances wherein the property cannot be plotted from the vesting instrument, where conflicts and ambiguities exist, where the transfer is vague, not complete enough to be located, identified or mapped and where the grantor's name is not the same as currently mapped, the cartographer will make a field edit. The field edit will be made on RP Form 15 (Property Change Form), see Appendix F. No field edit will be made by phone, except for questions concerning owner. It is not intended that the cartographer go beyond a field interview(s) in an endeavor to interpret ownership or boundary disputes, nor is it intended that he will either settle or create any. If any exist, he will note it on the Property Change Form as instructed.
- g. Drafting: Drafting changes on the original will be done in accordance with Drafting Specifications as shown in Appendix C-1 through C-6. This will insure uniformity of all maps. At the end of each update period, the initials of the cartographer and the date through which the maps are updated will be inked on each map changed in the legend column. This date will let all persons using the map know its current status.
- h. Right-of-Ways: The addition of new or changed right-of-ways for roads, railroads, utility lines, new streets, etc. will be added to the Mylars, and the dimensions of each ROW's shown along with name and highway number will be shown.
- i. Subdivision: New subdivisions or re-subdivisions will be mapped with each lot being considered as a separate parcel, even though there may be only one owner for the entire subdivision. As future transfers occur, they will be handled as sell-offs or splits.
- j. Land hooks: Lots of any plat (sub-division plat) separated by a public thoroughfare are not considered to be contiguous. Lots so separated will be mapped and appraised separately regardless of common ownership. Land hooks can be used only where a parcel is split by a railroad or highway right-of-way to denote single ownership. The exception to this will be where interstate highways, lakes, rivers, or reservoirs split parcels. Land hooks will be acceptable to denote common ownership diagonally across common corners.

Note: Cartographers should add dashed land hooks on contiguous parcels on same map and adjoining sections.

- k. Ditto Marks: Ditto marks used when placing lot dimensions are acceptable but not required in subdivided property in urban areas under the following conditions: If the rear of the parcel is the exact same dimensions as the front, dittos may be used in the rear of the parcel. As to the dimensions for depth where all depths are exact dimensions, no dittos will be required to be shown on interior lot lines. See Appendix I-3 for sample map.
- l. Contiguous Parcels: Contiguously owned parcels in two or more sections shall be mapped as separate parcels. Only contiguously owned parcels in the same section will be mapped as

one parcel. However, parcels with a land area of two acres or less in the rural area, not subject to further subdivision, or a lot in a subdivision extending into an adjoining map area, can be included in the map which has the largest land area or facing a street or road, by indicating beyond the neat line of the map, dash lines showing the remaining part of the parcels. Dimensions will be shown. The portion of the parcel extended across the neat line will be shown by dash lines and not by solid lines. The map that carries the remaining portion of the parcel will be referenced in the margin area. The map that has the land area not assigned the parcel number will have a reference note to which map, block and parcel number the land area is parceled. In summary, any land area will be shown by dash lines to show that it is considered and included in another map and the maps will be cross-referenced and all land area in every map must be accounted for.

- m. Encroachments/Conflicts: In plotting property where a field edit and deed has determined an encroachment actually exists, the area of encroachment will be visibly marked by the use of hash lines on the map. The cartographer is not responsible for settling differences between property owners.
- n. Supplemental and Insert Maps: In the past, it has been acceptable to pull a congested area out of a section and enlarge it. This practice is now discouraged. It is now recommended, if the need occurs to enlarge an area of a section to a different scale, the entire section should be enlarged. Example: If a portion of a section on a 1" = 400' maps needs to be enlarged to 1" = 200', then the entire section will be mapped as 1" = 200'. The same applies for 1" = 200' to 1" = 100'.
- o. Combining of Property: The combining of parcels should only be done upon the request of the owner, within a section on the same map.
- p. Photo Number: When a cartographer has made a change on an original map or has created additional map, he will ink the flight line and the exposure number of the enlargement that covers that map in the legend area below the sub-sheet index indicator. Whenever a county has new photography flown the re-flight date of photography should be shown in legend area under original date of photography.

1.11.2 Placement of Drafting Information

The cartographer will ink all changes of ownership boundaries, ink all newly recorded subdivisions or re-subdivision of existing subdivisions, all changes of right-of-ways of public roads or newly created public roads and new municipal annexations. The cartographer will show by the appropriate symbol all new major transmission lines, such as electric and gas lines.

1. Names of or street numbers and roads should be placed in the center of the travel path.
2. Original Sub. lot numbers should be placed in the rear of the lots in a slanted position at a 0° angle.
3. Original Sub. block numbers should be centered in its block located inside a dashed block.

4. Subdivision information showing Sub. name, Plat Book and page number should be shown on map. If computerized this information would always be shown within map boundary.
5. Two recommended ways of delineating Sub.'s on maps is by the use of tick limits or solid line. If list of subdivisions is shown in legend, tick limits should be referenced with corresponding number on legend.
6. Map Block numbers should be placed in the center of the block with double rings included with blocking limits indicated if necessary.
7. Parcel numbers should be placed in the middle of the parcel and underlined. When parcel number will not fit within parcel the use of a leader line or reduction in the size of the parcel number will be permitted.
8. Dimensions should be near the center portion of a property line.
9. Acreage should be placed under the parcel number and if both deed and calculated acreage are utilized, the deeded acreage (d) in parenthesis should be listed first with the calculated acreage (c) in parenthesis being listed below the deeded acreage.
10. All highway symbols should straddle the road right of way at a 0⁰ angle. ROW lines should be hidden within ROW symbols.
11. Names and symbols, government property, churches, schools and cemetery should be placed nearer the middle of the parcels.
12. Insert information should reference information and where it is to be found in the center of the unmapped area. (This applies only to current manually mapped inserts) Final drafting shall be done in Pelican TN ink or approved equal. Drafting shall be accomplished to provide clear and legible lines. Symbols and lettering are required. Lettering will be accomplished by use of mechanical lettering templates (Leroy or approved equal). For correct symbol, pen weights and template see Drafting Specifications in Appendix C-1 through C-6.

Final ownership maps shall be drafted on a matte finish, both sides, .004" polyester stabilized base Cronaflex, or equal. The overall sheet will be 31" X 40" and will contain a neat image area of 31 X 30 inches with a legend section of six inches along the right side of the map. For map size and format see Appendix A. The final maps will depict the following approximate areas:

- 1" = 400' mapping – 4 sections per map
- 1" = 200' mapping – 1 section per map
- 1" = 100' mapping – ¼ sections per map
- 1" = 50' mapping – 1/16 sections per map

All maps shall contain an index showing where it fits into the adjoining map sheets. A suitable legend list shall also be provided on each map. For sample legend showing minimum requirements and format see Appendix B-1 through B-3. The Alabama State Plain Coordinate System shall be depicted at 5" intervals by showing each intersecting point and values shown on west and south borders.

Unless otherwise instructed, all maps will show grid and true north and be constructed with north at the top of each sheet.

NOTE: Disclaimer Note-Located on the Mylar as shown on the map format in Appendix A will be the following statement:

MAPS TO BE USED FOR TAX PURPOSES ONLY - NOT TO BE USED FOR CONVEYANCE

NOTE: For examples, symbols, correct line and template sizes see Drafting Specifications in Appendix C-1 through C-6.

1.11.3 Ownership Index System

To complete the working system or ownership indexing, the cartographer will prepare a Property Change Form, RP Form 15 (see Appendix F). A Property Change Form will be prepared for each parcel, split, sell-off, or where an error was found on the original mapping. The Property Change Form will contain at least the following information:

1. Owner's name and mailing address
2. Property address
3. Property description
4. Dimensions and acreage
5. Section, township and range
6. Uniform parcel number
7. Acquisition reference (book, page and date)
8. Plat book and page for subdivided property
9. Any notes explaining the plotting of or the ownership if different from the vesting instrument.

A computer printout in alphabetical order and geographical order should be created annually and should be maintained in an electronic medium for each year for historical records.

1.11.4 Property Change Form

- a. Property Descriptions: A property description of the parcel mapped using a verbatim legal description from the vesting instrument in an abbreviated form and eliminating information not essential to the plotting of the parcel will be shown on the Property Change Form. This will be in accordance with the examples shown in Appendix J-2 through J-3. Abbreviations shown in the reference section.

Property descriptions utilizing fractional subdivisions of sections of land such as A, B, C, and etc., contained in deeds are not acceptable. Land that can be described in the conventional manner such as, quarter-quarter section, half section, full section, etc. will be described this way.

The section, township and range will be shown. If the property is located within an urban area the name of the city will also be shown.

The property description for subdivided property will be in the following manner: lot, block, subdivision, city or town. If the subdivided property is located in the rural area, the description should be lot, block, section, township and range. When a verbatim description in the vesting instrument cannot be used and a parcel must be described by metes and bounds, the following procedures will be utilized in writing the metes and bounds property description: the description will have a definite and existing point to start from on the ownership map; such as, $\frac{1}{4}$ $\frac{1}{4}$ section corner, an intersection of two (2) roads, an intersection of a road right-of-way and a section, $\frac{1}{2}$ section or $\frac{1}{4}$ $\frac{1}{4}$ section line, etc. Once the point has been determined then the distance and direction to a POB of the parcel will be stated. Such POB of the parcels will be used to describe the actual boundaries of the parcel. From the Point of Beginning the description will then continue around the boundaries of the parcel giving the direction and distances until the description closes back to the point of beginning. The deed dimensions and if required the scale dimensions and deed acreage and/or calculated acreage will be stated in the description. After closing at the Point of Beginning (POB) the description will have a summary stating that the parcel is located in NE $\frac{1}{4}$ or $\frac{1}{4}$ $\frac{1}{4}$ section, section 6, township 12 or range 4, etc. If the parcel is located within an incorporated area, the name of the city, town or community should be stated. See Code 40-7-16 How real estate may be described.

- b. Ownership: Full names of all parties in tenancy will be shown. Full interest of all owners will be determined by vesting instrument and/or field edit. If tenants own fractional interest, such interest will be indicated by each name on the Property Change Form. This also includes estate property or trust.
- c. Property Address: Where the property is located on a street, road or boulevard, the property address will give the house number, name or number of the road, street, or boulevard and city, town or community, if located in the rural area not having an address similar to that in the urban or suburban area above, show the following as an address:
 1. Property adjoining federal, state or county highway, the name or number of the highway will be acceptable as an address. If the property is located on a creek, river, railroad or any other identifiable point, the property address will show such identifiable point.

2. Property not located on or adjacent to the above; property not located on road, street, highway, creek, river or other identifiable point, but can be identified by property located north, south, etc., of a highway, river, creek or railroad will show the address that the property lies north or south or so forth of such physical feature. The location point shown in the address must be located within the section in which the parcel is located.
3. Parcels which are split by the above will reflect north and south, etc., of highway # and/or creeks, railroads, rivers and streets.
4. Parcels of land less than $\frac{1}{4} \frac{1}{4}$ section that cannot be given a property address in the above manner will show in the property address section of Property Change Form the $\frac{1}{4} \frac{1}{4}$ section in which the parcel is located.

1.11.5 Storage

Storage of Mapping Material All materials used in the updating and the maintenance of ownership maps; such as, Property Change Forms with deeds, subdivision plats and surveys, ROW plans, etc., will be filed by the cartographer in a manner prescribed by the assessing official, available for ready reference.

2 GIS / COMPUTER ASSISTED PROPERTY TAX MAPPING

The following section contains information on computerized cadastral mapping, minimum capabilities of computer mapping software, parcel map conversion, and data standard requirements for property tax administration land records geographic information systems. The Department of Revenue, Property Tax Division is the approval authority for property tax mapping digital conversion that is to be acquired through the Appraisal and Mapping Budget. Any data, forms, documents or other products whether digital or hard copy in all of its forms or formats, associated with the performance of a contract paid from the Appraisal and Mapping budget shall be the joint property of the contracting County and the State of Alabama. This document establishes minimum requirements.

The Property Tax Office has become the focal point of successful Geospatial Information System (GIS) projects in local government because this office has the information (database) essential for the retrieval and analysis of parcel level geographic information. This office collects and maintains information on all property. The records of the assessment office have always been an important public resource and these records become invaluable when they are part of a GIS. The property tax official should make every effort to form partnerships and/or cooperate with other county agencies and entities. Such agreements reduce redundancies and leverage resources during the acquisition phase and during long term growth and maintenance of the GIS environment. It may be necessary for the tax official to develop a single purpose mapping system if efforts at cooperation are unsuccessful. Whatever the situation, the responsible tax official must retain the ultimate authority to inventory, create, and define the parcels, parcel layer(s), their attributes, and related data.

It is the Property Tax Official who leads the effort to establish a GIS, not merely to update ownership maps, but to process assessment information in new ways that improve the efficiency and effectiveness of the assessment office. A GIS interfaced with a Property Tax Administration System is a powerful tool that can manage the rich data of the assessment office to provide cost-saving benefits to many branches of government. It is a management tool and a decision making aid. In a very real sense, these systems convert information into knowledge.

The development of a GIS entails a number of complex decisions. If these are not fully considered, the resulting GIS, no matter what its size, will perform below expectations. Therefore, a written project plan must be completed and agreed upon by the responsible property tax official, the county commission and the Department of Revenue prior to committing or expending funds from the Appraisal and Mapping budget.

2.1 GENERAL INFORMATION

1. The Department of Revenue maintains a list of qualified firms or counties that may contract for conversion of maps and/or host out-sourced GIS system/services for other counties. Any firm or county wishing to convert maps or host out-sourced GIS systems and/or map maintenance must demonstrate compliance with the Department of Revenue standards and specifications for computerized ownership mapping.

The Department of Revenue prefers to have all work performed by the contracting vendor; however, it will not be the sole criterion for selection. Where a vendor proposes a

subcontracting arrangement, the submitted proposal must address how quality and workmanship will be maintained and should demonstrate the knowledge, expertise, capacity and oversight to insure a successful project. Advance approval must be requested from the contracting county and the Department of Revenue for any proposed subcontracted map conversion, project implementation, or outsourced hosting of GIS and/or map maintenance. Due to Homeland Security issues and the number of military installations and other security sensitive locations within the State of Alabama, the Department of Revenue requires that all work conducted for a project be performed within the boundaries of the United States. Under no circumstances shall it be permitted to send any maps or any other data, whether digital or hard copy, associated with the performance of a contract to destinations outside of this country. The use of offshore labor or non US citizens in performance of any aspect of a project or work performed in the United States by a company that in any way is owned or partly owned or managed by a non United States Citizen must be considered on a case-by-case basis and advance approval requested from the County and the Department of Revenue.

2. The Department of Revenue requires a set of pilot test maps to be checked for accuracy. County and State cadastral mapping personnel will inspect and evaluate the Pilot Test Maps. This phase of the contract work will include digital conversion of 2 adjacent 1"= 400' scale maps and 2 adjacent 1"= 100' scale maps as a pilot area to test conversion procedures and ensure delivery of all data in full compliance with state specifications.
3. Appropriate task training of County personnel must be done in conjunction with the delivery of newly converted maps as set out in the delivery schedule of the contract. Formal system training for County employees will be conducted within 12 months from the effective date of any Contractual Agreement at the places and time mutually agreed upon by the county and the contractor.
4. Each county will have at least one plotter and one laser printer capable of printing maps in full size, one-half size, or one-quarter size or portions of any map as directed.
5. GIS systems will employ appropriate daily back-up procedures.
6. Upon completion of the annual update period each county will prepare two back-up copies of the data. The County will retain one copy and the other copy will be submitted to the Department of Revenue, Property Tax Division in the format and method that is or can be directly imported into the DOR GIS system.
7. The Department of Revenue prefers the use of either Intergraph or ESRI GIS software. These software platforms are most compatible with the Department of Revenue's in-house GIS system.
8. The "*Standard on Digital Cadastral Maps and Parcel Identifiers*" approved July 2003 by the International Association of Assessing Officers is incorporated as a primary reference for property tax GIS systems.

2.2 MINIMUM GIS SOFTWARE CAPABILITIES

1. The connectivity, area definition and contiguity of the map features such as points, lines, polygons and annotation that define topology will be structured to be topologically sound data structures. Non-graphic data must provide all attributes of the Computer Assisted Mass Appraisal and Property Tax Administration database files.
2. The software will be capable of showing layers or coverage independently or in any multiple as necessary.
3. The software must provide mainstream GIS functionality that includes zoom-in, zoom-out, and pan and identify. Parcel datasets will automatically apply required symbols and annotations according to these specifications.
4. The software must be able to produce ownership maps that comply with the specifications for hardcopy production.
5. The software will be capable of reducing each map or designated area of each map. When an area is enlarged or reduced, the software will adjust the line weight and lettering to the size and weight specified in the ownership mapping specifications.
6. The software will be capable of running a plotter of sufficient size to print ownership maps with required features at a speed determined by the county. The software shall be capable of printing ownership maps with or without the digital aerial photography and shall be capable of plotting multiple maps to the plotter or to plot files.
7. The software will be capable of calculating the area of each parcel in both square feet and acreage or metric equivalent and placing this information in the appropriate location within the parcel as directed in another section of these instructions.
8. The software will be capable of displaying the correct map by entering the map number or the public land survey section, township, range, or the recorded subdivision, lot and/or block.
9. The software will be capable of displaying the correct parcel by entering either the Uniform Parcel Number (UPN), owner name, street address, the subdivision lot and/or block, or the recorded deed book and page.
10. The software will be capable of plotting parcels from a metes and bounds description or from a recorded subdivision lot and/or block.
11. The software will be capable of writing a metes and bounds description and interfacing with the Property Tax Administration system so that the description only needs entering into the system one time for all stations.
12. The software should have a rigid standardized address format established that should be used throughout the system.

13. The software will be capable of printing the following from only the Uniform Parcel Number (UPN) being entered: description of property, owners name and address, improvements on property and value of each, assessment and taxes due, in either one or all of the above. This should also include showing of all or part of the above without printing.
14. The software should have the ability to plot legal descriptions of the following types: (a) azimuth, (b) bearing, (c) deflection angle, (d) interior angle, (e) State Plane Grid Coordinate and (f) any combination of the above.
15. The software must have the ability to plot curves and to incorporate the plotting of curves in the plotting of legal descriptions.
16. The software must have the ability to plot curves given any of the following combinations: (a) radius and curve, (b) radius and arc, (c) cord bearing, cord distance radius, and (d) tangent bearing in and tangent bearing out of a curve and radius. When necessary, the software should allow the user to specify if the curve is to the right or to the left.
17. The software must allow a variety of units of linear measure for plotting legal descriptions such as: (a) feet, (b) yards, (c) rods, (d) chains, (e) links, and (f) will be capable of conversion to metric system.
18. The software must be designed so that the drawing application is directly interfaced and it must operate by simple user commands and should plot each segment of the description on command.
19. The software must generate the mapping change forms and the mapping register. Deeds need not be attached to change form, but must be filed in a deed register if the system is not on line with the probate records.
20. The software should allow the user to digitize the centerline of a right-of-way or travel path, and then define the distance between segments. The graphic elements will then be copied parallel and remain tangent with the center line. No graphic editing should be necessary.
21. The software will be capable of calculating the area in feet and acreage or metric equivalent of the total parcel when a parcel is parceled on one map but a small segment goes over the map boundary into another map. On the adjoining map the software will also be capable of excluding that part of the parcel that extends across from the adjoining map. The same will be true when part of the parcel extends across the section line on a 1" = 400' scale map.
22. The software will be capable of converting scanned map raster images into identifiable vector images and to allow scanned subdivision plats to be properly scaled, positioned, and "heads-up" digitized.

23. The software must have user definable polygons.

24. The software must maintain a history or “date stamped” record of parcel changes.

2.3 DATA STANDARDS

These specifications are intended to meet or exceed Federal Geographic Data Committee (FGDC) standards. The purpose of FGDC standards is to facilitate data sharing and increase interoperability among geospatial information systems. In the terms of GIS architecture they can be thought of as technical specifications to be used as rules or guidelines. These guidelines will help ensure the integrity and interoperability of the GIS architecture.

The following framework data layers comprise the most commonly used set of base data:

1. Geodetic Control - Geodetic control provides a common, consistent, and accurate reference system for establishing coordinates for all geographic data. A geodetic control network consists of monument points whose locations on the surface of the earth are defined with certainty. These points may be described by latitude and longitude. Projection to state plane coordinates is required.
2. Base Map Layers - Base maps locate the major physical features of the earth’s surface such as roads, water features, elevation contours, fence lines and building footprints. Digital orthophotography at appropriate scales and accuracy and tied to the geodetic control network provides the fundamental information for the cadastral mapping base layer. Ortho imagery consists of images of the Earth's surface represented as geo-referenced pixels. Digital ortho images have the geometric characteristics of a map and image qualities of a photograph. The hydrography data theme includes surface water features such as lakes, ponds, streams and rivers, canals, oceans, and coastlines. Transportation data include the geographic locations, interconnectedness, and characteristics of the transportation system. Sub-themes include the road, railroad, transit, and waterway networks, plus airport facilities. Elevation data provide geo-referenced digital representations of the earth’s surface that describe vertical position above or below a datum.
3. Cadastral Map Layers - Cadastral data describe the geographic extent of real property, including above, surface, and below ground and water, and the foundation to support the description of that geographic extent.
4. Governmental Units - The governmental unit boundary data theme includes the description and boundaries of cities, counties, and other legal entities.

The database management system (DBMS) must be scalable and operate in a client–server environment. Open connectivity for relevant application programming interfaces (API) is desirable.

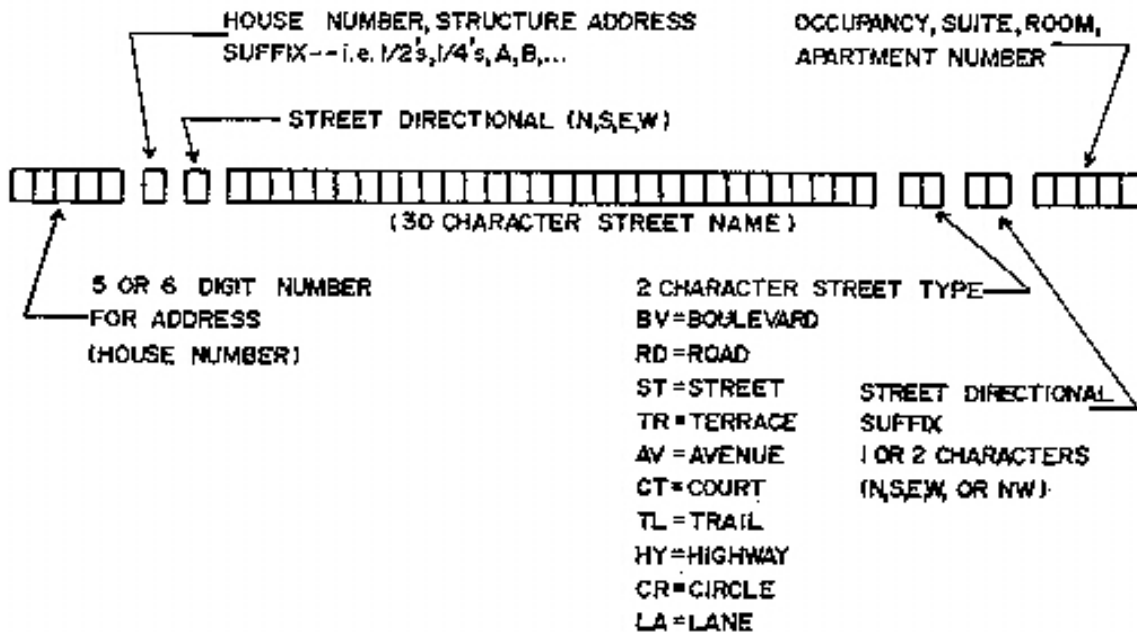
The system selected for use may impose specific requirements for DBMS design and must be considered on a case-by-case basis.

Data coding standards are necessary to promote data sharing. Many automated computer files and databases may allow for different queries, yet are not tied directly to an ownership parcel. With the adoption of data standards, data can be implicitly tied to geographic locations. Some of the elements

most commonly standardized are mailing addresses, property addresses, subdivisions descriptions, names, use codes, dates, etc.

Because addresses are the most common geographic key, used at the local level, it is particularly important that address standards are adopted and enforced as part of the database design. With address standards, address-based data can be effectively shared with parcel level appraisal information, but only if each parcel has an assigned address. To minimize redundancy and to maximize sharing, all addresses need to be standardized and captured accurately whenever they are entered into a computer system. Street names, whether they appear on a map or computer record, should be spelled only one way, county road numbers and other commonly used names should be managed as well. This allows many users to access and update the information, thus minimizing the number of duplicate address files.

Below is a sample of a standardized address format.



2.4 CONVERTING PARCEL MAPS INTO DIGITAL FORMAT

Converting parcel maps (Mylars) into digital form may be accomplished in several different ways depending on the resources available. Accuracy of the maps is dependant upon the accuracy of the source materials. Alabama Property Ownership Mapping Specifications must be maintained in the conversion process. The preferred method of conversion is to scan and “heads up” digitize the ownership maps over an orthophoto base map using “best fit” methodology. Below are several methods of conversion.

2.4.1 Coordinate Geometry (COGO)

This is the process of converting parcel maps into digital form using a mathematical process that calculates locations using distances and bearings from known reference points. This data comes from existing plat and deed information and the process can be fairly expensive depending on the

accuracy of the existing deeds and plats. COGO uses the distances and bearings recorded on the plats and deeds to recreate the maps.

2.4.2 Digitizing Existing Maps

Usually one of the least expensive methods of converting parcel maps into a digital format. This process involves placing a map on a digitizing board, registering the map to a digital database and then tracing the lines on the map with a puck or cursor. This process captures maps and drawings as vector data. The main problem with digitizing is one of accuracy both in property lines and with edge matching. Note: this method is becoming obsolete and is seldom used.

2.4.3 Scanning and “Heads-Up” Digitizing

This process of converting maps into a digital format would also be one of the less expensive methods of conversion. Scanning as it applies to mapping leads to a raster image of the map. For mapping purposes these raster images must be “vectorized” and identified in order to have a working mapping system and to be linked to a database. This may be the most feasible method of conversion for many counties.

2.4.4 Creating a Map Manuscript

This method is a combination of COGO, scanning and “heads-up” digitizing of the existing maps. This method provides a high degree of accuracy at less effort and expense than COGO. Basically, the mapper would digitally redraft the existing ownership map onto an orthophoto base map, making obvious corrections as he goes. “Best fit” methodology will be used to ensure that the converted parcel lines are consistent with the precise location of features that typically represent property boundaries. Buildings and roadways will also be considered to ensure that property boundaries do not overstrike them or fall within designated rights of way. For problem areas the mapper would refer back to source materials, such as plats and deeds.

2.5 CONVERSION

2.5.1 Setup

All four corner points of a county tax map are used to scale or tie the map to the surface of the earth through the use of the coordinate system. All county tax maps were created using the Alabama State Plane Coordinate System registered to North American Datum 1927 (NAD 27). County tax maps converted to the computer environment will be registered to the more current North American Datum of 1983 (NAD 83).

2.5.2 Digitizing Accuracy

Digitizing accuracy refers to the results of comparing a check plot of the digitized data at the same scale of the source map (Mylar). Line smoothness and consistency shall be evaluated when reviewing line accuracy. If the county chooses to contract the digitizing then the contractor will conduct quality control measures and prepare reports in order to compare the newly digitized

calculated acreage versus the calculated or deed acreage being used for assessment. Should there be a discrepancy of greater than three percent (3%) in the resultant calculated acreage versus the current calculated or deed acreage, the mapping or digitizing discrepancy will be documented in an errata list that will be delivered to the county and state. The county will be responsible for correcting their mapping errors and the contractor will be responsible for correcting the digitizing errors.

2.5.3 Project Procedures

When a county contracts the digitizing, the contractor shall digitize the information from the source maps and will then complete the necessary edits and produce a check plot on a stable material. The check plot will be prepared at the deliverable scale and shall contain all information that will be required in the final deliverable product. Additionally, in counties with digital orthophotography, the check-plot must be printed with the orthophotography in order to see that the line work is properly registered to the ortho base. Each check plot must include the legend and grid ticks. The county will review check plots and associated material for line placement, line quality, labeling accuracy, correct symbols, pen weights, and template sizes. All lines will be examined for accuracy against the source maps. All maps that have line accuracy problems, etc. will be returned to and corrected by the contractor. All maps that have been returned to the contractor for editing must, after correction, be resubmitted to the county for review.

2.5.4 Delivery Schedule

When a county contracts the digitizing the contractor shall develop a delivery schedule, for all deliverable products of the project, hardware and software (if applicable), check plots, etc. Contractors will perform a complete (100%) quality control check of each map prior to delivery to the county. A copy of this delivery schedule will be submitted to the Department of Revenue.

2.6 EDGE MATCHING

No edge match tolerance will be allowed in digital mapping. Before digitizing, the contractor shall examine all source maps for edge match problems. It is anticipated that during the digitizing process, that as the map sheets are being digitally edge matched, and fitted into digital coordinates that minor discrepancy in the digital edge matching may occur. When this occurs, the contractor or county will be required to fit that map sheet into the coordinate system so that the sheet facet will be contiguous throughout the county. The contractor will not be responsible for edge matching between adjoining counties.

2.7 CONVERSION OF INSERT MAPS and 1" = 50' SCALE MAPS

Insert Maps must be eliminated (redrafted in the appropriate map) at the time maps are converted to a digital format. All 1"= 50' scale maps will be reduced to 1" = 100' scale maps.

3 AERIAL PHOTOGRAPHY AND DIGITAL CAMERA IMAGERY

This document addresses aerial photography, digital camera imagery, geodetic control and base mapping for use with parcel level cadastral mapping. The Department of Revenue, Property Tax Division is the approval authority for aerial photography, digital camera imagery, Geodetic Control and Base Maps that is to be acquired through the Appraisal and Mapping Budget for property tax administration purposes. This is a minimum standard intended to promote consistency of imagery data and base mapping throughout the State of Alabama.

The primary purpose for aerial photography or digital camera imagery and ground control is to establish accurate base map layers and digital orthophotography. Therefore this document will primarily address photography/imagery and geodetic control that is to be used to build a base map and orthophotography for the property tax administration geographic information system (GIS). Geodetic Control is required to accurately register the photography/imagery to the earth's surface. The National Oceanic and Atmospheric Administration (NOAA) Height Modernization Program places an increased emphasis on ground control requirements that will benefit the State, County and private industry.

Base Mapping Layers are required to provide the County with an accurate and up-to-date representation of the County's current infrastructure at true and constant scale. This information in a digital environment will enhance the County's ability to make decisions on future development. Digital Orthophotography removes all distortion due to tip and tilt of the aircraft and terrain variations. All features are depicted in their true horizontal location, which produces an image with true and constant scale.

Rectified photography is an acceptable alternative in those counties that have only manual mapping capability. It is considered adequate in primarily flat terrain as it eliminates only the distortion caused by tip and tilt of the aircraft (camera).

Definitions:

Aerial Photography: A film based positive or negative picture of the earth's surface acquired from an airborne analog (metric) frame cameras such as the RC-30 and RMK.

Digital Camera (sensor) Imagery: A digital image of the earth's surface acquired from an airborne digital (sensor) camera such as the Z/I DMC, Vexcel ULTRACAM-D and LEICA ADS40.

3.1 GENERAL REQUIREMENTS

Due to Homeland Security issues and the number of military installations and other security sensitive locations within the State of Alabama, the Department of Revenue requires that all work conducted for a project is performed within the boundaries of the United States. Under no circumstances shall it be permitted to send any maps or any other data, whether digital or hard copy, associated with the performance of a contract to destinations outside of this country. The use of offshore labor or non US citizens in performance of any aspect of a project or work performed in the

United States by a company that in any way is owned or partly owned or managed by a non United States Citizen must be considered on a case-by-case basis and advance approval requested from the County and the Department of Revenue.

The Department of Revenue prefers to have all work performed by the contracting vendor; however, it will not be the sole criterion for selection. Where a vendor proposes a subcontracting arrangement, the submitted proposal must address how quality and workmanship will be maintained and should demonstrate the knowledge, expertise, capacity and oversight to insure a successful project. Advance approval must be requested from the contracting county and the Department of Revenue for any proposed subcontracted or outsourced project implementation, digital imagery, photography, and processing or photogrammetric work.

The Department of Revenue requires a set of pilot test maps to be checked for accuracy. County and State cadastral mapping personnel will inspect and evaluate the Pilot Test Maps. This phase of the contract work will include development of either rectified enlargements or digital planimetric Base Map Layers and corresponding digital Orthophotography as contracted by the County. The Pilot Test area will consist of 2 adjacent 1"=400' scale tiles and 2 adjacent 1"=100' scale tiles as a pilot area to test applicable production results and ensure delivery of all data in full compliance with Department of Revenue specifications. All Department of Revenue Data Specifications are compliant with Federal Geographic Data Committee Standards.

The Department of Revenue requires appropriate task training of County personnel for those "first time counties" receiving digital planimetric Map Base Layers and / or digital Orthophotography as set out in the delivery schedule. Formal introductory level product user training for County Cadastral Mapping employees will be conducted within 1 month from the Contractual Agreement date of delivery of the digital Base Map Layers and / or digital Orthophotography. The county and the contractor will mutually agree upon the training location and time frame.

The Department of Revenue requires that the contracted work done on all projects be completed by surveyors and photogrammetrists licensed in the State of Alabama.

3.2 AERIAL PHOTOGRAPHY - DIGITAL IMAGERY ACQUISITION

3.2.1 Project Area

The location, size and boundaries of the area to be photographed/imaged will be outlined on a county map at an approximate scale of 1 inch = 1 mile and further subdivided and designated in a way to show the scales of the final aerial photographs/images to be obtained. The areas to be photographed/imaged shall extend only to the boundary lines as indicated. This map shall be entitled the "County Area Map" and will be included with all proposals submitted. The flight plan proposed by the contractor shall be drawn on a similar county area map and submitted to the contracting authority for approval.

3.2.2 Atmospheric and Ground Conditions

Aerial photography/imagery will be accomplished during the period when deciduous trees are barren

(leaf-off). Photography/imagery will be flown between the hours of 10:00 a.m. and 2:30 p.m. and when the sun angle is not less than 30 degrees above the horizon. Photography/imagery will not be undertaken when the ground is obscured by snow, haze, fog, or dust; when streams are not within their normal banks; or when the clouds or cloud shadows will appear in any one photograph/image within the respective scale bounding limits or project county boundary. The photography/imagery shall not contain objectionable shadows caused by relief or low solar altitude.

3.2.3 Re-Flights

The contractor shall correct unacceptable aerial photography/imagery at no additional cost to the county. Re-flight coverage will overlap the accepted photography/imagery by a sufficient amount to provide for continuous stereoscopic coverage.

Scale of Aerial Photograph Negatives

Aerial photography shall be obtained for each respective map scale as specified below.

<u>Map Scale</u>	<u>Photo Scale</u>	<u>Above Ground Level</u>
1" = 400'	1" = 2,000'	12,000'
1" = 200'	1" = 1,320'	7,920'
1" = 100'	1" = 660'	3,960'

Negatives deviating from the Photo Scales by more than 2% shall be cause for rejection.

3.2.4 Scale of Digital Images

The three major Digital Cameras (sensors) developed to supplement or replace the film-based cameras were designed by each respective manufacturer to have different focal lengths and CCD sensor planes with differing pixel sizes. As a result, a standard fixed image scale and/or AGL values to be mandated by the user for each desired map scale couldn't be included in this document. However, the contractor will include in the proposal the planned Image scale, Above Ground Level height, sensor pixel Ground Distance Resolution and the expected horizontal and vertical accuracy of the perspective image center at time of collection. The Ground Distance Resolution of the imaging sensor will not exceed the final Ground Distance Resolution of the final Orthophotography. Images deviating from the proposed scale by more than 2% shall be cause for rejection.

3.2.5 Project Area Overlap

Overlapping photographs/images in each flight line shall provide full stereoscopic coverage of the project area. The first flight line of aerial photography/imagery will be flown to overlap the project's boundary by approximately 15% to 25% of the image area. The final flight line will provide this amount of project boundary overlap or greater. Each flight line will have a minimum of 2 principal points outside of the project area at the beginning and end of each flight line.

3.2.6 Endlap

Consecutive photographs/images in each flight line shall have an endlap of approximately 60% to insure stereo coverage. Overlap area expressed as a percentage will be no more than plus or minus 5%. Endlap error will average no more than plus or minus 2% for optimal coverage.

3.2.7 Sidelap

Sidelap will not be less than thirty (30) percent between parallel flight lines. Any point on any flight line will not deviate from its flight plan location by more than 10% of the width of coverage of the photograph/image. Sidelap error will average less than 5% for optimal coverage.

3.2.8 Crab

Crab in excess of three (3) degrees may be cause for rejection of a flight line or any portion thereof in which the excess crab occurs.

3.2.9 Tilt

Tilt of the camera from verticality at the instant of each exposure shall not exceed 3 degrees nor shall it exceed 5 degrees between successive exposure stations. Average tilt over the entire project shall not exceed one (1) degree.

3.2.10 Drift

Changes in course between successive photographs/images will not exceed 3 degrees.

3.2.11 Aircraft

The aircraft to be used shall be configured and equipped for aerial photography/imagery purposes with all essential navigational and photographic/sensor instruments and will be operated by a well-trained and experienced crew. Performance of the aircraft shall be adequate to complete the proposed project in accordance with the technical specifications. All operations shall be in conformity with the applicable official regulations and ordinances.

3.3 AERIAL PHOTOGRAPHY (applicable to Film based Analog Cameras only)

3.3.1 Aerial Camera

The aerial camera shall be a high precision aerial cartographic mapping camera of equivalent or better quality than a Leica RC-30, equipped with a low distortion, high resolution lens. The calibrated focal length of the lens shall be 153 millimeters + 3 millimeters (6" focal length). The camera shall expose a 9" X 9" size negative and produce a minimum of eight fiducial marks in each negative. It shall be equipped with adequate means of flattening the film in the focal plan to + .005"

at the instant of exposure. No glass will be permitted between the lens and the film. An appropriate anti-vignetting filter will be used. All of the aerial cartographic photographs of the same scale should be taken using the same camera. Differing mapping scales may use different cameras.

A USGS camera calibration report, no more than three years old, shall be submitted to the contracting officer for each aerial camera to be used to assure that the camera, lens, focal length, and its device for holding the film flat at the time of exposure are all photographically adequate and within acceptable accuracies. Maximum shutter speed and aperture setting shall be used to minimize image motion.

3.3.2 Aerial Film

Black and white aerial film shall be a fine grain high-speed photographic emulsion on a dimensionally stable base. The film must have been stored and handled in accordance with the manufacturer's instructions. Only one type of film shall be used for the entire project. Outdated film shall not be used.

Color aerial film will be high quality such as AGFA X100 or equal and must have been stored and handled in accordance with the manufacturer's recommendations. Only one type of film shall be used for the entire project. Outdated film will not be used.

3.3.3 Image Quality

Images on the aerial negatives shall be clear and sharp in detail and free from light streaks, static, marks, scratches, and other blemishes. Special care shall be exercised to insure proper development and thorough fixing and washing of all film, and to avoid rolling film on drums or in any way distorting it during processing or drying. Film shall be exposed and processed with a target density range of 1.0 ± 0.2 , as measured in the neat image areas of each roll of film. Minimum density, as measured with a densitometer with a scale range of 0 to 3.0 should not be less than 0.3 and the maximum density not greater than 1.5. All fiducial mark images shall be clear and sharp.

3.3.4 Film Labeling

Automated:

When available, all film labeling will be accomplished through automated means at the time of exposure. Data programmed into the camera system will be printed on the edge of the negative outside of the image area. Data will include Date of Photography, Scale, County Name, and Flight-Exposure numbers.

Manual:

Each exposure shall be clearly labeled at the edge of the negative just inside the image area and on the north edge for North-South flights. The labeling shall include the following information as a minimum:

DATE OF PHOTOGRAPHY
SCALE OF PHOTOGRAPHY
COUNTY NAME
FLIGHT-Strip & Exposure Number (12-24)

The "Scale of Photography" shall be given in inches, e.g., 1" = 24,000', etc. "Flight Strip" numbers are not to be repeated anywhere within the photographic coverage of the project, but will be numbered consecutively, starting with "Strip No. 1" and continued sequentially over all flight lines and scales. "Exposure Numbers" for any flight strip will be numbered consecutively from "Exposure No. 1", and continuing to the end of that flight line.

3.4 CONTACT PRINTS of AERIAL PHOTOGRAPHY
{{(Optional) (not available with Digital Camera Imagery}}):

One (1) set of contact prints of the original aerial negatives may be prepared on double-weight, semi-matte paper or equivalent weight resin-coated paper. All prints will be clear and free from chemicals, stains, blemished, fog, streaks, or any defects that would render them unusable. One set of contact prints will be delivered to the contracting officer for a quality control inspection as soon as they can be made available and prior to any reproductions.

3.5 SCREENED HALFTONE REPRODUCTIONS
{{(Optional) (not available with Digital Camera Imagery}}):

Halftones shall be screened on a matte finish, polyester film, and thickness being 4 mills. Sheet size shall be 30" x 30" to match existing tax map sheets. The enlargement factor will be that which matches each map sheet for each scale. Within the lower right hand corner, the corresponding tax map number will be in 1/2" high numbers in order to match the halftone with the map sheet. The county will provide the map sheets for the contractor to use while making the enlargements.

3.6 PAPER ENLARGEMENTS
{{(Optional) (not available with Digital Camera Imagery}}):

Paper enlargements shall be of a high quality, black & white, semi-matte finish and on medium weight paper. Sheet size shall be 30" x 30" to match existing tax map sheets. The enlargement factor will be that which matches each tax map sheet for each scale. Within the lower right hand corner, the corresponding tax map number shall be in 1/2" numbers to match the corresponding map sheet. The edges of each paper enlargement shall be bound with tear proof tape.

Locator Index:

The contractor shall furnish a locator index to assist county personnel in identifying the photograph from which the enlargements are made. One (1) index for each scale shall include flight line and exposure number of each photograph used for easy referral to map sheets.

3.7 DIGITAL CAMERA (sensor) IMAGERY

Digital Camera:

The digital camera shall be a high precision aerial photogrammetric mapping camera of equivalent or better quality than a Z/I DMC, equipped with a low distortion, high resolution lens. The sensor will have a calibrated focal length that will vary between manufactures. The Z/I DMC focal length is 120 millimeters (4.8"); Vexcel Imaging ULTRACAM-D has 100 millimeters (4.0") while the Leica ADS40 has a 62 millimeters (2.5") focal length. The sensor will be capable of full forward motion compensation and producing high geometrical resolution images in panchromatic (B&W), color (RGB) and IR. All of the digital images of the same scale will be taken using the same camera. Differing scales may use different cameras.

The respective digital camera manufactures provide an extensive calibration report and parameters with each respective camera to be used in the post processing raw imagery. Currently, USGS does not provide a camera calibration for digital cameras.

Direct Sensor Orientation (Bore site):

The vendor should perform a bore site misalignment for the direct sensor orientation that must be accomplished together with a system calibration including the focal length and principal point of the used digital array or metric camera. For digital array systems, direct sensor orientation must be accomplished using a minimum of two different flying heights similar to those required for county imagery.

3.8 GEODETIC CONTROL

(Alabama Height Modernization Program & Photogrammetric Control):

The Department of Revenue (DOR), Department of Transportation (DOT) and National Geodetic Survey (NGS), of The National Oceanic and Atmospheric Administration (NOAA) have entered a cooperative agreement to improve the Geodetic Control Network within Alabama through the NOAA developed Height Modernization Program. This effort is an evolving process for the State. The DOT has developed a 40 km Primary Base Station Network throughout the State and will provide direct management for the development of the Local Network Stations with the contractor and the DOR. The DOR will coordinate the development of the Local Network Stations as part of the GIS Base Map Layer and/or Digital Orthophotography contracts. The mapping consultants awarded the respective county contracts will incorporate Local Network Stations requirements in their production procedures.

The survey consultant will develop LNS permanent survey monuments within the County at locations in accordance with the NOAA Height Modernization Program (HMP) for Local Network Stations (LNS). All control will be coordinated with the County and the DOT, Locations Division prior to submission to NGS for final network plan approval. The consultant provided coordinate positions of all HMP/LNS survey control points will be developed from Global Positioning System

(GPS) technology on NAD83 (horizontal) and NAVD88 (vertical). All AHMP developed control points shall comply with NOAA Technical Memorandum NOS NGS-58 for Local Network Stations – 2-centermeter standard.

Consultant developed GPS Data will be submitted to the National Geodetic Survey as outlined in the NOAA Technical Memorandum NOS NGS-58, Appendix L and Input Formats and Specifications of the NGS Data Base – The NGS Bluebook.

Supplemental horizontal and vertical ground control in addition to the Local Network Stations may be required to support isolated 1"=100' and/or 1"=200' scale mapping areas. As a minimum all supplemental control will be marked with temporary monuments such as rebar/cap or PK nails. All Height Modernization Program control and supplementary photogrammetry control will be paneled with contrasting materials of sufficient size to be seen on the respective scale photography/imagery. All supplemental control shall be surveyed using GPS technology to meet Federal Geodetic Data Committee STD-007.2-1998.

Sufficient documentation shall be provided to verify that the Height Modernization Program Local Network Stations survey and supplementary photogrammetry control meets specifications. The survey shall be sufficient to yield mapping products that meet National Map Accuracy Standards at the scale of 1"=100', 1"=200' and 1"= 400' when utilized by a trained Photogrammetrist using film-based photography or digital imagery, analytical and/or softcopy technology in accordance with standard industry practice.

3.8.1 Coordinate System

The horizontal control shall be tied to the Alabama State Plane Coordinate System, North American Datum 1983 (NAD83), U. S. Survey Feet.

The vertical control shall be tied to the North American Vertical Datum 1988 (NAVD88), U.S. Survey Feet.

The County will be provided the Latitude, Longitude and Elevation (Ellipsoid height) as well as X, Y and Z coordinate values for all Height Modernization Program Local Network Stations and supplementary photogrammetric control stations.

3.8.2 Airborne GPS/Inertial Measurement Unit (IMU)

The Height Modernization Program Local Network Stations will provide sufficient horizontal and vertical control to support the airborne GPS/IMU and aero-triangulation solution. Flight plans shall indicate the locations of all control points to be collected. The use of IMU is optional. An A/T report will be available to provide statistical validation for the triangulation and/or IMU solution used in the production process.

3.9 GIS LAYERS

3.9.1 Digital Map Compilation

Digital map data (elevation/planimetric data) shall be compiled directly from the aerial photography or imagery using First Order Analytical or Digital stereo plotters. All photogrammetric digital map compilation shall meet or exceed the National Map Accuracy Standards for the map scales requested. A Certified Photogrammetrist must supervise the compilation process and the results will be delivered in a digital file format appropriate to the County's GIS software platform.

3.9.2 Digital Orthophotography

To attain photogrammetric accuracy standards, the scanned photography or digital imagery shall be rectified using the digital terrain model generated during the map compilation phase of the project. This shall be accomplished with software, which shall rectify the imagery on a pixel-by-pixel basis for relief and other distortions. This shall produce a scale-accurate digital photographic image. The tiled images shall have uniform density and tone and they shall be free of mismatched imagery. Orthophotography created from scanned photography should be free of scan lines, double exposures, out-of-focus images, and man-made artifacts introduced during scanning. Images shall be rectangular and maintain a minimum overlap with adjacent images in order to appear seamless when referenced together in each respective scale. The Department of Revenue reserves the right to require pilot test images to be checked for accuracy and quality. County and State cadastral mapping personnel will inspect and evaluate the Pilot Test imagery.

The following orthophotography tiles will be created:

Color or Black and White 1"=100' tiles with .5 foot pixels (minimum)

Color or Black and White 1"=200' tiles with 1 foot pixels (minimum)

Color or Black and White 1"=400' tiles with 2 foot pixels (minimum)

3.9.3 DTM/DEM

A countywide DTM/DEM shall be generated based upon terrain data extracted from the 1"= 660', 1"= 1,320' and 1"= 2,000' aerial photography. If digital imagery is used the applicable image scale and AGL will be based upon the vertical accuracy achievable by the respective sensor. Depending on the type of sensor a lower AGL may be required to support the vertical accuracy than required for horizontal only accuracy. The contractor will include in the proposal the planned Image scale, Above Ground Level height, sensor pixel Ground Distance Resolution and the expected horizontal and vertical accuracy of the perspective image center at time of collection of digital imagery to support county requirements for GIS Planimetric Mapping with Orthophotography or GIS Topographic Mapping with Orthophotography.

3.9.4 GIS Planimetric Mapping and Orthophotography DEM

An “automated elevation extraction software program” supplemented with terrain modeling breaklines where necessary, may be used for development of DEM surface for production of orthophotography. The developed surface will be reviewed and modified as necessary prior to use in the orthophoto rectification process. It must be understood that contours generated from this surface will not meet NMAS for the respective map scale.

3.9.5 Topographic GIS Mapping and Orthophotography DEM

The DTM shall consist of breaklines and elevation points that accurately define the character of the terrain with point spacing appropriate to the output scale and contour accuracy requirements. Breaklines will be collected at significant terrain breaks, hydrographic features and along manmade features such as road centerlines, edges of pavement, and shall contain disturbed area polygons. The DTM/DEM shall, as a minimum, be capable of supporting the generation of 2-foot contours covering 1" = 100', 4-foot contours covering 1" = 200' map scale areas and 8-foot contours in the 1" = 400' map scale areas. A county may require contours of a closer elevation detail at their discretion (for example: 1 foot or 2 foot contours in 1" = 200' map scale areas, etc). Spot elevations, when required, shall be compiled at the highest point of significant closed contours, at the lowest point of significant closed depressions, significant saddles and inactive quarries, road intersections, rail intersections, each end of decks of bridges at the road centerline, and at points visible through dense vegetation in obscured areas. Elevations shall also be included for the surface of lakes and large ponds.

3.9.6 LiDAR DEM (Optional)

A LiDAR option is available for surface generation and contour development and will be considered on a case-by-case basis. If LiDAR is a county requirement, specifications are available upon request.

3.9.7 Base Mapping Layers (Planimetric feature selection including optional)

The following is a list of basic DOR required planimetric features to be provided in the Base Mapping Layers. The DOR has provided the Counties with the opportunity to request additional optional planimetric features at an additional cost to the respective county. The DOR maintains a feature collection and portrayal specifications, to be provided to the selected contractors, in order to maintain consistency in planimetric features collected for all counties necessary to support a Statewide GIS.

1. Building Roof Outline
2. Paved Road (Edges of Pavement)
3. Un-Paved Roads (Edges of Traveled way - graded dirt surface or edge of tire tracks).
4. Centerlines - Paved Roads

5. Centerlines – Un-Paved Roads
6. Hydrography to include coastlines, rivers, streams, lakes, swamps, major ditches and ponds.
7. Bridges (Road & Railroad) and Overpasses
8. Geodetic Control (Alabama Height Modernization Control / Photogrammetry Control / Etc.)
9. Railroads, Spurs, Yards (active)
10. Airports (Runways & taxiways) & Helipads
11. Fences (property line, cross country, utility only) – optional transportation right-of-way
12. Dam's
13. Major utility lines (cross-country electric transmission, above-ground gas pipelines, etc.)
14. Towers (cellular, microwave, radio)
15. Additional planimetric features may be added based on client requirements.

3.9.8 Contour Information (Optional)

Contours at 2-foot intervals will be indexed at 10-foot intervals and shall be uniquely attributed to allow for display of heavier line weight. Indexes will be labeled at approximately 1500-foot intervals. The map area contours generated at 4-foot intervals shall have index contours at 20-foot intervals and labeled at approximately 3000-foot intervals. The map area contours generated at 8-foot intervals shall have index contours at 40-foot intervals and labeled at approximately 6000-foot intervals.

The following contour information shall be included as applicable:

Indexes
 Hidden Indexes
 Depression Indexes
 Hidden Depression Indexes
 Index Contour Labels
 Intermediate Contours
 Hidden Intermediate Contours
 Depression Intermediate Contours
 Hidden Depression Intermediate Contours

Contour information shall be delivered in the appropriate topologically structured format (free of crossing contours, pseudo-nodes, gaps, overshoots, etc.).

3.10 ACCURACY STANDARDS

3.10.1 Base Mapping

All surface level features on the final base mapping levels shall meet horizontal National Map Accuracy Standards (NMAS) for each respective mapping scale. All remaining inputs and processes (i.e. flight AGL, aerotriangulation control and methodology, scanner calibration, and sensor calibration) used in digital mapping production shall be sufficiently accurate to ensure that the final

product meets NMAS.

3.10.2 Digital Orthophotography

All surface level features on the final digital Orthophotography shall meet horizontal National Map Accuracy Standards (NMAS) for each respective map scale. All remaining inputs and processes (i.e. flight AGL, aerotriangulation control and methodology, scanner calibration, and sensor calibration) used in digital orthophoto production shall be sufficiently accurate to ensure that the final product meets NMAS.

3.10.3 Topographic DEM's

All surface (points & breaklines) data on the final digital elevation model developed for generation of contour information shall meet both horizontal and vertical National Map Accuracy Standards (NMAS) for each respective map scale. All remaining inputs and processes (i.e. flight AGL, aerotriangulation control and methodology, scanner calibration, and sensor calibration) used in DTM/DEM production shall be sufficiently accurate to ensure that the final product meets NMAS.

3.10.4 Contours

All contours generated shall meet both horizontal and vertical National Map Accuracy Standards (NMAS) for each respective map scale. All remaining inputs and processes (i.e. flight AGL, aerotriangulation control and methodology, scanner calibration, and sensor calibration) used in contour production shall be sufficiently accurate to ensure that the final product meets NMAS.

4 PLANIMETRIC MAPPING GUIDELINES

4.1 PLANIMETRIC COLLECTION REQUIREMENTS

The following guidelines will be used to collect Base Mapping Layer planimetric information through photogrammetric means where visible on the imagery.

4.1.1 Area

- a. Differing mapping scale areas are defined by the County Cadastral Tax Maps. Many of the 100-Scale and 200-Scale maps are not full sheet maps. In these cases all partial 100-Scale and 200-Scale sheets will be expanded to equal the respective quarter section or section. This action will hold true unless the respective map sheet is bounded by the County boundary.
- b. Data will be collected 100 ft beyond the County boundary. See hydrography – Double line Rivers.

4.1.2 Buildings

The building (roof outline) shall have at least one side with a minimum length, as outlined below for each respective scale, in order to be collected. Buildings will be compiled as closed polygons.

- a. 100 Scale: 20'
 - i. Do not collect window awnings as part of the structure.
 - ii. Collect covered porches/decks and carports if they are part of the roof outline.
- b. 200 Scale: 20'
 - i. Do not collect window awnings as part of the structure
 - ii. Collect covered porches/decks and carports if they are part of the roof outline.
- c. 400 Scale: 20'
 - i. Collect all qualified buildings and generalize roofline by not showing minor changes in rooflines i.e. dormers, window awnings, etc.

4.1.3 Paved Roads

Edges of Pavement will be captured where applicable for all paved roads. No distinction will be made between public and private.

- a. 100 Scale:
 - i. Inter-state/state highways: Edge of pavement does not include the shoulder. Collect on outside edge of “Fog Line”. Collect acceleration and deceleration lanes as part of the edge of pavement. Collect entrance and exit ramps as part of the edge of pavement. Collect edge of pavement for through ways of rest stops (not parking area).
 - ii. Multi-lane Roads - Divided: Collect edge of pavements for both interior (at base/edge of median) and exterior edges. If curbs exist in urban areas collect a base of curb. Do not include shoulders.

- iii. Multi-lane Roads – Not Divided: Collect edge of pavements for exterior edges. If curbs exist in urban areas collect a base of curb. Do not include shoulders. Do not show interior turn lanes.
 - iv. County Roads: Majority of the county roads does not have shoulders. Collect actual “edge of pavement”.
 - v. Urban areas streets: collect “edge of pavement” at the base of curb when present.
 - vi. Collect Edge of pavement across top of bridges and overpasses. Do not breakline across these features.
 - vii. Collect roads in apartment complexes and industrial areas.
 - viii. Collect Edge of pavement below bridges and overpasses.
 - ix. All Edge of pavements will be collected concurrently with an associated breakline except bridges when crossing over and overpasses.
 - x. Edge of pavements will connect cleanly at all intersections, acceleration and deceleration lanes and at adjacent model ties. There will be a smooth transition from low to higher scales.
 - xi. A paved surface leading to two (2) or more residences is considered a paved road. Collect from the main road to the apparent driveway entrance and close off.
 - xii. Collect all edge of pavement to 100 ft past the scale/project boundary.
- b. 200 Scale:
- i. Inter-state/state highways: Edge of pavement does not include the shoulder. Collect on outside edge of “Fog Line”. Collect acceleration and deceleration lanes as part of the edge of pavement. Collect edge of pavement for through ways of rest stops (not parking area).
 - ii. Multi-lane Roads - Divided: Collect edge of pavements for both interior (at base/edge of median) and exterior edges. If curbs exist in urban areas collect a base of curb. Do not include shoulders.
 - iii. Multi-lane Roads – Not Divided: Collect edge of pavements for exterior edges. If curbs exist in urban areas collect a base of curb. Do not include shoulders. Do not show interior turn lanes.
 - iv. County Roads: Majority of the county roads does not have shoulders. Collect actual “edge of pavement”.
 - v. Collect Edge of pavement across top of bridges and overpasses. Do not breakline across these features.
 - vi. Collect Edge of pavement below bridges and overpasses.
 - vii. All Edge of pavements will be collected concurrently with an associated breakline except when crossing over bridges and overpasses
 - viii. Edge of pavements will connect cleanly at all intersections, acceleration and deceleration lanes and at adjacent model ties. There will be a smooth transition from low to higher scales.
 - ix. A paved surface leading to two (2) or more residences is considered as a paved road. Collect from main road to the apparent driveway entrance and close off.
 - x. Collect all edge of pavement to 100 ft past the scale/project boundary

- c. 400 Scale:
 - i. Inter-state/state highways: Edge of pavement does not include the shoulder. Collect on outside edge of “Fog Line”. Collect acceleration and deceleration lanes as part of the edge of pavement. Collect edge of pavement for through ways of rest stops (not parking area).
 - ii. Multi-lane Roads: Collect edge of pavements for both interior (at base/edge of median) and exterior edges. Do not include shoulders.
 - iii. County Roads: Majority of the county roads does not have shoulders. Collect actual “edge of pavement”. If possible – collect centerline and copy parallel for each edge of pavement.
 - iv. Edge of pavements will connect cleanly at all intersections, acceleration and deceleration lanes and at adjacent model ties. There will be a smooth transition from low to higher scales.
 - v. A paved surface leading to two (2) or more residences are considered as a paved road. Collect from main road to the apparent driveway entrance and close off.
 - vi. Collect all edge of pavement to 100 ft past the project boundary.

4.1.4 Un-Paved Roads

Edge of Traveled Way (graded dirt surface or edge of tire tracks) will be captured as unpaved roads.

All scales:

- a. An unpaved surface leading to two (2) or more residences are considered as an un-paved road. Collect from main road to the apparent driveway entrance and close off.
- b. Do not include logging roads, temporary construction roads or off road vehicle trails, etc.
- c. Trails do not need an associated breakline unless the roadbed goes through a significant cut or fill.
- d. Trails will connect cleanly at all intersections and at adjacent model ties. There will be a smooth transition from low to higher scales.

4.1.5 Paved Road Centerlines

Centerlines shall be captured for all paved traveled ways throughout the County as follows (all scales):

- a. General Instructions:
 - i. Centerlines will be carried across and under bridges and overpasses.
 - ii. Minimum vertices will be used during collection intersection to intersection and with sufficient number of vertices to maintain curves in the traveled way.
 - iii. Centerlines for small “Y” type intersections will be extended through the “Y” median and extended to the crossing road forming a “T” intersection. This only applies to centerlines.
 - iv. Centerlines at intersections will be snapped with vertices at the true center of intersection.
 - v. Associated breaklines are not required with centerlines on this project.

- b. Interstate Highways:
 - i. One centerline will be collected at the center of each set of same direction traffic flow lanes (i.e. Northbound) and one centerline for the opposite direction (i.e. Southbound) will be collected at the center of each set same direction traffic flow lanes.
 - ii. Centerlines will be collected for exit and entrance ramps and connected to the main paved road centerline.
 - iii. Centerlines will be collected at rest-stop areas and connected to exit/entrance ramps.
 - iv. Do not collect centerlines for acceleration or deceleration lanes.
 - v. Centerlines will be collected for emergency vehicle crossovers.

- c. Multi-lane Divided with median:
 - i. One centerline will be collected at the center of each set of same direction traffic flow lanes (i.e. Northbound) and one centerline for the opposite direction (i.e. Southbound) will be collected at the center of each set same direction traffic flow lanes.
 - ii. A centerline will be developed for lane crossovers i.e. center between breaks in median.

- d. Multi-lane Not-Divided:
 - i. One centerline will be collected for the multi-lane road dividing opposite directions of traffic flow. If there is a “center turn lane” the centerline will traverse the center of the turn lane.
 - ii. If the multi-lane becomes divided, with median, for less than 500' continue the centerline through the median. If the multi-lane becomes divided for a city block or more use the rules for *Multi-lane Divided with median*.

- e. Two-lane Road:
 - i. One centerline will be collected for the two-lane road dividing opposite directions of traffic flow.
 - ii. If a passing lane exists the centerline will continue to be placed at the center dividing opposite directions of traffic flow.
 - iii. If the two-lane becomes divided, with median, for less than 500' continue the centerline through the median. If the two-lane becomes divided for more than 500' use the rules for *Multi-lane Divided with median*.

4.1.6 Unpaved Road Centerlines

- a. General (all scales):
 - i. Centerlines will be carried across and under bridges.
 - ii. Minimum vertices will be used during collection intersection to intersection and with sufficient number of vertices to maintain curves in the traveled way.
 - iii. Centerlines for small “Y” type intersections will be extended through the “Y” median and extended to the crossing road forming a “T” intersection. This only applies to centerlines.

- iv. Centerlines at intersections will be snapped with vertices at the true center of intersection.
 - v. Associated breaklines are not required with centerlines on this project.
- b. Centerlines shall be captured for all collected unpaved traveled ways throughout the County.

4.1.7 Hydrography

- a. General:
- i. Hydrography must maintain connectivity throughout the County.
 - ii. Hydrography features will continue under bridges and through culverts.
 - iii. Breaklines will be collected concurrently with all hydrography features with the exception of features represented with hidden lines.
 - iv. Use the USGS 30 x 60 Series Map (1:100000) as a collection guide for distinction river/stream.
 - v. Do not distinguish between Man-made and natural shorelines unless client makes a special requirement.
- b. Rivers Double line:
- i. Rivers are considered as flowing bodies of water greater than:
 - (1) 100 ft wide for 100 Scale
 - (2) 20 ft wide for 200 Scale
 - (3) 40 ft wide at 400 Scale
 - ii. River shoreline will be collected at edge of water line for both sides of the river.
 - iii. Discretion will be used to minimize frequent switching between single and double line representations where the river width is either more or less than specified width over relative short distances.
 - iv. When rivers are portrayed as the county boundary or mapping limits the far bank will be collected.
- c. Rivers Single line:
- i. Rivers are considered as flowing bodies of water but “less than”
 - (1) 10 ft wide for 100 Scale
 - (2) 20 ft wide for 200 Scale
 - (3) 40 ft wide at 400 Scale
 - ii. Discretion will be used to minimize frequent switching between single and double line representations where the river width is either more or less than specified width over relative short distances.
- d. Streams (all scales):
- i. Collect all significant (wet or dry) streams within the mapping area. Use the 100K map as a guide – if it’s on the map collect.
 - ii. Snap stream cleanly to other hydrography features (i.e. lake spillway, ponds, rivers etc).

- e. Lakes: Lakes are basically of two types: one being a closed bodies of water greater than 5 acres and two a large standing body of water created by building a dam at given points along rivers creating a recreational areas and/or for the purpose of water reservoirs.
 - i. Collect all Lakes at the interpreted mean water level
 - ii. Lake (shorelines), where created on rivers, will take precedence over river shorelines. Carefully determine the confluence of the river and lake to determine change in feature codes.
- f. Ponds: A closed body of water less than 5 acres.
 - i. Collect all ponds in 100 and 200 scale areas.
 - ii. Collect ponds in the 400 scale area that are identifiable
- g. Ditches (Major). Collect all major ditches, 100 ft in length or longer used to drain and or irrigate fields, pastures, swamps etc.
- h. Swamp (wetlands): collect all swamps that are identifiable.
- i. Coastlines: Collect all coast lines at the mean water level

4.1.8 Bridges/Overpasses

- a. Collect extent of bridge deck for all highway and road bridges.
- b. Collect extent of overpass deck for all highway and road overpasses.
- c. Collect extent of bridge deck for all Railroad bridges.
- d. Do not collect bridges for driveways.

4.1.9 Railroads

(active) Collect only active railroads:

- a. General:
 - i. Collect all railroads that cross railroad bridges or that may go under road bridges.
 - ii. Associated breaklines should be collected concurrent with the centerlines with the exception of bridge crossings.
- b. Single Track: Collect a single centerline between the pair of rails.
- c. Multiple Track: Collect a single centerline between each pair of rails.
- d. Spurs/Sidings: Collect a single centerline between each pair of rails of the spur and sidings. Minimum length of siding and spur will be 50 ft.
- e. Rail yards: Collect a single centerline between each pair of rails in the rail yard.

4.1.10 Airports

- a. Collect all paved runways and taxiways.
- b. Collect all unpaved runways visible on the imagery.
- c. Collect all paved helipads visible on the imagery.

4.1.11 Fences

(property line, cross country) (Note: right-of-way is optional feature)

- a. General:
 - i. Maintain connectivity where possible i.e. within a tree line
 - ii. Do not collect connector fences i.e. property line fence to a house.
 - iii. Do not collect internal fences i.e. pig pens, breeder lots etc.
 - iv. Do not cross driveways
- b. Collect transportation right-of-way fences (optional)
- c. Collect all cross-country fences
- d. Collect all fences defining property divisions
- e. Collect fences around public utilities i.e. cell towers, pumping stations, power stations.

4.1.12 Dam's

- a. Collect concrete dams and spillway
- b. Collect major man-made earthen dams

4.1.13 Major Utility Lines

- a. Cross Country Power lines:
 - i. Collect base of steel tower legs/poles for significant cross-country power transmission lines. A specific feature point symbol will be placed at the base of each leg/pole.
 - ii. Do not collect electrical power poles, telephone poles, streetlight etc. along transportation routes, driveways, within parking lots, athletic fields, etc.
 - iii. Do not collect transmission lines.
- b. Pipelines
 - i. Collect all "visible" (above ground) pipelines.
 - ii. Do not collect pipelines based on vegetation clearings and or scars.
 - iii. Do not collect breaklines for pipeline features.

4.1.14 Towers (cell, microwave, radio)

- a. Collect “stand-alone” towers as a point feature and attribute with type if possible.
- b. Do not collect whip antennas, Ham Radio Towers, etc.

4.1.15 Additional Planimetric Features

- a. Features may be added upon mutual agreement between the County and the Contractor.
- b. The County and Contractor will agree upon content and depiction within the final product.

4.2 DIGITAL ELEVATION MODEL COLLECTION REQUIREMENTS (Supporting Orthophotography Only Projects)

Auto correlation programs can be used to develop a DEM surface model to be used with the ortho rectification process. However, a stereo operator must quality review the generated surface models to remove any anomalies in the generated process and to add breaklines as necessary to support generation of quality orthophotography. DEM data will be collected at a minimum of 100 ft beyond the extent of the deliverable orthophotography tile.

4.3 DIGITAL ELEVATION MODEL COLLECTION REQUIREMENTS (Supporting Topographic Contour Generation Projects)

A combination of stereo compiled mass-points (point elevations) and breaklines will be collected in order to define the shape of the surface. Breaklines will be collected for all features impacting a change in the surface. DEM data will be collected at a minimum of 100 ft beyond the extent of the deliverable orthophotography tile and contour limits.

4.3.1 Mass Points

Mass points will be collected to supplement Breaklines with an optimum density to support 2' (two foot), 5' (five foot) and 10' (ten foot) contour intervals for 1"=100', 1"=200' and 1"=400' topographic mapping respectively. The stereo operator has the authority to place mass points where necessary to properly reflect the true terrain. Mass points will not be placed on buildings, storage material piles/areas or in bodies of water. Ground obscured areas will be outlined at the last visible surface elevation. Every effort should be made to place mass points within the ground obscured area where the surface is visible. The mass points along, with the breaklines, will be used in the development of DTM, TIN and DEM.

4.3.2 Hard Breakline Data

Hard Breakline Data will be placed at the following locations if they impact the surface and depiction of the contours:

- a. Edge of Pavements – Transportation, parking lots and driveways where they impact the surface – Edge of pavement and breaklines at edge of pavement **will coincide** horizontally ensuring contours break at the edge of pavement
- b. Retaining walls – top at ground level & bottom at ground level
- c. Hydrographic Features (breaklines and their associate hydrographic features **will coincide**)
- d. Shorelines
- e. Streams
- f. Drains/ditches
- g. Cliffs – Top and base (top & toe)

4.3.3 Soft Breakline Data

Soft Breakline Data will be placed at the following locations if they impact the surface and depiction of the contours:

- a. Transportation Road crowns
- b. Railroad – C/L, bridges, raised right of ways, and cuts and fills
- c. Top of riverbanks - (breaklines and their associate hydrographic features **will coincide**)
- d. Swamps/marshes
- e. Inundated (flooded) area
- f. Ground obscured polygon
- g. Levees - Top edges and base (top & toe)
- h. Main Ridge Line
- i. Small topographic changes impacting surface
- j. Cuts and fills (top & toe)

4.4 DIGITAL ORTHOPHOTOGRAPHY REQUIREMENTS

4.4.1 Surface Data

The digital image, regardless of source, must be rectified to the respective DEM generated from the source photography/digital imagery for this project or from a validated DEM from previous mapping. A USGS DEM will not be used unless previously authorized by the Department of Revenue and the County.

4.4.2 Image Source

The orthophotography can be developed from either scanned aerial photography or imagery from a digital camera. In either case the input pixel resolution will be less than the final output orthophotography pixel size (ground distance resolution).

4.4.3 Tile Size

The final Orthophotography Tile Size should be based on a “Minimum Bounded Rectangle” centered over the respective quarter section (100-Scale), section (200-scale) and 4 (Quad) Sections (400-Scale).

- a. Due to the nature of the PLSS not being consistent in size and square shape, a “standard” minimum bounded orthophotography tile should be developed from the largest “average” quarter section, section or Quad Sections. Each tile should overlap each adjacent orthophotography tile by a minimum of 50 ft for 100-Scale, 100 ft for 200-Scale and 200 ft for 400-Scale to insure a seamless file appearance when two or more files are referenced together. Care should be taken where differing scales overlap.
- b. Tiles that cover the respective County or County/State boundary will be designed to be smaller than the minimum bounded rectangle established for the normal tile. However, smaller minimum bounded rectangle must provide for the minimum overlap.
- c. Differing size minimum bounded rectangle tile size for abnormally large or small tiles covering unusual areas i.e. along major rivers, Freeman Line, St. Stephens Meridian should be discussed with the County.

4.5 COMPRESSED FILES

Compressed files (example: *Mr. Sid*) may be generated to meet individual County needs.

4.6 FILE NAMING CONVENTIONS

File naming conventions will be provided by the County

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GLOSSARY

Deed Terms

1. Auctioneer's Deed: Deed issued by a person authorized to auction property for unpaid debts. Auctioneer can only sell – not buy
2. Bargain and Sale Deed: Conveys all of the grantor's interest in the property but usually does not contain warranties as to the title of the property conveyed; however, the grantor claims to have possession or an interest in the property conveyed. Trustees, executives and officers of the court often convey property under their control by way of a bargain and sale deed.
3. Bond for Title: Agreement to make title in the future if all aspects of the contract are met.
4. Condemnation Deed: Used to convey property taken by a judicial or administrative proceeding after the power of eminent domain (the power of government to take private property for public use) is exercised.
5. Court Decree: When a court rules on ownership of property and rules you must give or get a deed for said property as in boundary dispute or agreement.
6. Deed of Correction: Is used to correct errors in a prior deed, for example, changing the description of a parcel when the property is resurveyed and an error is discovered. A grantee can force a grantor to execute a deed of correction if the original deed contained a covenant of further assurance.
7. Easement Deed: Conveys a property interest (short of an estate) that one person has in land owned by another, entitling the holder of the interest to limited use of the other's land.
8. Eminent Domain Deed: Right of the government to take private property for public use with just compensation.
9. Executor Deed or Administrative Deed: The legal proceeding by which the affairs of descendants are resolved and their estates distributed, including their real property. An executor is appointed by a testator to carry out the directions of a will. An administrator is appointed by a court to settle the estate of a person who has died intestate.
10. Foreclosure Deed: Deed to shut out, destroy, bar an equity right of redemption.
11. Grant Deed: Grantors warrant that they have not previously conveyed the estate being granted to another, that is not encumbered except as noted in the deed, and that the grantor will convey to the grantee any title to the property that he or she may later acquire.

12. Installment Deed (Sales Contract): Provides for payment of the purchase price in installments and conveyance of title on completion of payments.
13. Leases: Agreements, written or unwritten, transferring the right to exclusive possession and use of real estate for a period of time. A valid lease must provide for reversion of the property from the lessee back to the lessor. The lessor's interest is termed "leased fee simple" and the lessee's interest is "leasehold".
14. Lien: Claim made by one person upon the property of another for nonpayment of a debt or obligation. Types of involuntary liens are: tax lien (statutory lien imposed against real property for payment of taxes), mechanics lien (a lien to secure payment for materials supplied and services rendered), and judgment lien (general lien on both real and personal property).
15. Life Estate: Grantor retains right of use and all other rights except right to sell, destroy or alter for duration of his life. After death the property reverts to the grantee. Grantee may sell property – subject to the life estate already provided for.
16. Mineral Deed: Conveys all or a portion of the mineral rights. It may be specific identifying only one mineral being conveyed; or general, conveying any and all minerals.
17. Partition Deed: Persons possessing real property, either as joint tenants or as tenants in common, divide the property they hold in common among themselves, each taking a distinct part.
18. Quitclaim Deed: Operates, in effect, as a release of whatever interest the grantor has in the property. Grantors of quitclaim deeds do not warrant title or possession; they only pass whatever interest they may have, if in fact any exists.
19. Registrar Deed: Court decree for property has to have a deed issued by the Registrar to have binding title.
20. Sheriff's Deed: Document giving right to another by sale by Sheriff to pay judgment against grantor.
21. Special Warranty Deed: The grantor warrants or guarantees title only against defects arising during the period of his or her tenure and ownership of the property and not against defects existing before that time. A special warrant deed is often used by executors or trustees when conveying the property of their principal, as they usually have no authority to warrant against acts of their predecessors in title.
22. Survivorship Deed: Deed whereby joint tenancy exists. Title passes to the survivor upon the death of one of the parties.
23. Tax Deed: Document giving title to another person when grantor fails to pay property taxes, sold for at least amount of taxes. After three years redemption period, a tax deed is issued. After seven years a quiet title warranty deed may be issued.

24. Timber Deed: Conveys the right to harvest growing timber within a specified time and area.
25. Trust Deed: Transfers legal title of property to a third party trustee as security for repayment of a loan or performance of other conditions.
26. Vendor's Lien: Creation of equity, lien belonging to purchaser for unpaid price of land.
27. Warranty Deed: The grantor warrants the title against defects arising before and during the time the grantor owned the land. The usual covenants of title contained in a warranty deed are:
 - a. Covenant of Further Assurance: Obligates the grantor to perform any acts necessary to perfect the title to the grantee. Used to force grantor to execute a correction deed if an error is found in the original.
 - b. Covenant Against Encumbrances: Guarantee against all encumbrances not specifically accepted in the deed.
 - c. Covenant of Quiet Enjoyment: Guarantee from grantor that grantee will have no acts or claims from third parties.
 - d. Covenant of Seizing: Guarantee that the grantor owns the property and has the right to sell.
 - e. Covenant of Warranty Forever: Guarantee from grantor to bear the expense of defending the grantee's title to the property in the event that a third party asserts a rightful claim.
28. Wills: A vesting instrument that leaves real and personal property to certain individuals as a person desires after death. A Will may be changed and/or revoked until death. Examples: Verbal, Holographic, Joint, and Conditional.

Abbreviations For Writing Descriptions In Brief Form

<u>Term</u>	<u>Abbreviation</u>
Acre	Ac.
Addition	Add.
Angle	Ang.
Assessors	Ass'ors.
Beginning	Beg.
Between	Bet.
Bound	Bd.
Boundary, Boundaries	Bdy., Bdrs.
Block	Blk.
Center	Cen.
Center Line	C.L.
Chain	Ch.
Commerce	Com.
Commencing	Com.
Continue	Cont.
Continuing	Contn.
Continued	Contd.
Corner, Corners	Cor., Cors.
Correction	Corr.
Correction Deed	Corr D
Dedication	Ded.
Deed in Error	D.I.E.
Description	Desc.
Degree	Deg.
Distance	Dis.
District	Dist.
East	E.
Easement	Esmt.
Except	Exc.
Foot or Feet	Ft. or ‘
Fourth	1/4
Fraction	Fr.
Fractional	Frl.
General Land Office Survey	G.L.O.
Government Lot	Gov't Lot
Half	1/2
Highway	Hwy.

Incorporated	Inc.
Inch, Inches	in.
Intersection	Int.
Joint Survivorship Deed	JSD
Left	Lt.
Liber	L.
Link, Links	Lk., Lks.
Meridian	Mer.
Mile	Mi.
Minutes	M.
More or Less	M. or L. or M/L
Miscellaneous	Misc.
North	N.
Northeast	NE.
Northwest	NW.
Northeasterly	NE'ly
Northwesterly	NW'ly
Number	No. or #
Original	Orig.
Page	P.
Parallel	Par.
Point	Pt.
Point of Beginning	P.O.B.
Quarter	Qtr. or 1/4
Quit Claim Deed	QCD
Radius	Rad.
Railroad	R.R.
Railway	Rwy.
Range, Ranges	R., or Rng.
Reserve	Res.
Right	Rt.
Right-of-way	R/W or R.O.W.
Rods	Rds.
Running	Rng.
Sales Contract	SC
Seconds	S.
Section, Sections	Sec., Secs.
Square	Sq.

South	S.
Southeast	SE.
Southwest	SW.
Southeasterly	SE'ly
Southwesterly	SW'ly
Street	St.
Streets	Sts.
Subdivision	Sub.
Supervisor, Supervisors	Super., Supers.
Thence	Th.
Town	T.
Township, Townships	Twp., Twps.
Unincorporated	Uninc.
Undivided	Und.
Variation	Var.
Village	Vill.
West	W.
Westerly	W'ly

Plotting Terms

1. Angles

a. Interior Angle 61 degrees

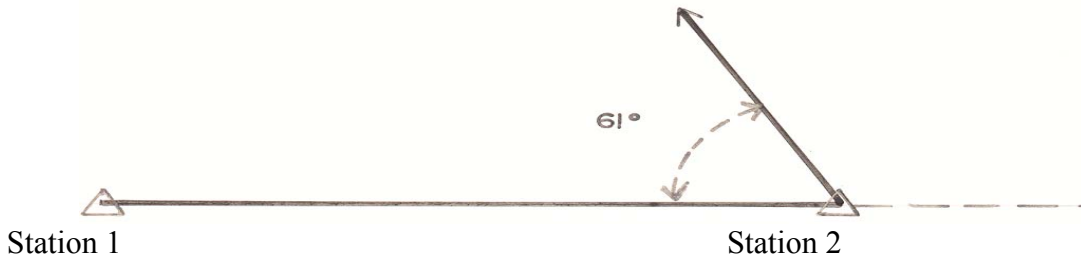


Fig. 15

b. Deflection to the right 39 degrees - 40'

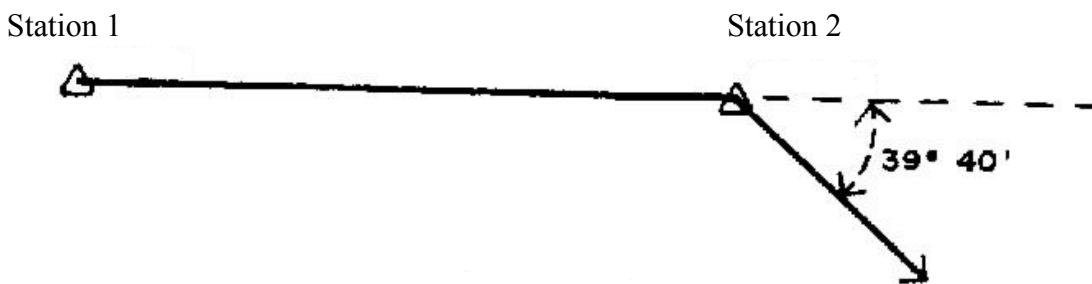


Fig. 16

c. Deflection angle to the left 39 degrees - 40'



Fig. 17

2. Azimuth: An angle usually measured from the north in a clockwise direction not exceeding 360 degrees.

3. Bearing: An angle measured from north or south to east or west, not exceeding 90 degrees.
4. Block: A tract or piece of land within a subdivision bounded by streets and/or the subdivision boundary. This is usually broken down into smaller units called lots.
5. Contour Interval: The vertical distance between contour lines.
6. Contour Lines: Connect together all points of the same elevation. They must always close back on themselves or run off the map. Also they never cross except where there is an overhanging cliff or cave.
7. Control: Any point or line that can be used as a base from which other points and lines can be plotted.
8. Culvert: A drainage structure, by which storm water is passed under a road, but is not a bridge.
9. Curves:

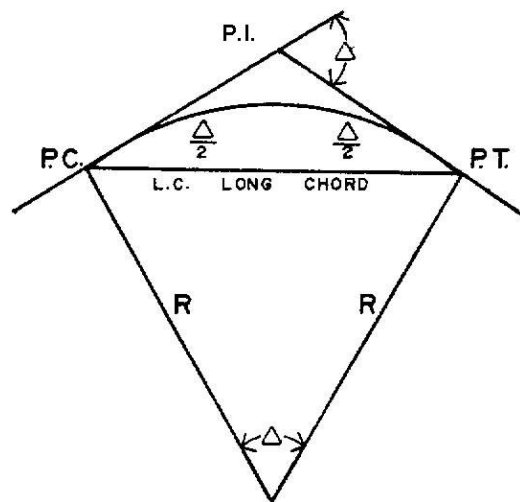


Fig. 19

- a. Delta: " Δ " The angle made by the two radii from the center of the arc to the point of tangency and point of curvature. The angle made by either tangent and the long chord is equal to $\Delta/2$
- b. Long Chord: "L" or "LC" the chord from the point of tangency to the point of curvature.
- c. Point of Compound Curve: "C" A point at which a curve of one radius changes to another of a different radius but in the same direction.
- d. Point of Curvature: "PC" The beginning of the curve..

- e. Point of Intersection: "PI" The point at which the two tangents meet. The deflection angle at this point is equal to delta.
 - f. Point of Reverse Curvature: "PRC" A point at which a curve in one direction ends and another curve in the opposite direction begins.
 - g. Point of Tangency: "PT" The point at which the curve ends.
 - h. Radius: "R" The distance from the tangent to the center of curve or arc. *Note: Radii are always perpendicular to the tangents at the point of curvature and the point of tangency.*
 - i. Tangent Distance: "T" The distance from the point of curvature to the point of intersection or from the point of intersection to the point of tangency which distances are always equal for any given curve.
10. Double Assessment: Any piece of land that is entered twice on the tax roll.
 11. Easement: A property interest that entitles the holder to limited use of another's land. The more common types are easement by necessity (provides access to landlocked property), easement by gross (utility service), and negative easement (prevents owner of land from obstructing another's view).
 12. Encroachment: Is the unauthorized placing of a fixture on another's property. It can be either a trespass (actually on another's land) or a nuisance (violation of air space).
 13. Fractional Section: A section that does not have the full 640 acres due to the original survey that was made.
 14. Highway Survey Stations: Indicated 125 + 70.5. The 125 indicates chaining pins or 100 foot marks so that this would equal 12,570.5 feet from the beginning of the survey.
 15. Line: A series of points that has **BOTH** direction and length.
 16. Lot: The smallest unit of a subdivision
 17. Make-up: The cutting and arrangement of maps that are to be used in the field for the location of parcels and buildings.
 18. Map: A drawing showing an area that includes more than one subdivision or acreage parcel.
 19. Meander Lines: A traverse that generally follows the shore line of a lake or river. Usually this refers to the mean high water mark. This is not used as a boundary line for properties that butt on the water unless the deeds specifically state that it shall be the boundary line or in the case of a government lot.

20. Meridian: A center line running north and south from which ranges are measured and numbered or a center line running east and west from which townships are measured and numbered.
21. Metes and Bounds: A legal description of a tract of land using distance, direction and land references except where reference is made to a plat.
22. Monument: Anything whether natural or artificial, which is used to designate a point of reference.
23. Parcel: Any piece of property, undivided and owned by one party, although the party may consist of more than one person. This may consist of a fractional lot or lots in a subdivision, or acreage.
24. Parceling: The act of plotting ownership boundaries on a map whether in subdivisions or metes and bounds.
25. Pavement Line: The line showing the edge of the pavement of a road but is not to be confused with a property line or right-of-way line.
26. Plat: A drawing showing boundaries with its respective rights-of-way, easements, blocks, lots, etc. (Also: see "Subdivisions")
27. Plot Plan: A drawing showing one parcel and location of the improvements on it.
28. Point of Beginning: "POB" The point at which the description of a parcel of land actually begins, not to be confused with the point of commencement. A description may read: "Starting (or commencing) at a point on the N side of State Rd. #20 - said point being N 720' and W 1,225' of the SE corner of Sec. 15, T25, R 3W - from said point run 300' due W to **POINT OF BEGINNING** from said point of beginning run thence.
29. Projections: The term used to refer to the various ways of showing the surface of a sphere on a flat surface. The most common one that we use is simply a grid in which all sides are equal and opposite sides are parallel.
30. Property Line: The line showing the boundary and enclosing all the property in question.
31. Public Utilities: A group of service companies, such as railroad, telegraph, electric, and natural piped gas and telephone.
32. Range: Six lineal miles running east and west from a given meridian, or from another parallel range line.
33. Right-of-Way (R/W) : Any tract of land that has been procured by a sale, lease or dedication for the passage of persons or vehicles other than the original owners, but may include them.
34. Riparian Boundaries: Where a non-navigable stream serves as a boundary line, it is

common law that ownership extends to the center or thread of the stream. It is impossible in many situations to say whether a stream is to be regarded navigable or non-navigable. In addition, courts often differ somewhat in defining the term "thread of stream." It is sometimes defined as the line midway between shorelines, but the more common interpretation defines it as the center of the main channel. Perhaps the best interpretation can be made through reference to the individual deed. Many deeds for tracts along shore lines of ponds, lakes, or streams will have the riparian rights of an owner defined. Through reliction (the gradual recession of a shoreline) or alluvium (the gradual deposition of soil so as to increase the area of contiguous land), the riparian owner has often suffered a loss or experienced a gain in acreage owned. Recent plats of subdivided areas with lakes or streams will indicate any riparian boundaries.

- a. Many public land surveys in the United States will have traverses called meander lines, run roughly following the bank of a stream or lake where regular corners fall in the water. Riparian boundaries often stop at this meander line.
35. Section: One square mile = 640 acres. An arbitrary division of land containing 640 acres more or less. The boundaries run north and south and east and west more or less.
 36. Subdivision: A tract of land that has been divided into blocks and lots with the necessary streets and for which a plat has been drawn to show them. In the case of a recorded subdivision, the plat takes the place of a metes and bounds description for parcels within the subdivision; i. e., Lot 2, Block C, as recorded in Plat Book 3, Page 147, instead of the East 100' of the North 200' of N 1/2 of the SE 1/4 of the SE 1/4 of the NW 1/4, Section 14, Township 2 N, Range 3 E.
 37. To Plot: To lay out to scale a map, plat or plot plan.
 38. Township: Either 36 square miles or when used in conjunction with ranges six lineal miles running north or south from a given meridian, or from another parallel township line.
 39. Traverse: A series of lines, with their descriptions, that have been run in the field by a surveyor. This is sometimes encountered as a metes and bounds description of a piece of property.

Computer Mapping Terms

1. Base Map Data Base map data are coordinates referenced to the geographic control for planimetric features that can be seen from an airplane. For example, rivers, lakes, streams, travel paths, and railroad tracks may be included.
2. Cadastral Data Cadastral data are the graphic information describing parcels. These data include property corners, boundaries, and parcels of land.
3. Computer Assisted Mass Appraisal(CAMA) A computerized system of appraising property that incorporates statistical analysis to assist the appraiser in estimating value. (See Department of Revenue CAMA Specifications.)
4. Computer-Aided Design (CAD) An automated system for the design, drafting, and display of graphical information. Typically it has additional features for drafting, such as dimensioning and text entry.
5. Computer-Aided Mapping (CAM) Mapping software that typically uses a vector format without topological links.
6. Coordinate Geometry(COGO) Mapping software that calculates locations using bearings and distances. It is used to recreate tax maps from existing plat and deed information. Basically, COGO uses the distances and bearings recorded on the plat to create the tax map.
7. Contour Map A topographic map that portrays relief by means of contour lines indicating elevation above a datum, usually mean sea level.
8. Data Conversion Translating data from one format to another, usually in order to move it from one system to another.
9. Database A set of interrelated files that is created and managed by a database management system typically an electronically stored collection of data.
10. Database Management System (DBMS) Software that controls the organization, storage, retrieval, security and integrity of data in a database. It accepts requests for data from the application program and instructs the operating system to transfer the appropriate data.
11. Data set A collection of data with a common theme.
12. Datum A datum is any quantity that may serve as a reference basis for calculation of other quantities such as coordinate systems. Most fall into two categories, horizontal and vertical. There are two widely accepted horizontal datums in the United States. The North American Datum of 1927 (NAD 27), and the North American Datum of 1983 (NAD 83), which is a more recent model of the earth.
13. Digital Traditionally the use of numbers and comes from digit. Computers process information as combinations of binary digits (bits).

14. Digital Orthophotography This is the process of converting orthophotographs into a computer readable image through the use of a digitizing scanner. Once captured by the computer, planimetric line maps can be viewed at the same time with the orthophotograph image.
15. Digitizing A common form of digitizing is manual, or trace, digitizing. This process involves placing a map on a digitizing board, registering the map to a digital database and then tracing the lines on the map with a puck or cursor. Trace digitizing captures maps and drawings as vector data. "Heads-up" digitizing involves scanning the map to create a raster image and then digitizing the raster image to create a vector image.
16. Dots per Inch (DPI) A measure of printer resolution. A 300 dpi printer means 90,000 dots are printable in one square inch (300x300).
17. Download To transmit data from a central computer to a remote computer or from a file server to a workstation. It implies transmitting an entire file.
18. Entities Things that computerized data relate to. Ownership parcels, for example, have a graphic representation as a polygon in the computerized mapping system, and have related information in other databases such as tax rolls, appraisal, and ownership databases.
19. File Server A high-speed computer in a local area network that stores the programs and data files shared by users on the network.
20. Geographic Information System (GIS) A coordinated system of computer hardware, software, spatial and tabular data for capturing, storing, updating, manipulating analyzing, and displaying all forms of geographically referenced information.
21. Global Positioning System (GPS) Satellite based measurement system that allows technicians to survey virtually any terrain, day or night with accuracy.
22. Hardware Term given to the computers and other devices that are used in computer systems.
23. Interface Connection and interaction between hardware, software and the user. Hardware interfaces are the plugs, sockets and wires that carry electrical signals in a prescribed order. Software interfaces are the languages, codes and messages that programs use to communicate with each other, such as between an application program and the operating system. User interfaces are the keyboards, mice, dialogues, command languages and menus used for communication between the user and the computer.
24. Laser Printer A printer that uses the electro photographic method used in copy machines. A laser paints the dots of light onto a photographic drum or belt. The toner is applied to the drum or belt and then is transferred onto the paper.

25. Layer/Levels Can be defined as all data relating to a particular theme. Thus, one layer or level may contain road right of ways and another may contain subdivision lot lines. A layer/level may be thought of as one of several maps that go into a final map product.
26. Mainframe Cabinet that holds the central processing unit. Although mainframe still means main housing, it usually refers to a large computer system and all the associated expertise that goes with it.
27. Megabyte One million bytes
28. Megahertz (Mhz) One million cycles per second. References a computer's clock rate, which is a raw measure of its internal speed.
29. Modem A device that adapts a terminal or computer to a telephone line. The modem handles the dialing and answering of the call and controls the transmission speed.
30. Monuments Tangible landmarks indicating boundaries.
31. Orthophotography Orthophotographs remove distortions resulting from camera tilt and terrain variations (hills and valleys), which produces an image with true and constant scale.
32. Pixel (Picture Elements) Each scanned element is represented by a matrix of pixels each having an X and Y value. The density of this matrix is determined by the resolution of the scanner and is expressed in dots per inch (dpi).
33. Planimetric Map Two-dimensional map of base data. They can be created from aerial photography or survey. The result is a line map of physical features with the distortion removed.
34. Polygon In computer graphics, a multi-sided object that can be filled with color, area calculated, or moved around as a single entity.
35. Query To interrogate a database (count, sum, list selected records).
36. Random Access Memory (RAM) Computer's primary workspace. Although true of most memory chips, "random" means that the contents of each byte can be directly accessed without regard to the bytes before or after it. RAM chips require power to maintain their content.
37. Raster Graphics In computer graphics, a technique for representing a picture image as a matrix of dots. It is the digital counterpart of the analog method used in TV.
38. Rectified Photography This type of photography is one in which only the distortions caused by the tilt of the airplane have been removed.
39. Relational Database Data stored in tables that are associated by shared attributes. Any data element can be found in the database through the name of the table, the attribute

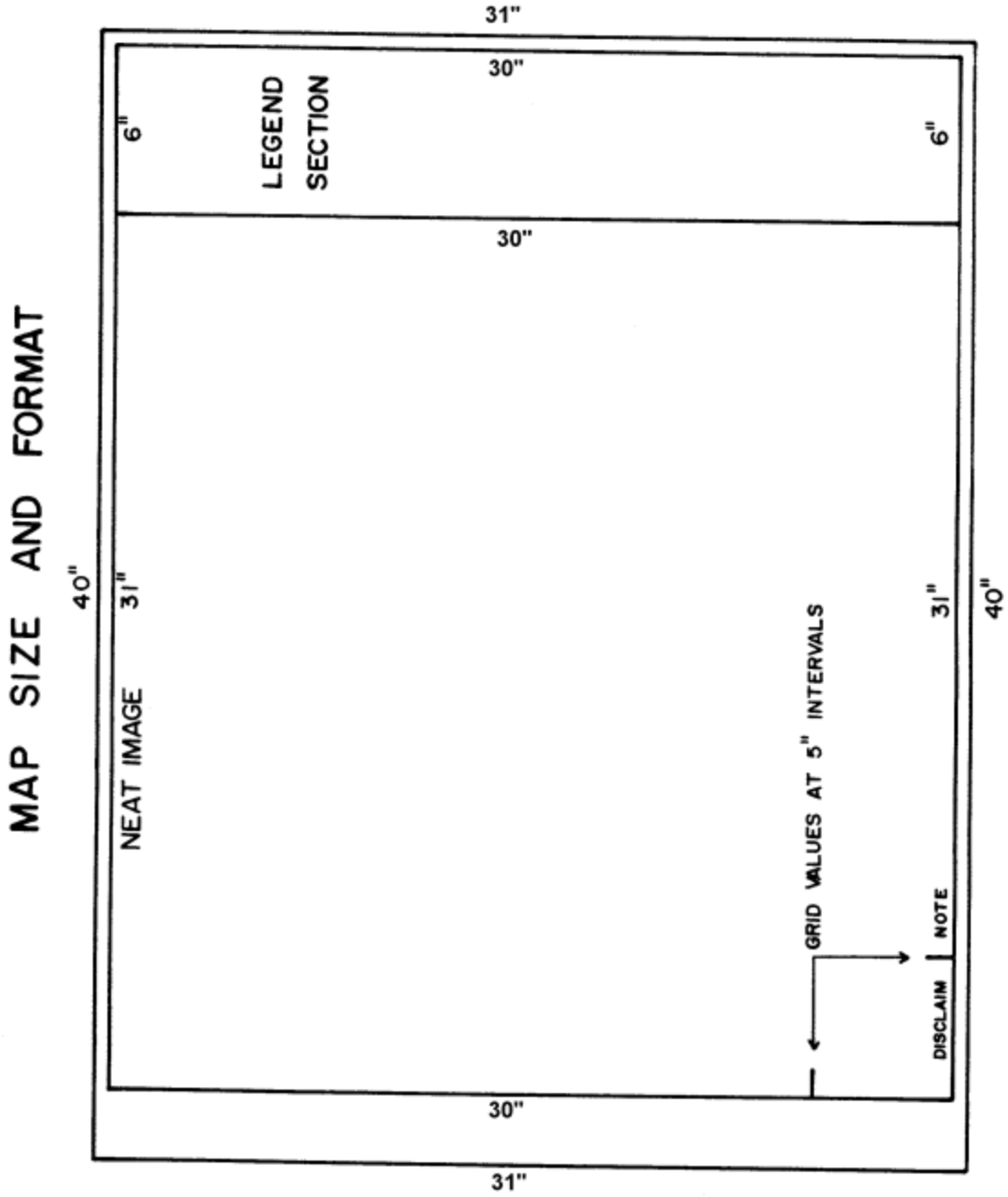
(column) name, and the value of the primary key. In contrast to hierarchical and network database structures, the data can be arranged in different combinations.

40. Scanner A device that reads text and images. Text scanners recognize printed fonts and convert them into digital code. Graphic scanners convert a printed image into a video image.
41. Scanning Scanning as it applies to mapping involves the placement of a map original (Mylar) on a scanner. The optical eyepiece of the scanner simply recognizes the value of each pixel location on the map. This pixel location is determined across the map and leads to a raster image of the map. For computer mapping purposes the raster image must be converted into a vector data structure.
42. Software Software describes the programs, or instructions, executed by the hardware.
43. Spatial Analysis Studying the locations and shapes of geographic features and the relationships between them. It traditionally includes overlay and contiguity analysis, surface analysis, linear analysis, and raster analysis.
44. Spatial Data Any data that can be mapped. Information about the locations and shapes of geographic features, and the relationships between them; stored as coordinates and topology.
45. State Plane Coordinate System The plane-rectangular coordinate system established by the U.S. Coastal and Geodetic Survey, one for each State in the Union, for use in defining positions of geodetic stations in terms of plane-rectangular (X and Y) coordinates. Each state is covered by one or more zones, over each of which is placed a grid upon a conformal map projection. The relationship between the grid and the map, projection is established by mathematical analysis.
46. Topographic Map A map which represents the horizontal and vertical positions of the features represented; distinguished from a planimetric map by the addition of relief in measurable form. A topographic map uses contours or comparable symbols to show mountains, valleys, and plains, and, in the case of hydrographic charts, symbols and numbers to depth in bodies of water.
47. Translation Process is which data or graphic images are taken from one software package, formatted into another structure, and input into another software package.
48. Triangulation Locating positions on the earth's surface using the principle that if the measures of one side and the two adjacent angles are known, the other dimensions of the triangle can be determined.
49. Upload To transmit data from a personal computer or workstation to a central computer or file server. It implies transmitting a block of data rather than an interactive session.
50. Vector Graphics In computer graphics, a technique for representing a picture as points, lines and other geometric entities.

51. Workstation (1) High performance, single user microcomputer or minicomputer that has been specialized for graphics, CAD, CAE or scientific applications. (2) In Local Area Network, a personal computer that serves a single user in contrast with a file server that serves all users in the network. (3) Any terminal or personal computer.

APPENDIXES

Appendix A - Map Size and Format





Appendix B - Legend Sample

SAMPLE LEGEND

OWNERSHIP MAP
COUNTY OF LEE

PREPARED UNDER THE DIRECTION
OF THE
STATE OF ALABAMA
DEPARTMENT OF REVENUE
PROPERTY TAX DIVISION

PREPARED BY
 **TELEDYNE GEOTRONICS**
DIGITIZED BY
SOUTHERN DIGITAL SERVICES

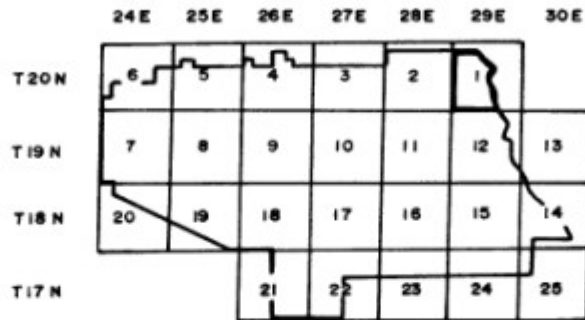

SCALE: 1" = 200'

DATE OF PHOTOGRAPHY :
DATE OF REFLIGHT :
DATE OF MAP :
DATE OF DIGITAL CONVERSION :
DATE MAP REVISED :
MAP REVISED BY :

Appendix B - 1



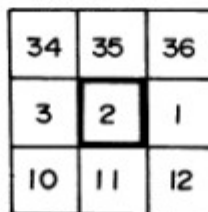
COUNTY LOCATOR



TOWNSHIP LOCATOR



SUB-SHEET INDEX



Appendix B - 2

LEGEND

STATE LINE		AREA (FROM DEED)	10.5 Ac
COUNTY LINE		AREA (CALCULATED)	10.5 Ac(c)
CITY LIMIT LINE		DIMENSION (FROM DEED)	16.5'
TOWNSHIP LINE		DIMENSION (SCALED)	66's
SECTION LINE		INTERSTATE HIGHWAY	
PROPERTY LINE		U.S. HIGHWAY	
ROAD R/W		STATE HIGHWAY	
ROAD TRAVEL PATH		COUNTY HIGHWAY	
PRIVATE ROAD OR TRAIL		COUNTY HIGHWAY 911 NUMBERING	
RAILROAD R/W		ROADS OR STREETS BY NAME	
WATER		PARCEL NUMBER <u>15</u> <u>15.001</u>	
LAND HOOK		SUBDIVISION LOT NUMBER	<u>29</u>
ORIGINAL SUB. LOT LINE		MAP BLOCK NUMBER (WHERE APPLICABLE)	
MAJOR TRANSMISSION LINES		MAP BLOCK LIMIT (WHERE APPLICABLE)	
CONFLICT		MAP BLOCK TICK (WHERE APPLICABLE)	
CHURCHES, SCHOOLS, CEMETERIES, AIRPORTS, BY NAME GOV'T LAND, ETC.		SUBDIVISION BLOCK NUMBER (WHERE APPLICABLE)	
		SECTION CORNERS	
		STATE PLANE COORDINATES	

SECTIONS 2

TOWNSHIP 20 NORTH RANGE 29 EAST

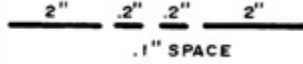
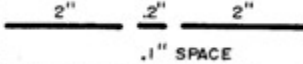

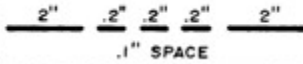

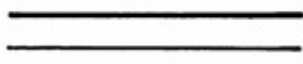


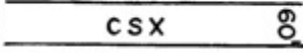
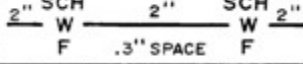
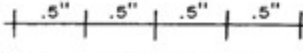
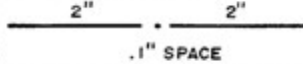
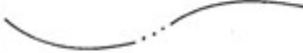
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MAP NUMBER

Appendix B - 3

Appendix C - Drafting Specifications

DRAFTING SPECIFICATIONS

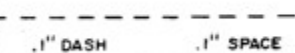

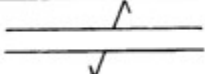

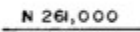
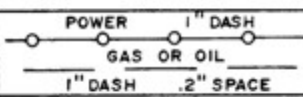







ALL SCALES

ITEM	SYMBOL	PEN WEIGHT	TEMPLATE SIZE	REMARKS
STATE LINE		3	300-3	
COUNTY LINE		3	240-3	
TOWNSHIP LINE		4	140-1	
CITY LIMIT LINE		3	140-1	
PROPERTY LINE		1		
SECTION LINE QUARTER LINE		3 2	140-1	
ROAD R/W		1	120-1	LABEL NAME INSIDE ROW. DIMENSIONS PERPENDICULAR TO ROW
ROAD TRAVEL PATH		00		
RAILROAD R/W		1	120-1	LABEL NAME INSIDE ROW. DIMENSIONS PERPENDICULAR
SPECIAL DISTRICT LINE IF APPLICABLE		2	100-00	SCHOOL WATER FIRE
RAILROAD TRACK		00		IF ABANDONED R/R LEAVE OUT TRACK SYMBOL
INDIAN RESERVATION BOUNDARY		2	140-1	
WATER LINE		00		USE NO.1 PEN IF WATER LINE IS PROPERTY LINE

Appendix C - 1

DRAFTING SPECIFICATIONS







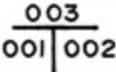

ALL SCALES

ITEM	SYMBOL	PEN WEIGHT	TEMPLATE SIZE	REMARKS
PRIVATE ROAD OR TRAIL	 .1" DASH .1" SPACE	00	100-00	BY NAME
LEADER LINE		00		
LAND HOOK		0		SIZE IS DEPENDENT UPON SCALE AVAILABLE
GRID TICKS		00		EVERY 5 INCHES AT MAP SCALE. 1" IN LENGTH
GRID VALUES		00	80-00	EVERY 5 INCHES AT MAP SCALE
MAJOR TRANSMISSION LINES		00	100-00	
SUBDIVISION BOUNDARY LINE		3		
SUBDIVISION BOUNDARY TICKS		1	100-0	
PARCEL NUMBER		2	140-2	0 DEGREE ANGLE UNDERLINED
ACREAGE		0	120-0	
DEED DIMENSIONS		00	100-00 80-00	50', 100' & 200' SCALE 400' SCALE
SCALED DIMENSIONS		00	100-00 80-00	50', 100' & 200' SCALE 400' SCALE
SUBDIVISION NAMES		1 00	120-1 80-00	0 DEGREE ANGLE SUBDIVISION NAME PLAT BOOK & PAGE

Appendix C - 2

DRAFTING SPECIFICATIONS







ALL SCALES

ITEM	SYMBOL	PEN WEIGHT	TEMPLATE SIZE	REMARKS
SUBDIVISION ORIGINAL LOT NUMBERS	23	00	120-00	SLANTED TO REAR OF LOT 0 DEGREE ANGLE
ORIGINAL SUBDIVISION BLOCK NUMBER		0	140-1	0 DEGREE ANGLE
ORIGINAL SUBDIVISION LOT LINE		00		
EDGE MATCH NUMBER	43-10-02	0	120-0	
SECTION CORNERS		3	140-1	
MOUNTAIN	<i>CHEHA MOUNTAIN</i>	0	120-0	SLANTED & ELONGATED
CHURCHES, SCHOOLS, GOV. LAND, ETC.		0	100-0	BY NAME 0 DEGREE ANGLE
STREAMS, CREEKS, PONDS & DRAINAGE	JACKSON CREEK	00	100-00	BY NAME
RIVERS & LAKES	JACKSON RIVER	00	120-0	BY NAME
MAP BLOCK NUMBER		2	175-2	0 DEGREE ANGLE
MAP BLOCK LIMIT LINE		2		
MAP BLOCK LIMIT TICK		2	120-1	
CONFLICT PROPERTY		00	100-0	

Appendix C - 3

DRAFTING SPECIFICATIONS






ALL SCALES

ITEM	SYMBOL	PEN WEIGHT	TEMPLATE SIZE	REMARKS
INTERSTATE HIGHWAY		1	120-1	0 DEGREE ANGLE
US HIGHWAY		1	120-1	0 DEGREE ANGLE
STATE HIGHWAY		1	120-1	0 DEGREE ANGLE
COUNTY HIGHWAY		1	120-1	0 DEGREE ANGLE
COUNTY HIGHWAY 911 NUMBERING		1	120-1	0 DEGREE ANGLE
LAND ZONING		3	175-2	

Appendix C - 4

DRAFTING SPECIFICATIONS

TOPO ALL SCALES

ITEM	SYMBOL	PEN WEIGHT	TEMPLATE SIZE	REMARKS
HORIZONTAL MONUMENTED, (WITH ELEV)	6JS-15  496.82	00	80-00	
INDEX CONTOUR	 300	1	120-1	
APPROXIMATE CONTOUR	 .5" DASH .1" SPACE	000		
INTERMEDIATE CONTOUR		000		
ELEVATION STEREO	496.2	00	80-00	
DEPRESSION CONTOUR		000		

Appendix C - 5

Appendix G - RP-2 Cross Index Cards

ADV-RP-2 PROPERTY CROSS INDEX CARD	MAP INDEX NO. _____ COUNTY, ALABAMA																	
OWNER NAME AND ADDRESS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="font-size: small;">UNIFORM PARCEL NUMBER</th> <th style="font-size: small;">COUNTY</th> <th style="font-size: small;">TSP.</th> <th style="font-size: small;">AREA</th> <th style="font-size: small;">SECTION</th> <th style="font-size: small;">1/4 SEC</th> <th style="font-size: small;">BLOCK</th> <th style="font-size: small;">PARCEL NO.</th> </tr> <tr> <td style="height: 20px;"></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	UNIFORM PARCEL NUMBER	COUNTY	TSP.	AREA	SECTION	1/4 SEC	BLOCK	PARCEL NO.									
UNIFORM PARCEL NUMBER	COUNTY	TSP.	AREA	SECTION	1/4 SEC	BLOCK	PARCEL NO.											
DESCRIPTION	PROPERTY ADDRESS																	
		NOTES																

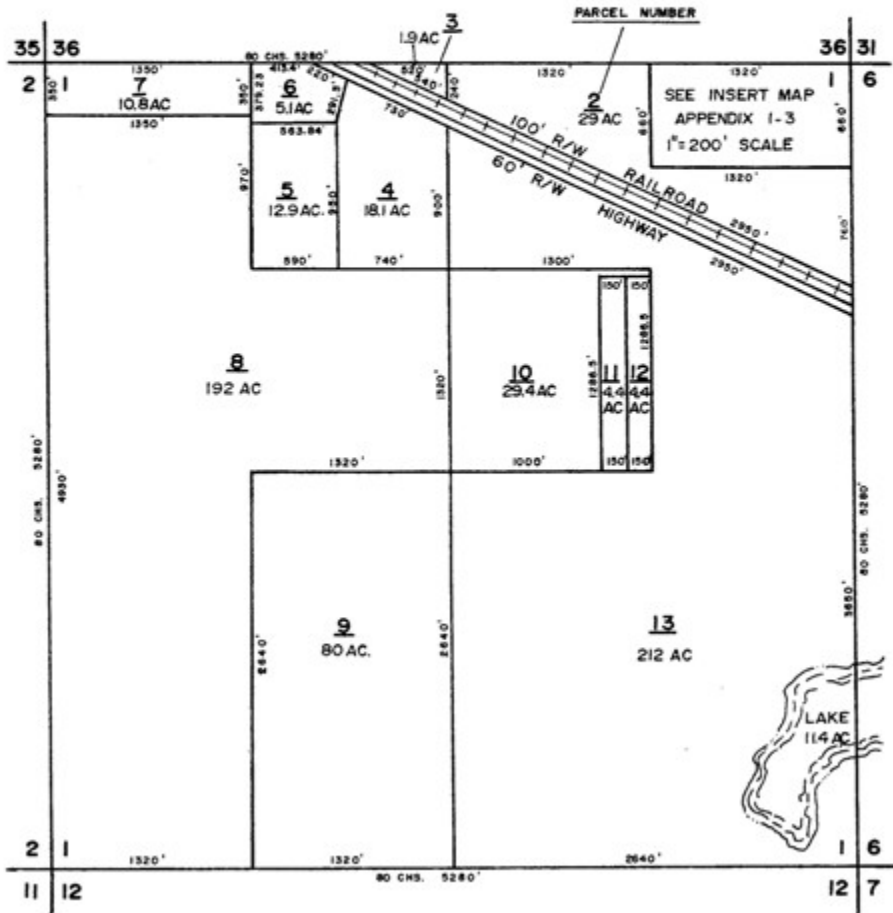
Appendix H - RP-16 Parcel Error Change Form

ADV-RP-16 PARCEL ERROR CHANGE FORM					
COUNTY	TSP	AREA	SECTION 1/4 SEC. BLOCK	PARCEL NO.	DATE:
					PHOTO NO. FL. EXP.
THE FOLLOWING ERROR (S) HAVE BEEN FOUND IN THE ABOVE PARCEL:					
COMPUTATION	<input type="checkbox"/>	DIMENSION	<input type="checkbox"/>	ACREAGE	<input type="checkbox"/>
				OWNER	<input type="checkbox"/>
OTHER	<input type="checkbox"/>	(SPECIFY)			
REPORTED BY: OWNER <input type="checkbox"/> TAX ASSESSOR <input type="checkbox"/> MAPPER <input type="checkbox"/> APPRAISER <input type="checkbox"/> OTHER <input type="checkbox"/>					
ROUTING	DATE	BY	NOTES:		
TO MAPPER					
INDEX CARD					
MAP CORRECTED					
TO APPRAISER					
M & L AND DESCRIPTION					
LAND					
VALUATION					
REVIEWED					

Appendix I - Typical Section Map

TYPICAL SECTION MAP

SEC. 1 - T 16 N - R 15 W



SEE FOLLOWING PAGES FOR DESCRIPTIONS

Appendix I - 1

DESCRIPTIONS IN BRIEF FORM FOR PARCELS ON APPENDIX I - 1

Parcel No. 2

Beg. NW cor. of the NE 1/4 of Sec. 1, th E 1320', S 660', E 1320', S 760', NW alg. N R/W of Railroad 2950', N 240' to POB. Containing 29 Acres. S1 T16N R15W

Parcel No. 3

Beg. NE cor. of the NW 1/4, th S 240', NW alg. N R/W of R/R 540', E 520' to POB. Containing 1.9 Acres. S1 T16N R15W

Parcel No. 4

Beg. SE cor. of the NE 1/4 of NW 1/4, th N 900', NW 730', SW 291.3', S 950', E 740' to POB. Containing 18.1 Acres. S1 T16N R15W

Parcel No. 5

Beg. SW cor. of the NE 1/4 of NW 1/4, th E 590', N 950', W 563.84', S 950' to POB. Containing 12.9 Acres. S1 T16N R15W

Parcel No. 6

Beg. NW cor. of the NE 1/4 of NW 1/4, th E 413.4', SE 220', SW 291.3', W 563.84', N379.23' to POB. Containing 5.1 Acres. S1 T16N R15W

Parcel No. 7

Beg. NW cor. of Sec. 1, th E 1350', S 350', W 1350', N 350' to POB. Containing 10.8 Acres. S1 T16N R15W

Parcel No. 8

W 1/2 of W 1/2 of Sec. 1, less the No. 350', and SE 1/4 of NW 1/4. Containing 192 Acres. S1 T16N R15W

Parcel No. 9

E 1/2 of SW 1/4. Containing 80 Acres. S1 T16N R15W

Parcel No. 10

Beg. NW cor. of the SW 1/4 of NE 1/4, th E 1300', S 33', W 300', S 1286.5', W 1000', N 1320' to POB. Containing 29.4 Acres. S1 T16N R15W

Parcel No. 11

Com. SE cor. of SW 1/4 of NE 1/4, th W 150' to POB, th W 150', N 1286.5', E 150', S 1286.5' to POB. Containing 4.4 Acres. S1 T16N R15W

Parcel No. 12

Beg. SE Cor. of SW 1/4 of NE 1/4, th W 150', N 1286.5', E 150', S 1286.5' to POB. Containing 4.4 Acres. S1 T16N R15W

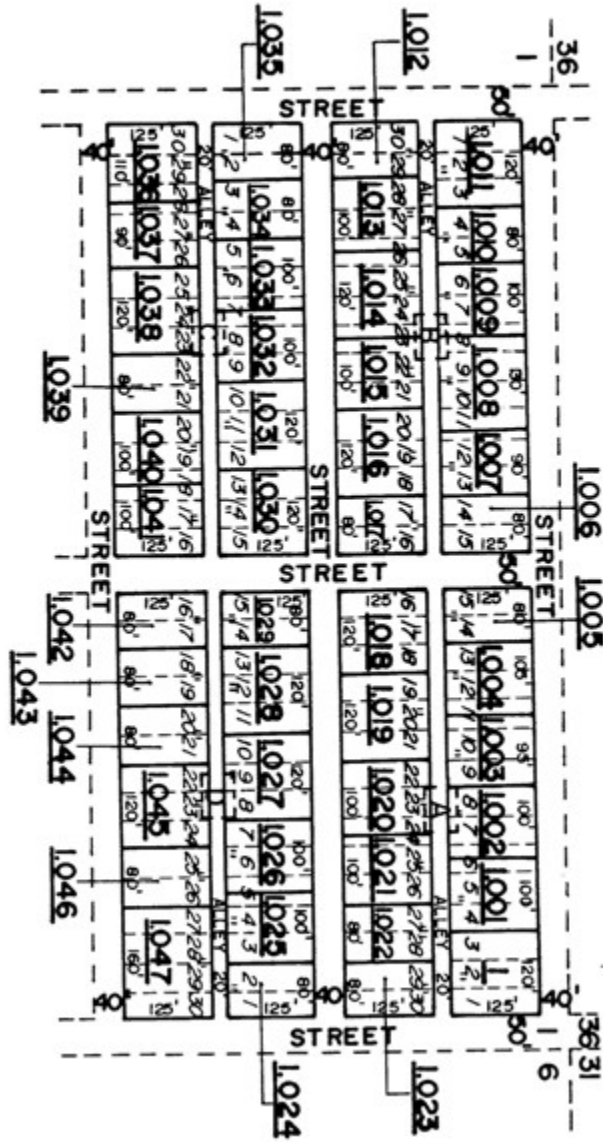
Parcel No. 13

All of E 1/2 of Sec. lying So. of R/R and Hwy. R/W less the SW 1/4 of NE 1/4. Containing 212 Acres. S1 T16N R15W

Appendix I - 2

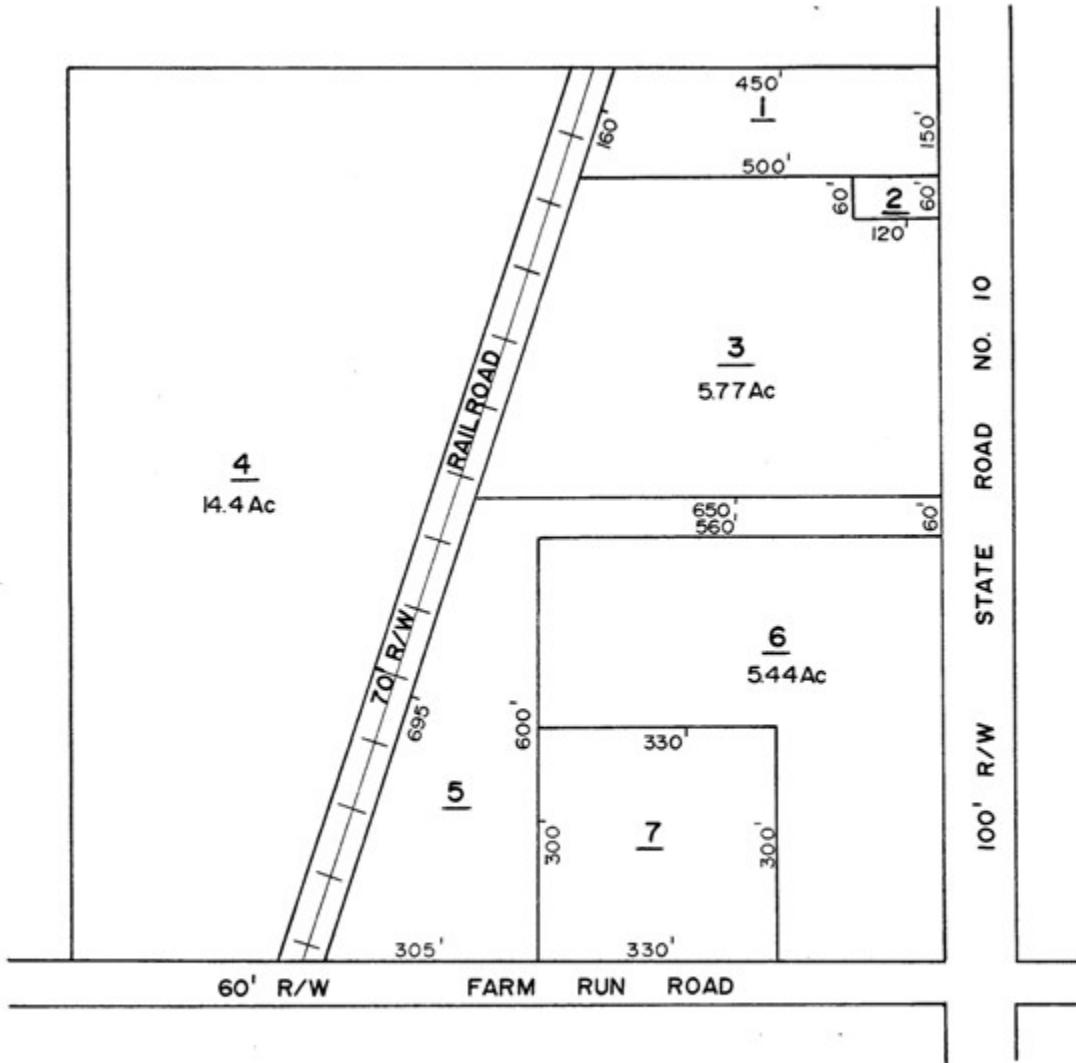
TYPICAL SUPPLEMENT MAP

INSERT MAP FROM APPENDIX I



Appendix I - 3

Appendix J - Metes and Bounds Description



NW 1/4 OF SE 1/4

SEE APPENDIX J-2 & J-3 FOR DESCRIPTION

Appendix J - 1

Descriptions Rewritten In Brief Form

Original Descriptions

PARCEL NO. 1

That part of the NW 1/4 of SE 1/4 Section 6 Township 4 S Range 20 East thence com. 100 ft. W of NE cor. of NW1/4 of SE1/4 th W 450 ft along the quarter section line 450', th SW along railroad easterly right of way 160 ft more or less to point th easterly parallel to N line 500 ft to a point 150 ft S. of point of beg. th N to beg.

PARCEL NO. 2

That part of the NW 1/4 of SE 1/4 Section 6, Township 4 S Range, 20 East, lying west of State Road 10, thence com. 100 ft W of the NE cor. of the NW1/4 of th SE1/4 Section 6, TWP 4 S, RNG 20 E; thence sly along the west R/W of State Road 10. 150 ft to south boundary of J. P. Howard's land and P.O.B.; thence W along the J. P. Howard's land 120' to Pt; thence South 60'; thence easterly parallel to Howard's S line 120 ft to W R/W line of SR. 10; thence N 60' to P.O.B.

PARCEL NO. 3

Beg. at the NE cor. of NW 1/4 of SE 1/4 Sec. 6, T 4 S, R 20 E; thence due W 100 ft to W R/W line SR. 10 th S 210' to P.O.B.; th W 120 ft; N 60 ft to land of J. P. Howard; W 380 ft along Howard line to RR R/W 475 ft; to N line of Jones' land; th E 650 ft to SR. 10; th N along W edge of SR. 10 390' to P.O.B.

PARCEL NO. 4

Beg. at the intersection of the W RR R/W line and the N line of NW 1/4 of SE 1/4 Sec 6, T 4 S, R 20 E; thence W 708 ft more or less to the W line of the NW 1/4 of SE 1/4 Sec. 6; thence South along said line 1,260' to N R/W line of public road; thence east along said public road 285 ft more or less to W line of RR R/W; thence N E'ly 1,330 ft more or less to P.O.B.

Brief Form

Including Abbreviations

N. 150 ft of NW 1/4 of SE 1/4 lying E of RR R/W and W of SR. 10 sec. 6, T 4 S, R 20 E

Beg. 100 ft W. and 150 ft South of NE Cor. of Sec. 6, T 4 S, R 20 E; Th W at 90 angle to SR. 10 120 ft; S 60; E 120', N 60' to POB.

Beg. 100 ft W and 210 ft S of NE Cor. of Sec. 6, T 4 S, R 20 E; th W 120 ft N 60 ft W 380 ft to E line RR R/W; SW 1/4 475 ft; E 650 ft to SR. 10; N 390 ft to POP.

All of NW 1/4 of SE1/4 Sec. 6, T 4 S, R 20 E, lying N of Farm Run Road & W of RR R/W.

Appendix J - 2

PARCEL NO. 5

Beg. SE Cor. of SE 1/4 of NW 1/4 of SE 1/4 Sec 6 TWP 4 S, R 20 E; thence 60 ft to N line public road; thence W 660 ft to P.O.B.; thence N 600 ft along West line of lands formerly owned by J. S. Cook to NW cor of said Cook lands; thence E 560' to the west line of SR. 10; thence N 60 ft; W along S line of Morgan lands 650 ft more or less to RR R/W, thence SW'ly to N line of public road; thence E to P.O.B.

PARCEL NO. 6

That part of the SE 1/4 of NW 1/4 of SE 1/4 Sec 6 TWP 4 S, R 20E lying N of public road and W of State Road; except Com. at a point 330 ft W. and 60 ft N of SE Cor. of NW1/4 of SE1/4 thence W 330 ft; N 300 ft; E 330 ft; S 300 ft to P.O.B. and being all the lands now owned by J. S. Cook in the NW1/4 of SE1/4 Sec 6, TWP 4S, R 20E.

PARCEL NO. 7

Beg. at the SE cor. of the NW 1/4 of SE 1/4, Sec 6, TWP 4S, R 20E. Thence N 60 ft; W 330 ft to P.O.B.; thence cont. W along the N line of public road 330 ft; N 300 ft; E 330 ft; S 300 ft to POB & being all in the SW 1/4 of SE 1/4 of NW 1/4 of SE 1/4 Sec 6. TWP 4 S, R 20 E.

All of the SW 1/4 of NW 1/4 of SE 1/4 Sec 6, T 4 S, R 20 E lying E of RR R/W. also the S 60 ft of NE 1/4 of NW 1/4 of SE 1/4 Sec. 6 and the S 60 ft of the NW 1/4 of NW 1/4 of SE 1/4 Sec. 6 lying E of RR R/W.

All the SE 1/4 of NW 1/4 of SE 1/4 Sec 6, T 4 S, R 20 E, less lands for public roads and less the SW 1/4 of SE 1/4 of NW 1/4 of SE 1/4.

All the SW 1/4 of SE 1/4 of NW 1/4 of SE 1/4 Sec. 6, T 4 S, R 20 E; less 60 ft for road R/W.

Appendix J - 3

Appendix K - Formulas for Computing Area

ONE LINK = 7.92 INCHES
 ONE ROD = 16 1/2 FEET, 1/4 CHAIN OR 25 LINKS
 ALL MEASUREMENTS IN GOVERNMENT SURVEYS ARE INDICATED BY LINKS AND CHAINS
 ONE CHAIN = 66 FEET, 4 RODS OR 100 LINKS
 ONE MILE = 5,280 FEET, 320 RODS OR 80 CHAINS
 ONE SQUARE ROD CONTAINS 272 1/4 SQUARE FEET
 ONE ACRE IS ABOUT 208 3/4 FEET SQUARE
 ONE ACRE CONTAINS 43,560 SQUARE FEET OR 160 SQUARE RODS
 TEN SQUARE CHAINS = ONE ACRE
 A SECTION OF LAND IS ONE SQUARE MILE AND CONTAINS 640 ACRES
 1/4 SECTION CONTAINS 160 ACRES
 A TOWNSHIP AREA IS 36 SQUARE MILES AND CONTAINS 23,040 ACRES

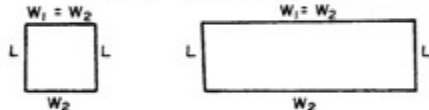
EQUIVALENTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
FEET	66	132	198	264	330	396	462	528	594	660	726	792	858	924	990	1056	1122	1188	1254	1320
YARDS	22	44	66	88	110	132	154	176	198	220	242	264	286	308	330	352	374	396	418	440
RODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CHAINS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

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

FORMULA FOR COMPUTING AREAS

THE AREA OF ANY TAXABLE PARCEL IS EQUAL TO THE LENGTH OF THE PARCEL MULTIPLIED BY THE AVERAGE WIDTH OF THE PARCEL WITH THE LENGTH AT RIGHT ANGLES TO WIDTH.

SQUARE OR RECTANGLE



$$\text{AVERAGE WIDTH} = \frac{W_1 + W_2}{2} = \frac{2W_2}{2} = W_2$$

$$\text{AREA} = W_2 \times L$$

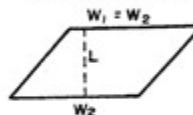
TRIANGLE



$$\text{AVERAGE WIDTH} = \frac{W_1 + W_2}{2} = \frac{0 + W_2}{2} = 1/2 W_2$$

$$\text{AREA} = 1/2 W_2 \times L$$

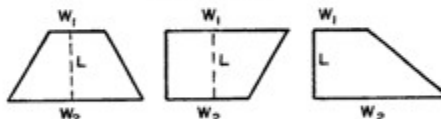
PARALLELOGRAM



$$\text{AVERAGE WIDTH} = \frac{W_1 + W_2}{2} = \frac{2W_2}{2} = W_2$$

$$\text{AREA} = W_2 \times L$$

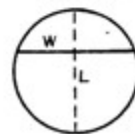
TRAPEZOID



$$\text{AVERAGE WIDTH} = \frac{W_1 + W_2}{2}$$

$$\text{AREA} = 1/2 L (W_1 + W_2)$$

CIRCLE



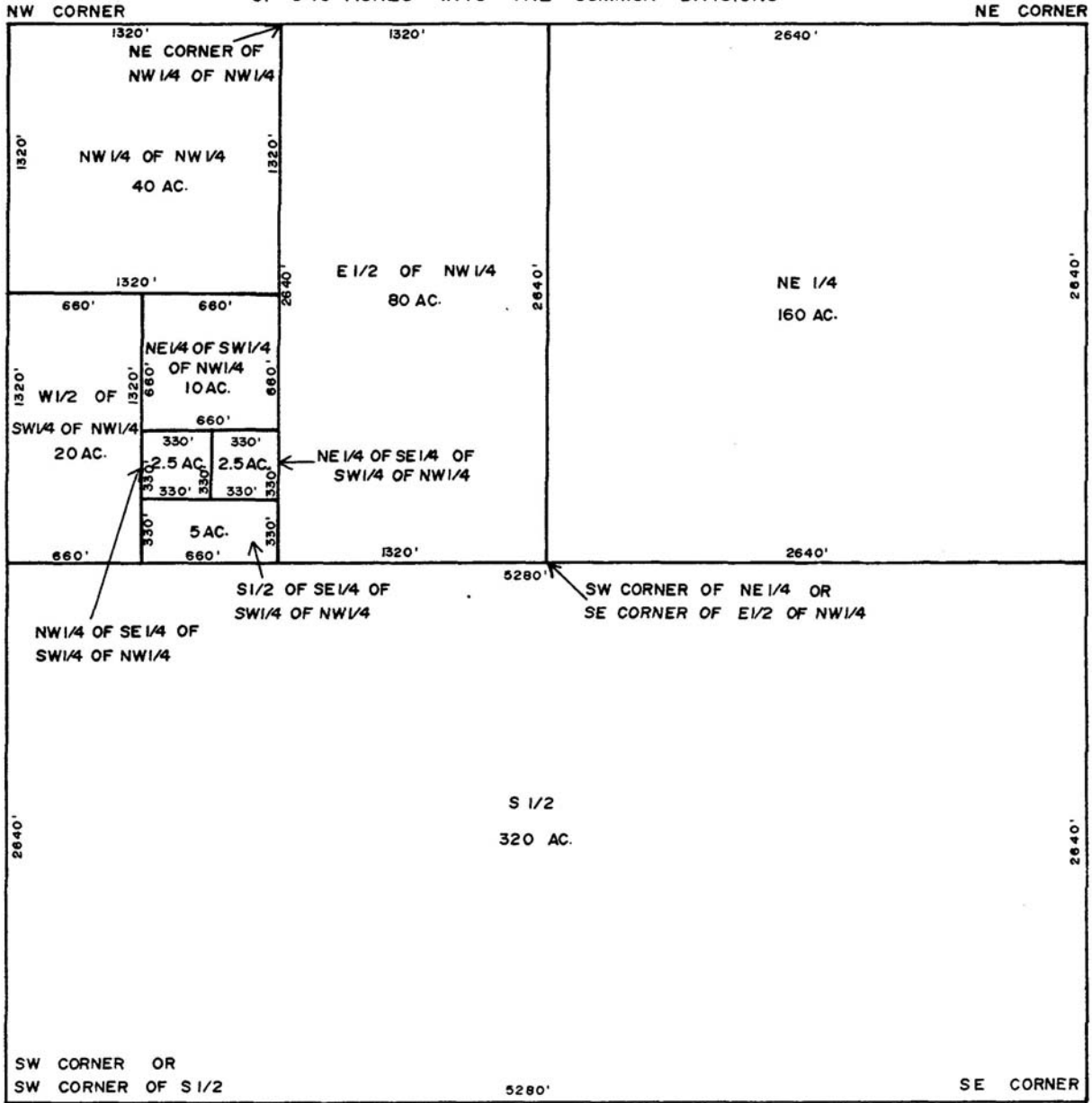
$$\text{AVERAGE WIDTH} = 7854 L$$

$$\text{AREA} = 7854 L \times L$$

NOTE: TO CONVERT THE SQUARE FEET OF AREAS LARGER THAN ONE ACRE TO HUNDREDS OF AN ACRE APPLY THE FOLLOWING RULE.
 AREA IN SQ. FT. X .000023 = ACRES IN AREA
 125,663 SQ. FT. X .000023 = 2.890249 OR 2.89 ACRES.
 THE SAME RESULT IS OBTAINED BY MULTIPLYING BY 23 AND POINT OFF SIX FIGURES.

Appendix L - Illustration of Division of a Section

ILLUSTRATION OF THE DIVISION OF A SECTION
OF 640 ACRES INTO THE COMMON DIVISIONS



1 MILE = 5,280' = 80 CHAINS = 8,000 LINKS = 320 RODS
 1/2 MILE = 2640' = 40 CHAINS = 4,000 LINKS = 160 RODS
 1/4 MILE = 1320' = 20 CHAINS = 2000 LINKS = 40 RODS
 1/8 MILE = 660' = 10 CHAINS = 1000 LINKS = 20 RODS
 1/16 MILE = 330' = 5 CHAINS = 500 LINKS = 10 RODS

Appendix M - Uniform Parcel Number

UNIFORM PARCEL NUMBER

THE PARCEL NUMBERING SYSTEM CONTAINS SEVEN SETS OF NUMBERS

1	2	3	4	5	6	7
---	---	---	---	---	---	---

- | | | | |
|----|------------------------|---|-------|
| 1. | COUNTY NUMBER | 2 | DIGIT |
| 2. | TOWNSHIP NUMBER | 2 | DIGIT |
| 3. | AREA NUMBER | 2 | DIGIT |
| 4. | SECTION NUMBER | 2 | DIGIT |
| 5. | QUARTER SECTION NUMBER | 1 | DIGIT |
| 6. | MAP BLOCK NUMBER | 3 | DIGIT |
| 7. | PARCEL NUMBER | 6 | DIGIT |

EXAMPLE

43	01	02	10	4	003	001.012
----	----	----	----	---	-----	---------

Appendix N - Pen Weight and Lettering Template

PEN WEIGHT AND LETTERING TEMPLATE

LINE WEIGHT

4 X 0	. 18MM
3 X 0	. 25MM
00	. 30MM
0	. 35MM
1	. 50MM
2	. 60MM
3	. 80MM
4	1. 20MM

PEN WEIGHT	TEMPLATE SIZE	EXAMPLE	
4 X 0	50	123	ABC
3 X 0	60	123	ABC
00	80	123	ABC
0	100	123	ABC
1	120	123	ABC
2	140	123	ABC
3	175	123	ABC
4	240	123	ABC

Appendix O - Metric Conversion Table

MEASUREMENTS U. S. EQUIVALENT AND METRIC EQUIVALENT

LENGTH

U.S. Customary Unit	U.S. Equivalents	Metric Equivalents
inch	0.083 foot	2,540 centimeters
foot	1/3 yard, 12 inches	0.305 meter
yard	3 feet, 36 inches	0.914 meters
rod	5 1/2 yards, 16 1/2 feet	5.029 meters
mile (statute, land)	1,760 yards, 5,280 feet	1.609 kilometers
mile (nautical, international)	1.151 statute miles	1.852 kilometers

AREA

U.S. Customary Unit	U.S. Equivalents	Metric Equivalents
square inch	0.007 square foot	6,452 square centimeters
square foot	144 square inches	929,030 squarecentimeters
square yard	1,296 square, 9 square feet	0.836 sq meters
acre	43,560 square feet,	4,047 sq meters
square mile	4,840 square yards, 640 acres	2,590 square kilometers

Appendix O - 1

**MEASUREMENTS
U. S. EQUIVALENT AND
METRIC EQUIVALENT**

Length

Unit	Number of Meters	Approximate U.S. Equivalent
myriameter	10,000	6.214 miles
kilometer	1,000	0.621 mile
hectometer	100	109.361 yards
decameter	10	32.808 feet
meter	1	39.370 inches
decimeter	0.1	3.937 inches
centimeter	0.01	0.394 inch
millimeter	0.001	0.039 inch

Area

Unit	Number of Square Meters	Approximate U.S. Equivalent
square kilometer	1,000,000	0.386 square mile
hectare	10,000	2.477 acres
are	100	119.599 square yards
deciare	10	11.960 square yards
centare	1	10.764 square feet
square centimeter	0.0001	0.155 square inch

Appendix O - 2

Appendix P - Digital Mapping Layer Index

Name	Level/ Layer	Style	Weight	Color	Legend Name	Color Name	RGB Value	Line Style
PAR Quarter- Section Line	1	0	3	0	Parcel	White	0,0,0	Solid
PAR Section Line	2	0	3	3	Parcel	Red	255,0,0	Solid
TAX Section Number	3	0	2	3	Tax	Red	255,0,0	Solid
PAR Township & Range Line	4	0	4	3	Parcel	Red	255,0,0	Solid
TAX Township & Range Text	5	0	2	3	Tax	Red	255,0,0	Solid
PAR Parcel Line	6	0	2	2	Parcel	Green	0,255,0	Solid
TAX Primary Parcel Number	7	0	2	2	Tax	Green	0,255,0	Solid
TAX Property Dimension	8	0	0	0	Tax	White	0,0,0	Solid
TAX Acres	8	0	1	0	Tax	White	0,0,0	Solid
TAX Landhook	9	0	0	0	Tax	White	0,0,0	Solid
BND Subdivision Centroid	10	0	1	3	Boundary	Red	255,0,0	Solid
BND Map Block Number	11	0	2	3	Boundary	Red	255,0,0	Solid
BND Map Block Line	12	3	3	3	Boundary	Red	255,0,0	Long Dash
TAX Railroad Name	14	0	2	0	Tax	White	0,0,0	Solid
TAX Interstate ROW Name	14	0	2	4	Tax	Yellow	255,255,0	Solid
TAX U.S. & State ROW Name	14	0	2	5	Tax	Magenta	255,0,255	Solid
TAX City ROW Name	14	0	2	6	Tax	Orange	255,127,0	Solid

Appendix P - 1

Name	Level/ Layer	Style	Weight	Color	Legend Name	Color Name	RGB Value	Line Style
TAX Railroad Centerline	15	0	0	0	Tax	White	0,0,0	Solid
LMK Interstate Symbol	15	0	2	4	Landmark	Yellow	255,255,0	Solid
TAX Interstate Travel Path	15	0	0	4	Tax	Yellow	255,255,0	Solid
LMK U.S. ROW Symbol	15	0	2	5	Landmark	Magenta	255,0,255	Solid
LMK State ROW Symbol	15	0	2	5	Landmark	Magenta	255,0,255	Solid
TAX State Travel Path	15	0	0	5	Tax	Magenta	255,0,255	Solid
TAX City Travel Path	15	0	0	6	Tax	Orange	255,127,0	Solid
TAX City Travel Path Dashed	15	3	0	6	Tax	Orange	255,127,0	Long Dash
LMK County ROW Symbol	15	0	2	7	Landmark	Light Blue	0,255,255	Solid
TAX County Travel Path	15	0	0	7	Tax	Light Blue	0,255,255	Solid
TAX County Travel Path Dashed	15	3	0	7	Tax	Light Blue	0,255,255	Long Dash
BND Lot Number	17	0	0	4	Boundary	Yellow	255,255,0	Solid
TAX Private ROW Line	18	3	0	3	Tax	Red	255,0,0	Long Dash
BND Subdivision Boundary Line	19	0	4	4	Boundary	Yellow	255,255,0	Solid
BND Lot Line	20	3	0	4	Boundary	Yellow	255,255,0	Long Dash
BND Subdivision PB/PG	21	0	0	4	Boundary	Yellow	255,255,0	Solid
BND Subdivision Name	21	0	2	4	Boundary	Yellow	255,255,0	Solid
TAX Water Text	22	0	1	1	Tax	Dark Blue	0,0,255	Solid
LMK Dam	23	0	0	1	Landmark	Dark Blue	0,0,255	Solid
LMK Bridge	23	0	1	1	Landmark	Dark Blue	0,0,255	Solid

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Name	Level/ Layer	Style	Weight	Color	Legend Name	Color Name	RGB Value	Line Style
TAX Water Line	23	7	0	1	Tax	Dark Blue	0,0,255	Long Dash Triple Dot
TAX Lake	23	7	0	7	Tax	Light Blue	0,255,255	Long Dash Triple Dot
LMK Church Symbol	24	0	1	4	Landmark	Yellow	255,255,0	Solid
LMK State Symbol	24	0	1	4	Landmark	Yellow	255,255,0	Solid
LMK Airport Symbol	24	0	1	4	Landmark	Yellow	255,255,0	Solid
LMK Cemetery Symbol	24	0	1	4	Landmark	Yellow	255,255,0	Solid
LMK School Symbol	24	0	1	4	Landmark	Yellow	255,255,0	Solid
BND City Limits Line	25	6	4	5	Boundary	Magenta	255,0,255	Long Dash Triple Short Dash
BND City Limits Name	26	0	2	5	Boundary	Magenta	255,0,255	Solid
BND City Code	27	0	2	5	Boundary	Magenta	255,0,255	Solid
PAR Water- Property Line	29	7	2	2	Parcel	Green	0,255,0	Long Dash Triple Dot
LMK Gas Line	30	3	0	4	Landmark	Yellow	255,255,0	Long Dash
LMK Gas Line Text	31	0	0	4	Landmark	Yellow	255,255,0	Solid
BND Subdivision Block Number	32	0	1	4	Boundary	Yellow	255,255,0	Solid
BND Subdivision Block Symbol	32	3	1	4	Boundary	Yellow	255,255,0	Long Dash
LMK Transmission Line	33	0	0	4	Landmark	Yellow	255,255,0	Solid
LMK Transmission Line Text	34	0	0	4	Landmark	Yellow	255,255,0	Solid
PAR Hidden ROW Line	35	0	2	1	Parcel	Dark Blue	0,0,255	Solid
PAR City ROW Line	36	0	2	6	Parcel	Orange	255,127,0	Solid
PAR County ROW Line	37	0	2	7	Parcel	Light Blue	0,255,255	Solid

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Name	Level/ Layer	Style	Weight	Color	Legend Name	Color Name	RGB Value	Line Style
PAR Interstate ROW Line	38	0	2	4	Parcel	Yellow	255,255,0	Solid
PAR Private Road Solid	39	0	2	3	Parcel	Red	255,0,0	Solid
PAR Railroad ROW Line	40	0	2	0	Parcel	White	0,0,0	Solid
PAR Railroad ROW Line Dashed	41	3	2	0	Parcel	White	0,0,0	Long Dash
PAR U.S. & State ROW Line	42	0	2	5	Parcel	Magenta	255,0,255	Solid
TAX Non-Parcel ROW Line	43	0	2	9	Tax	Gray	192,192,192	Solid
TAX Miscellaneous Text	44	0	0	0	Tax	White	0,0,0	Solid
TAX Exempt Text	45	0	1	4	Tax	Yellow	255,255,0	Solid
TAX Private ROW Text	46	0	1	3	Tax	Red	255,0,0	Solid
PAR Parcel Number Centroid	47	0	0	0	Parcel	White	0,0,0	Solid
TAX Quarter-Section Line Dashed	50	3	3	0	Tax	White	0,0,0	Long Dash
TAX Section Line Dashed	51	3	3	3	Tax	Red	255,0,0	Long Dash
TAX Township & Range Line Dashed	51	3	4	3	Tax	Red	255,0,0	Long Dash
TAX County Line Dashed	53	3	4	4	Tax	Yellow	255,255,0	Long Dash
PAR County Line	54	5	4	4	Parcel	Yellow	255,255,0	Long Dash Short Dash
TAX County Name	55	0	2	4	Tax	Yellow	255,255,0	Solid
BND Border	56	0	0	0	Boundary	White	0,0,0	Solid
LMK Grid	57	0	0	0	Landmark	White	0,0,0	Solid
PAR Parcel Boundary	58	0	2	0	Parcel	White	0,0,0	Solid
TAX Processing Section Number	59	0	2	3	Tax	Red	255,0,0	Solid

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Name	Level/ Layer	Style	Weight	Color	Legend Name	Color Name	RGB Value	Line Style
TAX Conflict Text	60	0	0	3	Tax	Red	255,0,0	Solid
TAX Conflict Line	60	3	0	3	Tax	Red	255,0,0	Long Dash
TAX Secondary Parcel Number	61	0	2	3	Tax	Red	255,0,0	Solid
TAX Displaced Parcel Number	62	0	2	2	Tax	Green	0,255,0	Solid

Appendix P - 5

Appendix Q - Sample Aerial Photography Contract

This sample contractual agreement is intended to serve as a guide only. Specific details and business practice will vary depending on the technical services required and an individual county’s business practices.

THIS CONTRACTUAL AGREEMENT, made this _____ day of _____, _____, by and between the County of _____, Alabama, hereinafter referred to as the “County”, and _____, whose principal office is at _____, hereinafter referred to as the “Contractor”.

WITNESSETH THAT:

WHEREAS, the County desires to engage the Contractor to render certain professional services and deliver certain materials hereinafter described;

and

WHEREAS, the Contractor represents that it is qualified, willing and able to provide the professional services and deliver the requested materials to the County according to the County’s specifications and the terms of this Contractual Agreement; it is therefore agreed and understood that;

Based upon the County’s project specifications and the Contractor’s Technical Proposal and Cost Proposal, it is the intention of both parties that these documents are attached hereto as Exhibits and are incorporated by reference into this Contractual Agreement as if fully set forth herein. The purpose of this project is to provide the County with Aerial Photography and Digital Orthophotography.

The agreed upon price to be paid to the Contractor for the entire project is _____.

This project is to be conducted in eight (8) phases as described in the provisions herein. These eight phases are not necessarily consecutive and may overlap in several instances.

The first phase of this project is to be effectuated within three (3) business days of receipt of written authorization to proceed and as follows:

- | | | |
|---|----------|----------|
| 1. Field Survey Operations | 11/15/02 | 02/25/02 |
| 2. Aerial Photography | 01/15/03 | 02/15/03 |
| 3. Scanning and Photo lab Operations | 02/16/03 | 03/31/03 |
| 4. Aerial Triangulation | 04/01/03 | 05/15/03 |
| 5. Planimetric Compilation | 05/16/03 | 08/10/03 |
| 6. Generation of the Digital Elevation Models | 07/16/03 | 08/15/03 |
| 7. Generation of the Digital Orthophotography | 07/20/03 | 08/31/03 |
| 8. Submission of Contract Deliverables | 09/02/03 | 09/30/03 |

ATTACHMENT A SCOPE OF WORK

1. PRODUCTS AND SERVICES

- a. Installation of permanent horizontal/vertical survey monuments throughout Sample County at locations approved by the County. Monuments shall be constructed using concrete with 24" to 36" rebar with aluminium caps that identify the County, have a unique identification number and date of establishment.
- b. Derivation of the positions of all installed survey control points using Global Positioning System (GPS) technology on NAD83 (horizontal) and NAVD88 (vertical). All control points shall comply with the Federal Geodetic Control Subcommittee (FGCS) standards for Order C 2-1 accuracy.
- c. Preparation of a **Survey Control Report** that includes a technical description of the survey process and includes station descriptions and "to find" diagrams and information.
- d. Paneling of all established control points by placing targets to ensure their identification on aerial photography.
- e. Planning and collection of Airborne GPS-controlled black and white aerial photography at scales that will support the generation of digital orthophotography at the mapping scales of 1" = 100', 1" = 200' and 1" = 400' that complies with Alabama Department of Revenue specifications.
- f. Processing, quality editing and acceptance, and titling of the black and white aerial photography. All imagery will be in compliance with the established flight plan and will be free of defects caused by atmospheric conditions, flight conditions, and film processing.
- g. Digital image scanning of the processed black and white aerial photography negatives at 14 microns.
- h. Developing a quality Fully Analytical Aerial Triangulation solution.
- i. Preparing a comprehensive Aerial Triangulation Report.
- j. Compiling the following planimetric features in a Softcopy Photogrammetric environment. All features shall be compiled to comply with National Map Accuracy Standards.
 1. Edges of paved roads with centerlines
 2. Edges of unpaved roads with centerlines
 3. Centerlines of railroads

4. Bridges
 5. Airport Runway Outlines
 6. Rivers, Lakes, and Dams
- k. Creating a Digital Elevation Model (DEM) suitable for use in performing digital orthophoto rectification of the scanned imagery at the specified mapping scales.
 - l. Preparing digital orthophotos that comply with NMAS for 1" = 100', 1" = 200' and 1" = 400' as required, based upon the County's tiling grid. The delivered pixel resolutions shall be .5-foot for the 1" = 100' tiles, 1-foot for the 1" = 200' tiles, and 2-feet for the 1" = 400" tiles.
 - m. Delivering the orthophoto tiles covering the County area of 605 square miles, 238 tiles total, in ARC-TIFF format on CD-ROM.

2. TECHNICAL REQUIREMENTS

A. AREA

The area for the digital orthophotography consists of the entire County with scales defined by the County's tiling grid as shown on the map that is part of this Attachment. Aerial photography shall be acquired when trees are barren (leaf-off) and when the sun angle is greater than 30 degrees. Contractor shall submit a flight plan(s) illustrating the number of control points and flight lines for each scale of photography. All ground control points (other than checkpoints) must be paneled prior to flying.

B. ORTHOPHOTO PRODUCTS

1" = 100' AREA - This area shall be flown at 1" = 660' photo scale to produce 1" = 100' orthophotos with a pixel resolution of one-half foot (.5'). These images shall be produced to seamlessly integrate into the County's existing grid system based on the Alabama State Plane Coordinate System on NAD83 in US Survey feet. Each of the images shall measure approximately 2,640 feet in the easterly direction and 2,640 feet in the northerly direction. Each negative shall be scanned in at a higher resolution than the output resolution necessary to provide an orthophoto with a one-half foot (0.5') pixel resolution; no down sampling shall be permitted.

1"=200' AREA – This area shall be flown at 1" = 1,320' photo scale to produce 1" = 200' orthophotos with a one foot (1') pixel resolution. These images shall be produced to integrate seamlessly into the County's existing grid system based on the Alabama State Plane Coordinate System on NAD83 in US Survey feet. Each of the images shall measure approximately 5,280 feet in the easterly direction and approximately 5,280 feet in the northerly direction. Each negative shall be scanned in at a higher resolution than the output resolution necessary to provide an orthophoto with a 1' pixel resolution; no down sampling shall be permitted.

1"=400' AREA - This area shall be flown at 1" = 2,000' photo scale to produce 1" = 400' orthophotos with a pixel resolution of two feet (2.0'). These images shall be produced to integrate seamlessly into the County's existing grid system based on the Alabama State Plane Coordinate System on NAD83 in US Survey feet. Each of the images shall measure approximately 10,560 feet in the easterly direction and approximately 10,560 feet in the northerly direction. Each negative shall be scanned in at a higher resolution than the output resolution necessary to provide an orthophoto with a two-foot (2.0') pixel resolution; no down sampling shall be permitted.

3. AERIAL PHOTOGRAPHY

- a. Aerial photography shall be acquired when deciduous trees are barren (leaf-off) and when the sun angle is greater than 30 degrees. Photography shall not be undertaken when the ground is obscured by snow, haze, fog, or dust; when streams are not within their normal banks; or when clouds' shadow shall appear in more than five percent (5%) of the area in any one photograph.
- b. Aerial photography at a photo scale of 1" = 660' (3,960' +/- 5% above average ground level) for 1" = 100' map scale, photo scale of 1"= 1,320' (7,920' +/- 5% above average ground level) for 1" = 200' map scale, and 1" = 2,000' (12,000' +/- 5% above average ground level) for 1" = 400' map scale shall be obtained. Aerial film used shall be a fine-grained, high-speed photographic emulsion on a dimensionally stable base. Negatives deviating the specified scale by more than five percent (5%) may be rejected.
- c. Aerial photographs shall have a minimum of sixty percent (60%) forward overlap, thirty percent (30%) side-lap, with crab and tilt not to exceed 3 degrees within a single photo and 5 degrees with respect to adjacent photographs.
- d. **AERIAL CAMERA.** The aerial camera shall be a precision aerial mapping camera (RC-30 or equivalent) equipped with forward motion compensation (FMC) and a low distortion, high-resolution lens. The focal length of the lens shall be 6" with an average weighted area resolution (AWAR) of 100 or greater.
- e. **CALIBRATION REPORT.** A USGS camera calibration report, no more than three years old, shall be submitted with the flight plan prior to the photo mission.
- f. **IMAGE QUALITY.** Images on the aerial negatives shall be clear and sharp in detail and free from light streaks, static marks, scratches, and other blemishes. Special care shall be exercised to ensure proper developing and thorough fixing and washing of all film. Special care should be exercised to prevent distorting the film during processing and drying. Digital images shall be balanced to ensure consistent tone, contrast, and shading.
- g. **FILM TITLING.** All lettering shall be positioned as close as possible to the inside leading edge of the format of the exposure. The characters used for making the exposures shall be 3/16 inch; drafted or stamped with opaque ink to avoid the deformation of the film that is manifested with heat embossed titlers. The lettering shall clearly show on all copies of the photographs.

h. **DOCUMENTATION**

1. Each exposure shall be marked beginning in the left-forward corner of the format with the numerical abbreviation of the date.
2. The time of day in hours and minutes shall be shown on the first and last exposures of each flight line midway between the date and the middle forward fiducial.
3. The roll-strip-exposure number shall be marked at the right-forward corner of the format.
4. All film on a single spool shall bear the same unique roll number.
5. The photographic strips shall be flown and numbered as specified in the detail sheet in an unbroken series.

- i. **SCALE.** The scale of the imagery will be its average scale (i.e. 1:7,920, 1:15,840, or 1:31,680) and shall be positioned immediately to the right of the middle forward fiducial and the right forward corner.

j. **HORIZONTAL CONTROL**

Contractor shall establish sufficient horizontal and vertical ground control for all photogrammetric mapping associated with this project. Prior to the establishment of the necessary control, Contractor will evaluate any existing control that may be sufficient for this project. All control shall be surveyed using GPS technology to meet Federal Geodetic Control Subcommittee Order C 2-1 accuracy standards.

- k. **AIRBORNE GPS.** Contractor shall utilize airborne GPS. Sufficient horizontal and vertical control to support the airborne GPS and aerotriangulation solution must be acquired. Flight plans shall indicate the locations of GPS control points collected.

- l. **SURVEY SPECIFICATIONS.** Contractor shall provide sufficient documentation to verify that the survey meets specifications. The survey shall be sufficient to yield mapping products that meet National Map Accuracy Standards at the scale of 1" = 100', 1" = 200' and 1" = 400' (assuming utilization by trained photogrammetrists using film-based, analytical and/or softcopy technology in accordance with standard industry practice). The County reserves the right to obtain data, readings, records, or other information relating to this project from the Contractor.

- m. **GROUND CONTROL REPORT.** Contractor shall document, in the Ground Control Report, the expected horizontal and vertical accuracy of any GPS ground control points that are proposed for this project. In addition, the expected horizontal and vertical accuracy of the camera perspective, centers obtained through airborne GPS collection shall be documented. The role of any existing control to be used shall be specifically stated in the Ground Control Report.

- n. **COORDINATE SYSTEM.** The horizontal control shall be tied to the Alabama State Plane Coordinate System, 1983 North American Datum, U.S. Survey feet, and as such, full compatibility with existing control shall be achieved.

4. DIGITAL ORTHOPHOTOGRAPHY

- a. **GENERAL REQUIREMENTS.** The tiled digital orthophoto images shall have a uniform tone and density for each scale of photography. They shall preserve the clarity and detail of the original negatives to the maximum extent possible and shall, to the maximum extent possible, be free of dust marks, scratches, fog, streaks, stains, and blemishes of any kind. The imagery shall be free of scan lines, double exposures, out-of-focus images, mismatched imagery and inconsistencies in tone and density from one image to an adjacent image that may interfere with the interpretability of ground features or that are aesthetically objectionable. Images shall be edge-matched to appear seamless when referenced together in each respective scale.
- b. **ACCURACY.** All ground level features on the final digital Orthophotos shall meet horizontal National Map Accuracy Standards (NMAS). All remaining inputs and processes (i.e. aerotriangulation control and methodology, scanner calibration, and sensor calibration) used in digital orthophoto production shall be sufficiently accurate to ensure that the final product meets NMAS.
- c. **DTM/DEM.** A Countywide DEM shall be generated based upon the DTM that consists of mass points and break lines compiled from the 1" = 500', 1" = 1,000' and 1" = 2,000' aerial photography. The DTM shall consist of elevation points compiled at the highest point of significant terrain features, at the lowest point of depressions, significant saddles and quarries, road intersections, rail intersections, each end of decks of bridges at the road centerline, centerline of roads above culverts, tops of headwalls, and at points visible through dense vegetation in obscured areas. Elevations shall also be included for the surface of lakes and large ponds. Break lines shall be compiled at significant terrain breaks, hydrographic features and along manmade features such as road centerlines, edges of pavement, and shall contain disturbed area polygons.

5. PLANIMETRIC REQUIREMENTS

- a. **Road Centerlines**

Compile the apparent physical centerlines for all traveled ways throughout the County. Centerlines shall be structured in node-to-node topology and shall meet NMAS positional standards for the 1" = 100', 1" = 200', and 1" = 400', as applicable, in accordance with ADOR specifications.
- b. **Railroad Centerlines**

Compile the centerlines of all railroads, active and inactive, throughout the County. Do not compile dismantled railroads. Centerlines shall be structured in node-to-node topology and shall meet NMAS positional standards for the 1" = 100', 1" = 200', and 1" = 400', as applicable, in accordance with ADOR specifications.
- c. **Edges of Pavement**

Compile the visible edges of pavement and edges of unpaved roads as interpreted from the imagery. Traveled ways shall be topologically structured as polygons and shall meet NMAS positional standards for the 1" = 100', 1" = 200', and 1" = 400', as applicable, in accordance with ADOR specifications.

- d. Bridges
Bridges shall be compiled as closed polygons that represent the surface of the actual bridge deck. Railroad bridges shall be compiled as polygons that include the entire rail structure for each span.
- e. Airport Runways
Compile the outline of airport runways and parking areas as polygons
- f. Hydrography
Rivers, streams, lakes, ponds, and dams will be compiled to meet NMAS positional standards for the 1" = 100', 1" = 200', and 1" = 400' in accordance with ADOR specifications.

2. CONTRACT DELIVERABLES

At the conclusion of this Project, and as a condition of its completion, Contractor shall deliver to the County the following products and information:

- a. Ground Control Report
- b. Fully Analytical Aerial Triangulation Report
- c. Camera Calibration Report
- d. Planimetric File (features listed in paragraph 5 above)
- e. ASCII data for the County Digital Elevation Models (DEM).
- f. Digital Orthophoto imagery tiled to the County's tiling scheme by scale area (1" = 100', 1" = 200' and 1" = 400'). The images shall be delivered in TIFF/TFW format on CD-ROMs.

**ATTACHMENT B
PROJECT SCHEDULE**

Sample County Project Schedule

The following is the Project Schedule. It contains the scheduled starting and ending dates for the major categories of services.

	<u>Start Date</u>	<u>Complete</u>
1. Notice to Proceed	10/31/02	09/30/03
2. Field Survey Operations	11/15/02	02/25/02
3. Aerial Photography	01/15/03	02/15/03
4. Scanning and Photo Lab Operations	02/16/03	03/31/03
5. Aerial Triangulation	04/01/03	05/15/03
6. Planimetric Compilation	05/16/03	08/10/03
7. Generation of the Digital Elevation Models	07/16/03	08/15/03
8. Generation of the Digital Orthophotography	07/20/03	08/31/03
9. Submission of Contract Deliverables	09/02/03	09/30/03
10. Contract Completion	09/30/03	09/30/03

ATTACHMENT C PAYMENT TERMS

1. CURRENCY

All amounts stated in this Contract are in US Currency dollars.

2. PRICE

The FIRM FIXED PRICE for the Work described in Attachment A - Scope of Work, is _____ (\$ _____) excluding any sales, use, value added or similar taxes.

3. LIMITATION OF EXPENDITURE

County shall not be obliged to reimburse Contractor in excess of this Limitation of Expenditure. Contractor shall not be obliged to perform any Work or provide any service that would cause the liability of County to exceed the said Limitation of Expenditure, unless so authorized in writing by County. Contractor shall notify County as to the adequacy of the Limitation of Expenditure and provide a new estimate of cost if, at any time, Contractor considers the funds provided are inadequate for the completion of the Work. It is understood and agreed between the parties that the giving of such notifications and estimates shall not increase County's liability for the Work over the above Limitation of Expenditure.

4. BILLING

The Contractor may secure payment for a percentage on a monthly work-in-progress basis, or for the full amount of monies allocated to tasks under each Phase by submitting to the county the following:

- a. All deliverable items or evidence of work-in-progress representing that percentage or the full amount of work for which the Contractor is claiming payment; and
- b. A dated invoice showing the amount of the claimed payment with a brief description of the work done for each separate amount being claimed. Invoices may be submitted on a monthly basis.
- c. A breakdown of the tasks for interim work-in-progress invoicing purposes is attached to this contractual agreement.

5. PAYMENT

The County will make prompt payments to the Contractor following receipt of the items described in Attachments A and B, above, subject to the following:

- a. Formal acceptance by the County as complete, satisfactory and meeting all applicable specifications of all deliverable items, or evidence of work in progress, representing that percentage of the full amount required to substantiate the claimed payment.
- b. Ten percent (10%) of the total amount of each billing will be withheld as retainage until final completion of the contract and all items are delivered to and formally accepted by the County as complete, satisfactory, and meeting all applicable specifications.

- c. The County shall pay within sixty (60) days all payment claims submitted by the Contractor, meeting all of the above requirements, and not formally disputed by the County. All payment claims not paid within sixty (60) days or disputed by the County may be considered overdue by the Contractor and shall bear a monthly charge of 1% on the unpaid amount until paid. The County shall not use the disputation of one payment claim as a reason for disputing or not paying on time any other payment claim, unless the disputed claim materially affects the usability of any other part, portion or phase of the work contemplated by this Contractual Agreement.

ATTACHMENT E GENERAL TERMS AND CONDITIONS

The following terms and conditions identify the minimum requirements. If prime contract terms and conditions apply, as provided or as referenced in the contract, the greater of or additional requirements contained in the respective terms and conditions shall apply.

1. CONTRACTOR

The Contractor is and shall at all times be an Independent Contractor to the County during performance under this Contract, and at no time shall be considered an agent, servant, or partner of County. All persons employed by Contractor to perform its obligations under the Contract shall be its employees or servants and not the employees, servants, or agents of County.

2. SOURCE MATERIALS

Within seven (7) calendar days of contract signing, the County will provide the Contractor with the Source materials requested and set out in the Contractor's Proposal. Should the Contractor determine there is relevant information missing from the source materials provided, which missing information is mandatory in order to proceed with completion of the contract, the Contractor will request and obtain prior authorization from the County for the additional costs associated with obtaining the same, prior to proceeding further with the contract.

The accuracy of the data contained in the source materials provided by the County, will be determined after the contractor has completed the flying, scanning and aerial triangulation portions of the contracted services. Should the Contractor discover that the County supplied data contains inaccuracies which inaccuracies must be either (1) corrected or (2) new data obtained, before contractor can proceed with the completion of the orthophotography work, the contractor will quantify and provide the County with the additional costs associated with either correcting or obtaining new data. The County will provide written authorization for the additional costs prior to the Contractor proceeding further with the Contract. Upon receipt of notice of any additional costs the County has the option to (a) approve the additional costs and work required, or (b) approve the work to proceed without correcting inaccuracies. Any delay in obtaining direction or authorization from the County will be deemed an excusable delay.

3. TITLE TO GOODS AND SERVICES - RISK OF LOSS

a. Except as may otherwise be provided herein, County shall acquire title to each and every of the goods and services to be provided by Contractor in this Contract. Contractor warrants that it has good and marketable title to each and every of such goods and services, and that they are and shall be free of and from any claims, liens, charges or encumbrances of any kind. Title to such goods and services shall pass to County upon receipt and acceptance at the place or places designated herein.

b. The risk of loss to such goods and services shall pass to County upon delivery to the County at the delivery point specified in this Contract.

4. INSPECTION AND ACCEPTANCE

a. Contractor shall inspect and test as required in the Contract and maintain records and a system thereof.

b. County, its representatives, or Client may from time to time wish to view Contractor's performance under the Contract or conduct tests or inspections. Contractor agrees to co-operate fully with such activities and to allow reasonable access to its facilities and those of its subcontractors or Contractors at all reasonable times for these purposes.

c. Any inspections, tests, review, or comments by County, its representatives, or Client shall in no way relieve Contractor of any of its obligations in the Contract, unless otherwise expressly provided herein and then only to the extent provided.

d. If any of the goods and services do not conform to the requirements of this Contract, County may, within fourteen (14) days of receipt, reject any or all of the goods and services. If the County has not rejected the goods and services within fourteen (14) days of receipt thereof the goods and services shall be deemed to be accepted. Rejected goods may, at the option of County, be held for Contractor's disposition instructions or returned to Contractor. Any approval or acceptance by County of part of the goods and services shall not relieve Contractor of its obligations. No act of payment by County shall be considered an approval or acceptance of any or all of the goods and services.

5. WARRANTIES/GUARANTEES

a. Contractor warrants that the goods and services to be provided herein shall:

be new and of the best quality where no quality is specified;

conform with the requirements of the Contract and any specifications or drawings incorporated herein; and

be free from defects in workmanship, materials, and design, where design is the responsibility of Contractor.

b. If at any time prior to the expiry of NINETY (90) DAYS from the date of the acceptance of the goods or services provided by Contractor the goods or services, or any part thereof, do not in any way conform to the requirements of the Contract, then upon Notice to Contractor by County within a reasonable period of time after the discovery thereof, Contractor shall promptly repair, replace, correct or re-perform such defective goods or services to the satisfaction of and at no cost to County.

c. This sole and limited warranty, is in lieu of all other warranties, guarantees or representations, whether express or implied, with respect to the goods and services, including but not limited to, those relating to merchantability or fitness for a particular purpose or function and whether arising out of statute, law, equity, course of dealing, usage of trade or otherwise. In no event shall Contractor be liable for any consequential losses or damage including loss of profit, data, use, or capital, by County, arising here from.

6. REPORTS AND MEETINGS

Contractor shall furnish County with reports and attend meetings when and as reasonably required by County.

7. CHANGES - SUSPENSION

a. County by Notice through its authorized representative shall at all times have the right to:

make changes (Change) hereto including, but not limited to, the goods or services to be provided; the time, place, or method of delivery; design, specifications, or drawings; or

suspend performance by Contractor (Suspension) herein, whereupon Contractor shall promptly comply with such Suspension as required; place no further orders or subcontracts; make all reasonable efforts to obtain suspension terms favorable to County; and use its personnel and facilities so as to minimize costs associated with the Suspension.

b. If Contractor believes any instruction, interpretation, or decision by County affects its performance obligations herein and should be considered a Change, it may within ten (10) working days of receipt thereof, give written Notice to County's authorized representative of the effect upon Contractor's performance obligations. Receipt of such Notice by County or acquiescence thereto shall not be construed as a Change. In no event shall any instruction, interpretation or decision by County that results from an error, mistake, or omission of Contractor in the provision of goods or services herein be considered as a Change.

c. If any Change or Suspension results in an alteration to the cost of or time required for Contractor performance herein, an equitable adjustment will be made and the Contract amended accordingly. Contractor shall continue performance of its obligations herein during the period of Change or Suspension until such equitable adjustment is made. In no event shall any alteration, modification or other change to the Contract have effect or be binding upon either party unless in writing and signed by both parties.

d. If County fails to make payments to Contractor in accordance with the terms of this Contract, Contractor may suspend performance hereunder until all amounts owing have been paid.

8. TERMINATION

a. County may at any time and without cause, upon thirty (30) days Notice to Contractor, terminate all or a portion of the Contract. Rights and obligations of the parties which may have accrued or arisen to the time of termination shall not be affected thereby. Contractor shall be paid for all work delivered and accepted in accordance with the Contract, the fully burdened cost of any work not completed or delivered up until the time of termination and reasonable costs of terminating the work plus overheads and a reasonable profit thereon.

b. Upon default by Contractor of any material term, condition, covenant or agreement to the Contract, and upon Contractor's failure to cure such default within thirty (30) days of written Notice thereof, County may terminate all or a portion of this Contract. Contractor shall be paid for all Work delivered to and accepted by County prior to the termination. Deemed acts of default by Contractor shall include but not be limited to:

Contractor ceasing to carry on its business in the ordinary course; or, insolvency or bankruptcy of Contractor, or the making of a general assignment for the benefit of creditors; or, an order of receivership, or for the liquidation or winding up of Contractor; or, the appointment of a Custodian, Receiver or Manager or similar person in respect of Contractor.

c. Upon default by County of any material term, condition, covenant or agreement to the Contract, and County's failure to cure such default within thirty (30) days of written Notice thereof, Contractor may terminate all or a portion of this Contract. Deemed acts of default by County shall include but not be limited to:

County ceasing to carry on its business in the ordinary course; or,

insolvency or bankruptcy of County, or the making of a general assignment for the benefit of creditors; or,

an order of receivership, or for the liquidation or winding up of County; or,

the appointment of a Custodian, Receiver or Manager or similar person in respect of County.

9. FORCE MAJEURE / EXCUSABLE DELAYS

A party hereto shall not be in default under the Contract from any failure to perform hereunder if such failure arises from causes beyond the control of and without the fault or negligence of such party. Such causes include but are not limited to: acts of God or of the public enemy; acts of Government in either its sovereign or contractual capacity (including but not limited to export/import control); fire; flood; strike; epidemic; quarantine restrictions; freight embargo; or unusually severe weather. The affected party shall immediately give Notice to the other, including all relevant information available, that any such actual or potential cause is delaying or threatens to delay the timely performance of the Contract.

10. COMPLIANCE WITH LAW

Contractor shall comply at all times with all federal, state, provincial, municipal or local laws and regulations.

11. CONFIDENTIAL INFORMATION

a. Both parties agree to:

receive and maintain as proprietary and confidential, any Confidential Information of the other party; and to protect same from disclosure to others or from use, by itself or others, for any purpose inconsistent with this Contract without the prior written consent of the providing party.

Confidential Information shall include information or property falling within the scope of a party's patents, copyright, trade secrets, technical data, know-how, or business information conveyed in written, graphic or other permanent tangible form; or if oral, if promptly reduced to a permanent tangible form, and shall also include all information received by a party under an obligation of secrecy or confidentiality, but shall not include information which:

was already known to the receiving Party without an obligation of secrecy at the time of disclosure under this Contract; or is lawfully in the public domain at the time of disclosure under this Contract, or becomes lawfully within the public domain but only after such time; or after disclosure is lawfully obtained by the receiving party from another source without restriction on disclosure.

b. The provisions contained within this Article, shall survive termination of the Contract for any reason whatsoever for ten (10) years from the effective date of this Contract.

12. SUBCONTRACTS / PURCHASE ORDERS

Contractor shall not subcontract or assign any of the work or any of its rights or obligations under this Contract without the prior written permission of the County. All work conducted for a project shall be performed within the boundaries of the United States. Under no circumstances shall it be permitted to send any film, film derivatives, or any other data, whether digital or hard copy, associated with the performance of a contract to destinations outside of this country. The use of offshore labor or non US citizens in performance of any aspect of a project or work performed in the United States by a company that in any way is owned or partly owned or managed by a non United States Citizen must be considered on a case-by-case basis and advance approval requested from the County and the Department of Revenue. Contractor agrees to preserve and protect the rights of the Parties hereto in the provision of any goods or services to be performed under any and all subcontracts or purchase orders associated with this Contract.

13. INDEMNITY FOR PATENT INFRINGEMENT

Contractor shall defend, indemnify and save harmless County or its Client from and against all damages, costs and expenses, including attorneys' fees and costs either may sustain, pay, or incur as a result of any cause, action, suit, proceeding or claim brought against County or its Client as a result of the sale or use of the goods or services provided by Contractor under this Contract and based upon actual or alleged infringement of any letters patent, copyright, trade secret, or trademark, or proprietary rights of others. County will provide Contractor with timely written Notice of any such claim, and will co-operate fully with Contractor in furtherance of Contractor obligations herein. Contractor obligations herein shall not apply to County-provided designs or specifications.

14. LIABILITY AND INDEMNIFICATION

- a. Contractor shall indemnify and save harmless County from and against all manner of actions, proceedings, claims, demands, losses, costs, damages, and expenses whatsoever which may be brought or made against, or which County may sustain, pay or incur, as a result of or in connection with the performance or non-performance of the Contract in whole or in part by Contractor, whether in contract, tort or otherwise.
- b. County shall provide Contractor with timely written Notice of any such claim, and will provide all relevant information and co-operate fully with Contractor in furtherance of Contractor's obligation herein.
- c. In no event shall contractor be liable for loss of profits, loss of revenue, special, indirect, or consequential damages.
- d. Notwithstanding any other provisions of this Contract, Contractor's liability under this contract shall be limited to the lesser of the amount paid under this Contract or one million dollars (\$1,000,000.00).

15. INSURANCE

Contractor shall maintain in force during the term of this Contract insurance with the following minimum limits:

General Liability \$1,000,000

Automobile Liability \$1,000,000

Worker's Compensation as required in any jurisdiction in which work is to be performed

Within ten days of the execution of the Contract the Contractor shall provide County with a certificate of insurance:

showing evidence of the above coverage;

showing County as an Additional Insured;

providing for a minimum of thirty (30) days prior written notice to County of any cancellation or material alteration to any coverage.

16. NOTICES

Any notice or communication pertaining to this Contractual Agreement shall be deemed to have been duly given by the parties hereto if sent to the other by registered mail, by telegraph or telex to the address hereinafter stated, or to such other address as the parties may mutually agree upon.

For the County:

For the Contractor:

County: _____

Commission Chairman:

17. DISPUTES

In the event of a dispute arising out of or relating to this Contract, the parties shall attempt to settle the matter amicably at the working level. Where the parties are unable to resolve the dispute, either party may by Notice setting out the particulars of the dispute, refer the matter to the senior management of the parties. If senior management cannot resolve the dispute within thirty (30) days of the Notice of Dispute the dispute shall be referred to arbitration. Any such arbitration will be conducted in accordance with the rules of the Alabama Arbitration Act and shall be conducted by a single arbitrator, in English, in Alabama. The parties agree to be bound by the decision of the arbitrator. The costs of the arbitration shall be apportioned between the parties, or against one or more of the parties, as the arbitrator may decide.

18. WAIVER

Waiver by either party of the strict performance of any term, condition, covenant, or agreement in the Contract shall not of itself constitute a waiver of or abrogate such term, condition, covenant or agreement, nor be a waiver of any subsequent breach of same, or of any other term, condition, covenant or agreement.

19. HEADINGS

Headings to any of the provisions of the Contract are for convenience only and shall not have the effect of modifying, amending, or altering any provision of the Contract.

20. SEVERABILITY

If any provision of the Contract is held to be invalid in whole or in part, the remainder of the Contract or of such provision, as the case may be, and the application thereof, shall not be affected thereby.

21. LAW OF CONTRACT

The laws of the State of Alabama shall govern the legal obligations of the parties and the interpretation of the Contract. The parties agree that the UNCITRAL rules are not applicable to this contract.

22. ASSIGNMENT

Neither the Contract nor any rights or obligations contained herein may be assigned, subcontracted, or otherwise transferred in whole or in part by Contractor without the prior written consent of County. Such consent shall not be unreasonably withheld.

23. REPRESENTATIVES, SUCCESSORS AND ASSIGNS

Each and every one of the provisions contained in this Contract on the part of either party shall apply to and enure to the benefit of and bind their respective legal representatives, successors and assigns.

24. TAXES/DUTY

Unless expressly included herein, prices for goods and services are exclusive of all sales, use and like taxes, value, value added, or business transfer taxes, customs or import/export duties and excise taxes; and any such taxes or duties required by law shall be paid by County.

25. PUBLICITY

Both parties acknowledge and accept that the other Party's name shall not be disclosed for purposes of advertising, including but not limited to press releases, brochures, photographic coverage, or verbal announcements concerning this Contract and/or any subsequent agreement, without the express written permission of the other party.

26. ENTIRETY OF CONTRACT

The terms and conditions of the Contractual Agreement and any document specifically incorporated herein by reference, if any, constitute the entire Contractual Agreement between the

parties. No prior communications, whether written or oral, nor any course of prior dealings between the parties shall be read into such Contractual Agreement for purposes of construction, interpretation or any other purpose whatsoever.

IN WITNESS WHEREOF, the parties have caused this instrument, consisting of ten (10) pages and Exhibits to be executed by themselves or their duly authorized officers or agents hereunto the day and year first written above.

County

Contractor

BY : _____ (Seal)

BY: _____

TITLE: _____

TITLE: _____

ATTEST:

 WITNESS:

Appendix R - Sample GIS Contract

This sample contractual agreement is intended to serve as a guide only. Specific details and business practice will vary depending on the technical services required and an individual county's business practices.

THIS CONTRACTUAL AGREEMENT, made this _____ day of _____, _____, by and between the County of _____, Alabama, hereinafter referred to as the "County", and _____, whose principal office is at _____, hereinafter referred to as the "Contractor".

WITNESSETH THAT:

WHEREAS, the County desires to engage the Contractor to render certain professional services and deliver certain materials hereinafter described;

and

WHEREAS, the Contractor represents that it is qualified, willing and able to provide the professional services and deliver the requested materials to the County according to the County's specifications and the terms of this Contractual Agreement; it is therefore agreed and understood that;

I. THE SCOPE OF CONTRACTUAL AGREEMENT

Based upon the County's project specifications and the Contractor's Technical Proposal, Cost Proposal and Equipment Specifications Document, it is the intention of both parties that all of these documents are attached hereto as Exhibits and are incorporated by reference into this Contractual Agreement as if fully set forth herein. The purpose of this project is to provide the County with a seamless parcel level Geographic Information System that includes the conversion of the existing assessment parcel maps, map maintenance software, training, setup and installation.

The agreed upon price to be paid to the Contractor for the entire project is _____, based on an estimated _____ parcels.

This project is to be conducted in five (5) phases as described in the provisions herein. These five phases are not necessarily consecutive and may overlap in several instances. This project is to be effectuated within three (3) business days of receipt of written authorization to proceed and as follows:

- | | | |
|---|----------|----------|
| 1. Pilot Test Maps | 11/15/02 | 12/15/02 |
| 2. Digital Conversion Production Work | 12/15/02 | 02/15/03 |
| 3. Installation and Implementation of GIS | 01/15/03 | 02/15/03 |
| 4. Formal Training | 01/15/03 | 03/15/03 |
| 5. System Hardware | 12/15/02 | 01/15/03 |

A. PILOT TEST MAPS

This phase of the contract work will include digital conversion of 2 adjacent 1" = 400' maps and 2 adjacent 1" = 100' scale maps as a pilot area to test conversion procedures and ensure delivery of all data in full compliance with state specifications and a Contractor supplied digital database design that complies with the State of Alabama Digital Cadastral Map Specifications.

County and State cadastral mapping personnel will inspect and evaluate the Pilot Test Maps. Unsatisfactory results may result in termination of the contract at the county's option.

All materials and associated products prepared under Phase I will be completed no later than _____. Initial task training on-site by the Contractor's personnel will begin upon conclusion of the pilot area conversion work.

B. DIGITAL CONVERSION PRODUCTION WORK

This phase of the contract work will involve production scale digital conversion of the County's tax maps and delivery of all products and services. All digital mapping will be based upon the Alabama State Plane Coordinate System (NAD 1983) and it will be in full compliance with the Alabama State Specifications, for computer-assisted mapping, the project specifications, and the Contractor's "Proposal". This work will be reviewed on a periodic basis for compliance with county and state specifications, contract requirements, delivery dates and contractor's proposal. Unsatisfactory reviews may result in one or more of the following actions:

- a. Retainage (see Section IV, C, 2.)
- b. Penalty (see Section II, B.)
- c. Termination of contract

All materials and associated products prepared under Phase III will be completed no later than _____.

C. PHASE FOUR – INSTALLATION AND IMPLEMENTATION OF GIS

This phase of the contract work will involve installation and implementation of Geographic Information System (GIS) software into the County to operate the tax parcel digital database to be constructed in Phase III above. The connectivity, area definition and contiguity of the map features such as points lines, polygons and annotation that define topology will be structured to be topologically-sound data structures. Non-graphic data must provide all attributes of the Computer Assisted Mass Appraisal and Property Tax Administration database files. Graphic and non-graphic databases must connect to the Department of Revenue's GIS system relational databases. The latest version of software available at the time of installation will be delivered. All required software and licenses for Operating Systems, Databases, Applications, and Utilities shall be detailed by the Contractor, per the Contractors proposal as to number required, cost and totals.

This software installation will be completed for a total fee of _____. This fee includes on-site installation onto the County's hardware and one (1) full year of Software Maintenance for all licenses, which shall be incorporated and made a part of this contract. Phase four will be completed within __ months from the effective date of this contract.

D. FORMAL TRAINING

Formal training for County employees will be conducted within 12 months from the effective date of this Contractual Agreement at the places and time mutually agreed upon by the county and the contractor.

Training of any additional personnel, if required, would be negotiated as necessary and as the situation dictates.

E. SYSTEM HARDWARE

The Contractor will provide specifications to the County for all hardware necessary for this project. The County will purchase the system hardware necessary to the GIS Implementation under a separate agreement and contract in accordance with State Bid Laws.

II. COMMENCEMENT AND PROSECUTION OF WORK

Work done by the Contractor will commence immediately upon receipt of authorization to proceed, and will be completed in full and with all “Deliverable Items” accepted by the County not later than _____. It is expected that both parties will carry out their respective responsibilities as diligently and expeditiously as possible. However, in the event that unforeseen circumstances arise that may delay the timely completion of any part of the project, the following provisions will apply:

A. County at Fault

Unless specifically excused by force majeure, if the County fails to supply the Contractor when requested with pertinent and necessary information or materials essential for the progress or completion of any part of the project, then the Contractor shall be permitted to effect a temporary suspension of work, and whatever time is lost as a result of the County’s delay in supplying said information or materials will become an automatic extension of the completion date.

B. Contractor at Fault

Delays on the part of the contractor that are not specifically excused by force majeure as defined below will result in a penalty of one-hundred dollars (\$100) per calendar day until the schedule is corrected. Delays may be excused and become an extension of the applicable completion date, if:

- a. The contractor has submitted in writing and in advance of the applicable completion date, a request that certain delays of work be excused by the County, stating therein explicit reasons which would justify such delays;

and

- b. The county responds in writing, granting to the Contractor approval for an extension in the applicable completion date for a specified time limit based upon the Contractor’s request.

C. Force Majeure

Neither the Contractor nor County shall be liable for loss or damage due to delay in delivery or progress of the work contemplated by this Contractual Agreement resulting from any cause beyond Contractor's or County's reasonable control or due to compliance with any regulations, order, acts, instructions or priority requests of any Federal, State or Municipal Government or any department or agency thereof, civil or military authority, acts of God, acts or omissions of the County or Contractor, respectively, fires, floods, unusually severe weather, strikes, blackouts, factory shutdowns or alterations, embargoes, wars, riots, delays or shortages in transportation or inability to obtain labor, manufacturing facilities, material or information from Contractor's or County's usual sources. In the event of such delay, the Contractor and County, shall mutually agree to an equitable adjustment to those contractual provisions, including price and delivery, as may be affected by such a delay. Such an agreement shall be documented in an amendment to this contract.

III. WARRANTY, LIABILITY, AND STANDARD OF CARE

Contractor shall perform services for the County in a professional manner, using that degree of care and skill ordinarily exercised by and consistent with the standards of competent contractors performing the same or similar work as set forth in this project and Contractual Agreement. In the event any portion of the services fails to comply with this warranty obligation, the Project Specifications, Contractor's Technical Proposal, cost Proposal and Equipment Specifications, the contractor is promptly notified in writing prior to one year after completion of the entire project made the basis of this Contractual Agreement. The contractor will promptly re-perform such portion of the services.

The warranty is in lieu of all other warranties except the statutory warranty of fitness for a particular purpose under Alabama law.

In no event shall the Contractor be liable for any special, indirect, incidental or consequential loss or damages in excess of the contract price as set herein.

IV. PAYMENTS TO CONTRACTOR

A. Payments of the agreed upon total cost for cost for each phase of work will be made by the County to the Contractor upon completion of each phase.

B. The Contractor may secure payment for a percentage on a monthly work-in-progress basis, or for the full amount of monies allocated to tasks under each Phase by submitting to the county the following:

- a. All deliverable items or evidence of work-in-progress representing that percentage or the full amount of work for which the Contractor is claiming payment; and a dated invoice showing the amount of the claimed payment with a brief description of the work done for each separate amount being claimed. Invoices may be submitted on a monthly basis.

- b. A breakdown of the digital conversion and GIS Implementation tasks for interim work-in-progress invoicing purposes is attached to this contractual agreement.

C. The County will make prompt payments to the Contractor following receipt of the items described in paragraph IV, A and B, above, subject to the following:

Formal acceptance by the County as complete, satisfactory and meeting all applicable specifications of all deliverable items, or evidence of work in progress, representing that percentage of the full amount required to substantiate the claimed payment.

D. Ten percent (10%) of the total amount of each billing will be withheld as retainage until final completion of the contract and all items are delivered to and formally accepted by the County as complete, satisfactory, and meeting all applicable specifications.

E. The County shall pay within sixty (60) days all payment claims submitted by the Contractor, meeting all of the above requirements, and not formally disputed by the County. All payment claims not paid within sixty (60) days or disputed by the County may be considered overdue by the Contractor and shall bear a monthly charge of 1% on the unpaid amount until paid. The County shall not use the disputation of one payment claim as a reason for disputing or not paying on time any other payment claim, unless the disputed claim materially affects the usability of any other part, portion or phase of the work contemplated by this Contractual Agreement.

V. WORK-IN-PROGRESS INSPECTIONS

The contractor shall cooperate fully with the County or the County's representatives in making possible work-in-progress inspections as frequently as desired by the County. In the event the County or its representatives find that project work is not being performed in accordance with the applicable specifications, then the County shall promptly notify the Contractor in writing of the unacceptable work, and the Contractor shall take immediate appropriate corrective actions.

VI. OTHER LEGAL RESPONSIBILITIES OF PARTIES

A. The Contractor shall observe and comply with all applicable federal, state and local laws, ordinances and regulations during its performance under this Contractual Agreement.

B. The Contractor shall save harmless the County and its representatives from all suits, actions or claims of any kind brought on account of any injuries or damages sustained by any person or property in consequence of any act or omission by the Contractor or its employees or agents, or from any claims or amounts due arising or recovered under the State's Workmen Compensation laws. Contractor's indemnity and hold harmless obligations undertaken pursuant to this contract, if any, shall specifically exclude that portion of such obligations that could require the Contractor to indemnify or hold harmless client, its agents, employees or contractors for their own negligence. The contractor will furnish evidence of Workmen Compensation and Public Liability Insurance with all policies being with companies authorized to do business in the State of Alabama.

C. The County agrees to mitigate its damages, should any damages arise in the course of this Contractual Agreement, to every extent possible, and to take such reasonable measures to prevent injury or damages within its jurisdiction as a reasonable prudent individual or entity would take.

VII. ASSIGNMENT

This Contractual Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective successors and assigns. Neither party shall assign its rights and/or obligations under this Contractual Agreement without the prior written consent of the other party.

VIII. WAIVER, MODIFICATION AND SEVERABILITY CLAUSE

No waiver, modification or cancellation of any term or condition of this Contractual Agreement shall be effective unless made in writing and signed by authorized representatives of each party. Nor shall any waivers be deemed to excuse the performance of any act other than those specifically referred to in said written notice of waiver.

IX. NOTICE PROVISION

Any notice or communication pertaining to this Contractual Agreement shall be deemed to have been duly given by the parties hereto if sent to the other by registered mail, by telegraph or telex to the address hereinafter stated, or to such other address as the parties may mutually agree upon.

X. CONSTRUCTION

This Contractual Agreement shall be construed and interpreted in accordance with the laws of the State of Alabama, exclusive of its rules pertaining to conflict of laws.

XI. DISPUTES

Any dispute arising under this contract that is not settled by agreement of the parties may be litigated in the Circuit Court of the State of Alabama, or a Federal District Court in Alabama.

XII. ENTIRE CONTRACTUAL AGREEMENT

The terms and conditions of the Contractual Agreement and any document specifically incorporated herein by reference, if any, constitute the entire Contractual Agreement between the parties. No prior communications, whether written or oral, nor any course of prior dealings between the parties shall be read into such Contractual Agreement for purposes of construction, interpretation or any other purpose whatsoever.

IN WITNESS WHEREOF, the parties have caused this instrument, consisting of ten (10) pages and Exhibits to be executed by themselves or their duly authorized officers or agents hereunto the day and year first written above.

County

Contractor

BY : _____ (Seal)

BY: _____

TITLE: _____

TITLE: _____

ATTEST:

WITNESS:

U.S. Geological Survey National Geospatial Program Lidar Guidelines and Base Specification

Version 13 – ILMF 2010

The U.S. Geological Survey National Geospatial Program (NGP) has cooperated in the collection of numerous lidar datasets across the nation for a wide array of applications. These collections have used a variety of specifications and required a diverse set of products, resulting in many incompatible datasets and making cross-project analysis extremely difficult. The need for a single base specification, defining minimum collection parameters and a consistent set of deliverables, is apparent.

Beginning in late 2009, an increase in the rate of lidar data collection due to American Reinvestment and Recovery Act (ARRA) funding for The National Map makes it imperative that a single data specification be implemented to ensure consistency and improve data utility. Although the development of this specification was prompted by the ARRA stimulus funding, the specification is intended to remain durable beyond ARRA funded NGP projects.

The primary intent of this specification is to create consistency across all NGP funded lidar collections, in particular those undertaken in support of the National Elevation Dataset (NED). Unlike most other “lidar specs” which focus on the derived bare-earth DEM product, this specification places unprecedented emphasis on the handling of the source lidar point cloud data. This is to assure that the complete source dataset collected remains intact and viable to support the wide variety of non-DEM science and mapping applications that benefit from lidar technology. In the absence of other comprehensive specifications or standards, it is hoped that this specification will, to the highest degree practical, be adopted by other USGS programs and disciplines, and by other Federal agencies.

Adherence to these minimum specifications ensures that bare-earth Digital Elevation Models (DEMs) derived from lidar data is suitable for ingestion into the NED (National Elevation Dataset) at the 1/9 arc-second resolution, and can be resampled for use in the 1/3 and 1 arc-second NED resolutions. It also ensures that the point cloud source data are handled in a consistent manner by all data providers and delivered to the USGS in clearly defined formats. This allows straight-forward ingest into CLICK (Center for Lidar Information, Coordination, and Knowledge) and simplifies subsequent use of the source data by the broader scientific community, particularly with regard to cross-collection analysis.

It must be stressed that this is a **base specification**, defining minimum parameters. It is expected that local conditions in any given project area, specialized applications for the data, or the preferences of cooperators, may mandate more stringent requirements. The

USGS encourages the collection of more detailed, accurate, or value-added data. A list of common upgrades to the minimum requirements defined here is provided in Appendix 1.

In addition, it is recognized that the USGS NGP also employs lidar technology for specialized scientific research and other projects whose requirements are incompatible with the provisions of this Specification. In such cases, and with properly documented justification supporting the need for the variance, waivers of any part or all of this Specification may be granted.

It is conceivable that in some cases, based on specific topography, land cover, intended application, or other factors, the USGS-NGP may require specifications more rigorous than those defined in this document. It is expected that this would be highly uncommon.

Lidar is still a relatively new technology; adolescent but not fully matured.. Advancements and improvements in instrumentation, software, processes, applications, and understanding are constantly being made. It would not be possible to develop a set of guidelines and specifications that address all of these advances. The current document is based on our understanding of and experience with the industry and technology at the present time. Furthermore, we acknowledge that there is a lack of commonly accepted “best practices” for numerous processes and technical assessments (i.e., measurement of NPS, point clustering, classification accuracy, etc.). The USGS encourages the development of such best practices through the appropriate industry and professional governance organizations, and we eagerly await the opportunity to include them in future revisions to this and other similar documents.

It is not the intention of the USGS to stifle the development of the lidar industry, nor to discourage innovation within the technology. Technical alternatives to any part of this document may be submitted with any proposal and will be given due professional consideration.

I. COLLECTION

1. Multiple Discrete Return, capable of at least 3 returns per pulse

Note: Full waveform collection is both acceptable and welcomed; however, waveform data is regarded as supplemental information. The requirement for deriving and delivering multiple discrete returns remains in force in all cases.

2. Intensity values for each return.
3. Nominal **Pulse** Spacing (NPS) of 1-2 meters, dependent on the local terrain and landcover conditions. Assessment to be made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath. Average along-track and cross-track point spacings should be comparable.
4. Collections designed to achieve the NPS through swath overlap or multiple passes are generally discouraged. Such collections may be permitted with prior approval.
5. Data Voids [areas $\Rightarrow (4*NPS)^2$, measured using 1st-returns only] within a single swath are not acceptable, except:
 - where caused by water bodies
 - where caused by areas of low near infra-red (NIR) reflectivity such as asphalt or composition roofing.
 - where appropriately filled-in by another swath
6. The spatial distribution of geometrically usable points is expected to be uniform and free from clustering. In order to ensure uniform densities throughout the data set:
 - A regular grid, with cell size equal to the design NPS*2 will be laid over the data.
 - At least 90% of the cells in the grid shall contain at least 1 lidar point.
 - Assessment to be made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath.
 - Acceptable data voids identified previously in this specification are excluded.

Note: This requirement may be relaxed in areas of significant relief where it is impractical to maintain a consistent NPS.

7. Scan Angle: Total FOV should not exceed 40° (+/-20° from nadir) USGS quality assurance on collections performed using scan angles wider than 34° will be particularly rigorous in the edge-of-swath areas. Horizontal and vertical accuracy shall remain within the requirements as specified below.

Note: This requirement is primarily applicable to oscillating mirror lidar systems. Other instrument technologies may be exempt from this requirement.

8. Vertical Accuracy of the lidar data will be assessed and reported in accordance with the guidelines developed by the NDEP and subsequently adopted by the ASPRS. The complete guidelines may be found in Section 1.5 of the Guidelines document. See:

http://www.ndep.gov/NDEP_Elevation_Guidelines_Ver1_10May2004.pdf

Vertical accuracy requirements using the NDEP/ASPRS methodology are:

FVA \leq 24.5cm ACCz, 95% (12.5cm RMSEz)

CVA \leq 36.3cm, 95th Percentile

SVA \leq 36.3cm, 95th Percentile

- Accuracy for the lidar point cloud data is to be reported independently from accuracies of derivative products (i.e., DEMs). Point cloud data accuracy is to be tested against a TIN constructed from bare-earth lidar points.
- Each landcover type representing 10% or more of the total project area must be tested and reported as an SVA.
- For SVAs, the value is provided as a target. It is understood that in areas of dense vegetation, swamps, or extremely difficult terrain, this value may be exceeded. Overall CVA requirements must be met in spite of "busts" in individual SVAs.

Note: These requirements may be relaxed in cases:

- *where there exists a demonstrable and substantial increase in cost to obtain this accuracy.*
 - *where an alternate specification is needed to conform to previously contracted phases of a single larger overall collection effort, i.e., multi-year statewide collections, etc.*
 - *where the USGS agrees that it is reasonable and in the best interest of all stakeholders to use an alternate specification.*
9. Relative accuracy \leq 7cm RMSE_Z within individual swaths; \leq 10cm RMSE_Z within swath overlap (between adjacent swaths).
 10. Flightline overlap 10% or greater, as required to ensure there are no data gaps between the usable portions of the swaths. Collections in high relief terrain are expected to require greater overlap. Any data with gaps between the geometrically usable portions of the swaths will be rejected.
 11. Collection Area: Defined Project Area, buffered by a minimum of 100 meters.
 12. Collection Conditions:
 - Atmospheric: Cloud and fog-free between the aircraft and ground
 - Ground:
 - Snow free. Very light, undrifted snow may be acceptable in special cases, with prior approval.

- No unusual flooding or inundation, except in cases where the goal of the collection is to map the inundation.
- Vegetation: Leaf-off is preferred, however:
 - As numerous factors will affect vegetative condition at the time of any collection, the USGS NGP only requires that penetration to the ground must be adequate to produce an accurate and reliable bare-earth surface suitable for incorporation into the 1/9 (3-meter) NED.
 - Collections for specific scientific research projects may be exempted from this requirement, with prior approval.

II. DATA PROCESSING and HANDLING

1. All processing should be carried out with the understanding that all point deliverables are required to be in fully compliant LAS format, v1.2 or v1.3. Data producers are encouraged to review the LAS specification in detail.
2. If full waveform data is collected, delivery of the waveform packets is required. LAS v1.3 deliverables with waveform data are to use external “auxiliary” files with the extension “.wdp” for the storage of waveform packet data. See the LAS v1.3 Specification for additional information.
3. GPS times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each pulse. Adjusted GPS Time is defined to be Standard (or satellite) GPS time minus 1×10^9 . See the LAS Specification for more detail.
4. Horizontal datum shall be referenced to the North American Datum of 1983/HARN adjustment. Vertical datum shall be referenced to the North American Vertical Datum of 1988 (NAVD 88). The most recent NGS-approved Geoid model shall be used to perform conversions from ellipsoidal heights to orthometric heights.
5. The USGS preferred Coordinate Reference System for the Conterminous United States (CONUS) is: UTM, NAD83, Meters. Each discrete project is to be processed using the predominant UTM zone for the overall collection area.

State Plane Coordinate Reference Systems that have been accepted by the European Petroleum Survey Group (EPSG) and that are recognized by ESRI GIS software may be used by prior agreement with the USGS.

Alternative projected coordinate systems for collections in Alaska, Hawaii, and other areas Outside the Conterminous United States (OCONUS) must be approved by the USGS prior to collection.

6. All references to the Unit of Measure “Feet” or “Foot” must specify either “International” or “U.S. Survey”
7. Long swaths (those which result in a LAS file larger than 2GB) should be split into segments no greater than 2GB each. Each segment will thenceforth be

- regarded as a unique swath and shall be assigned a unique File Source ID. Other swath segmentation approaches may be acceptable, with prior approval. Renaming schemes for split swaths are at the discretion of the data producer. The Processing Report shall include detailed information on swath segmentation sufficient to allow reconstruction of the original swaths if needed.
8. Each swath shall be assigned a unique File Source ID. The Point Source ID field for each point within each LAS swath file shall be set equal to the File Source ID prior to any processing of the data. See the LAS Specification.
 9. Point Families (multiple return “children” of a single “parent” pulse) shall be maintained intact through all processing prior to tiling. Multiple returns from a given pulse shall be stored in sequential (collected) order.
 10. All collected swaths are to be delivered as part of the “Raw Data Deliverable”. This includes calibration swaths and cross-ties. All collected points are to be delivered. No points are to be deleted from the swath LAS files. This in no way requires or implies that calibration swath data are to be included in product generation. Excepted from this are extraneous data outside of the buffered project area (aircraft turns, transit between the collection area and airport, transit between fill-in areas, etc.). These points may be permanently removed.
 11. Outliers, blunders, noise points, geometrically unreliable points near the extreme edge of the swath, and other points deemed unusable are to be identified using the “Withheld” flag, as defined in the LAS specification.
 - This applies primarily to points which are identified during pre-processing or through automated post-processing routines.
 - If processing software is not capable of populating the “Withheld” bit, these points may be identified using Class=11.
 - “Noise points” subsequently identified during manual Classification and Quality Assurance/Quality Control (QA/QC) may be assigned the standard LAS classification value for “Noise” (Class=7), regardless of whether the noise is “low” or “high” relative to the ground surface.
 12. The ASPRS/LAS “Overlap” classification (Class=12) shall not be used. ALL points not identified as “Withheld” are to be classified.
 - If overlap points are required to be differentiated by the data producer or cooperating partner, they must be identified using a method that does not interfere with their classification, such as:
 - Overlap points are tagged using Bit:0 of the User Data byte, as defined in the LAS specification. (SET=Overlap).
 - Overlap points are classified using the Standard Class values + 16.
 - Other techniques as agreed upon in advance
 - The technique utilized must be clearly described in the project metadata files.

Note: A standard bit setting for identification of overlap points has been planned for a future version of LAS.

13. Positional Accuracy Validation: The absolute and relative accuracy of the data, both horizontal and vertical, and relative to known control, shall be verified prior to classification and subsequent product development. This validation is obviously limited to the Fundamental Vertical Accuracy, measured in clear, open areas. A detailed report of this validation is a required deliverable.
14. Classification Accuracy: It is expected that due diligence in the classification process will produce data that meets the following test:

Within any 1km x 1km area, no more than 2% of non-withheld points will possess a demonstrably erroneous classification value.

This includes points in Classes 0 and 1 that should correctly be included in a different Class as required by the contract.

Note: This requirement may be relaxed to accommodate collections in areas where the USGS agrees classification to be particularly difficult.

15. Classification Consistency: Point classification is to be consistent across the entire project. Noticeable variations in the character, texture, or quality of the classification between tiles, swaths, lifts, or other non-natural divisions will be cause for rejection of the entire deliverable.

16. Tiles:

Note: This section assumes a projected coordinate reference system.

- A single non-overlapped tiling scheme will be established and agreed upon by the data producer and the USGS prior to collection. This scheme will be used for **all** tiled deliverables.
- Tile size must be an integer multiple of the cell size of raster deliverables.
- Tiles must be sized using the same units as the coordinate system of the data.
- Tiled deliverables shall conform to the tiling scheme, without added overlap.
- Tiled deliverables shall edge-match seamlessly and without gaps in both the horizontal and vertical.

III. HYDRO-FLATTENING REQUIREMENTS

Note: Please refer to Appendix 2 for reference information on hydro-flattening.

Hydro-flattening pertains only to the creation of derived DEMs. No manipulation of or changes to originally computed lidar point elevations are to be made. Breaklines may be used to help classify the point data.

1. Inland Ponds and Lakes:

- ~2-acre or greater surface area (~350' diameter for a round pond) at the time of collection.
- Flat and level water bodies (single elevation for every bank vertex defining a given water body).
- The entire water surface edge must be at or below the immediately surrounding terrain.
- Long impoundments such as reservoirs, inlets, and fjords, whose water surface elevations drop when moving downstream, should be treated as rivers.

2. Inland Streams and Rivers:

- 100' **nominal** width: This should not unnecessarily break a stream or river into multiple segments. At times it may squeeze slightly below 100' for short segments. Data producers should use their best professional judgment.
- Flat and level bank-to-bank (perpendicular to the apparent flow centerline); gradient to follow the immediately surrounding terrain.
- The entire water surface edge must be at or below the immediately surrounding terrain.
- Streams channels should break at road crossings (culvert locations). These road fills should not be removed from DEM. However, streams and rivers should **not** break at elevated bridges. Bridges should be removed from DEM. When the identification of a feature as a bridge or culvert cannot be made reliably, the feature should be regarded as a culvert.

3. Non-Tidal Boundary Waters:

- Represented only as an edge or edges within the project area; collection does not include the opposing shore.
- The entire water surface edge must be at or below the immediately surrounding terrain.
- The elevation along the edge or edges should behave consistently throughout the project. May be a single elevation (i.e., lake) or gradient (i.e., river), as appropriate.

4. Tidal Waters:

- Water bodies such as oceans, seas, gulfs, bays, inlets, salt marshes, very large lakes, etc. Includes any water body that is affected by tidal variations.
- Tidal variations over the course of a collection or between different collections, will result in discontinuities along shorelines. This is considered normal and these “anomalies” should be retained. The final DEM should represent as much ground as the collected data permits.
- Variations in water surface elevation resulting in tidal variations during a collection should NOT be removed or adjusted, as this would require either the removal of valid, measured ground points or the introduction of unmeasured ground into the DEM. The USGS NGP priority is on the ground surface, and accepts there may be occasional, unavoidable irregularities in water surface.
- Scientific research projects in coastal areas often have very specific requirements with regard to how tidal land-water boundaries are to be handled. For such projects, the requirements of the research will take precedence.

Cooperating partners may require collection and integration of single-line streams within their lidar projects. While the USGS does not require these breaklines be collected or integrated, it does require that if used and incorporated into the DEMs, the following guidelines are met:

1. All vertices along single-line stream breaklines are at or below the immediately surrounding terrain.
2. Single-line stream breaklines are not to be used to introduce cuts into the DEM at road crossings (culverts), dams, or other such features. This is hydro-enforcement and as discussed in Section VI, creates a non-traditional DEM that is not suitable for integration into the NED.
3. All breaklines used to modify the surface are to be delivered to the USGS with the DEMs.

The USGS does not require any particular process or methodology be used for breakline collection, extraction, or integration. However, the following general guidelines must be adhered to:

1. Bare-earth lidar points that are in close proximity breaklines should be excluded from the DEM generation process. This is analogous to the removal of masspoints for the same reason in a traditional photogrammetrically compiled DTM.

The proximity threshold for reclassification as “Ignored Ground” is at the discretion of the data producer, but in general should be approximately equal to the NPS.

2. These points are to be retained in the delivered lidar point dataset and shall be reclassified as “Ignored Ground” (class value = 10) so that they may be subsequently identified.
3. Delivered data must be sufficient for the USGS to effectively recreate the delivered DEMs using the lidar points and breaklines without significant further editing.

IV. DELIVERABLES

The USGS shall have unrestricted rights to all delivered data and reports, which will be placed in the public domain. This specification places no restrictions on the data provider's rights to resell data or derivative products as they see fit.

1. Metadata

Note: “Metadata” refers to all descriptive information about the project. This includes textual reports, graphics, supporting shapefiles, and FGDC-compliant metadata files.

- Collection Report detailing mission planning and flight logs.
- Survey Report detailing the collection of control and reference points used for calibration and QA/QC.
- Processing Report detailing calibration, classification, and product generation procedures including methodology used for breakline collection and hydro-flattening (*see Sections III and Appendix I for more information on hydro-flattening*).
- QA/QC Reports (detailing the analysis, accuracy assessment and validation of:
 - The point data (absolute, within swath, and between swath)
 - The bare-earth surface (absolute)
 - Other optional deliverables as appropriate
- Control and Calibration points: All control and reference points used to calibrate, control, process, and validate the lidar point data or any derivative products are to be delivered.
- Geo-referenced, digital spatial representation of the precise extents of each delivered dataset. This should reflect the extents of the actual lidar source or derived product data, exclusive of Triangular Irregular Network (TIN) artifacts or raster NODATA areas. A union of tile boundaries or minimum bounding rectangle is not acceptable. ESRI Polygon shapefile or geodatabase is preferred.
- Product metadata (FGDC compliant, XML format metadata). One file for each:

- Project
- Lift
- Tiled deliverable product group (classified point data, bare-earth DEMs, breaklines, etc.). Metadata files for individual tiles are not required.
- FGDC compliant metadata must pass the USGS metadata parser (“mp”) with no errors or warnings.

2. Raw Point Cloud

- All returns, all collected points, fully calibrated and adjusted to ground, by swath.
- Fully compliant LAS v1.2 or v1.3, Point Record Format 1, 3, 4, or 5
- LAS v1.3 deliverables with waveform data are to use external “auxiliary” files with the extension “.wdp” for the storage of waveform packet data. See the LAS v1.3 Specification for additional information.
- Georeference information included in all LAS file headers
- GPS times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each pulse.
- Intensity values (native radiometric resolution)
- 1 file per swath, 1 swath per file, file size not to exceed 2GB, as described in Section II, Paragraph 7.

3. Classified Point Cloud

Note: Delivery of a classified point cloud is a standard requirement for USGS NGP lidar projects. Specific scientific research projects may be exempted from this requirement.

- Fully compliant LAS v1.2 or v1.3, Point Record Format 1, 3, 4, or 5
- LAS v1.3 deliverables with waveform data are to use external “auxiliary” files with the extension “.wdp” for the storage of waveform packet data. See the LAS v1.3 Specification for additional information.
- Georeference information included in LAS header
- GPS times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each pulse.
- Intensity values (native radiometric resolution)
- Tiled delivery, without overlap (tiling scheme TBD)

- Classification Scheme (minimum):

Code	Description
1	Processed, but unclassified
2	Bare-earth ground
7	Noise (low or high, manually identified, if needed)
9	Water
10	Ignored Ground (Breakline Proximity)
11	Withheld (if the “Withheld” bit is not implemented in processing software)

Note: Class 7, Noise, is included as an adjunct to the “Withheld” bit. All “noise points” are to be identified using one of these to methods.

Note: Class 10, Ignored Ground, is for points previously classified as bare-earth but whose proximity to a subsequently added breakline requires that it be excluded during Digital Elevation Model (DEM) generation.

4. Bare Earth Surface (Raster DEM)

Note: Delivery of a bare-earth DEM is a standard requirement for USGS NGP lidar projects. Specific scientific research projects may be exempted from this requirement.

- Cell Size no greater than 3 meters or 10 feet, and no less than the design Nominal Pulse Spacing (NPS).
- Delivery in an industry-standard, GIS-compatible, 32-bit floating point raster format (ERDAS .IMG preferred)
- Georeference information shall be included in each raster file
- Tiled delivery, without overlap
- DEM tiles will show no edge artifacts or mismatch. A quilted appearance in the overall project DEM surface, whether caused by differences in processing quality or character between tiles, swaths, lifts, or other non-natural divisions, will be cause for rejection of the entire DEM deliverable.
- Void areas (i.e., areas outside the project boundary but within the tiling scheme) shall be coded using a unique “NODATA” value. This value shall be identified in the appropriate location within the file header.
- Vertical Accuracy of the bare earth surface will be assessed and reported in accordance with the guidelines developed by the NDEP and subsequently adopted by the ASPRS. The complete guidelines may be found in Section 1.5 of the Guidelines document. See:

http://www.ndep.gov/NDEP_Elevation_Guidelines_Ver1_10May2004.pdf

Vertical accuracy requirements using the NDEP/ASPRS methodology are:

FVA \leq 24.5cm ACCz, 95% (12.5cm RMSEz)

CVA \leq 36.3cm, 95th Percentile

SVA \leq 36.3cm, 95th Percentile

All QA/QC analysis materials and results are to be delivered to the USGS.

- Depressions (sinks), natural or man-made, are **not** to be filled (as in hydro-conditioning and hydro-enforcement).
- Water Bodies (ponds and lakes), wide streams and rivers (“double-line”), and other non-tidal water bodies as defined in Section III are to be hydro-flattened within the DEM. Hydro-flattening shall be applied to all water impoundments, natural or man-made, that are larger than ~2 acre in area (equivalent to a round pond ~350’ in diameter), to all streams that are nominally wider than 100’, and to all non-tidal boundary waters bordering the project area regardless of size. The methodology used for hydro-flattening is at the discretion of the data producer.

Note: Please refer to the Sections III and VI for detailed discussions of hydro-flattening.

5. Breaklines

Note: Delivery of the breaklines used in hydro-flattening is a standard requirement for USGS NGP lidar projects. Specific scientific research projects may be exempted from this requirement. If hydro-flattening is achieved through other means, this section may not apply.

- All breaklines developed for use in hydro-flattening shall be delivered as an ESRI feature class (PolylineZ or PolygonZ format, as appropriate to the type of feature represented and the methodology used by the data producer). Shapefile or geodatabase is preferred.
- Each feature class or shapefile will include properly formatted and accurate georeference information in the standard location. All shapefiles must include the companion .prj file.
- Breaklines must use the same coordinate reference system (horizontal and vertical) and units as the lidar point delivery.
- Breakline delivery may be as a continuous layer or in tiles, at the discretion of the data producer. Tiled deliveries must edge-match seamlessly in both the horizontal and vertical.

APPENDIX 1
COMMON DATA UPGRADES

1. Independent 3rd-Party QA/QC by another AE Contractor (encouraged)
2. Higher Nominal Pulse Spacing (point density)
3. Increased Vertical Accuracy
4. Full Waveform collection and delivery
5. Additional Environmental Constraints
 - Tidal coordination, flood stages, crop/plant growth cycles, etc.
 - Shorelines corrected for tidal variations within a collection
6. Top-of Canopy (First-Return) Raster Surface (tiled). Raster representing the highest return within each cell is preferred.
7. Intensity Images (8-bit gray scale, tiled)
8. Detailed Classification (additional classes):

Code	Description
3	Low vegetation
4	Medium vegetation (use for single vegetation class)
5	High vegetation
6	Buildings, bridges, other man-made structures
n	additional Class(es) as agreed upon in advance

9. Hydro-Enforced and/or Hydro-Conditioned DEMs
10. Breaklines (PolylineZ and PolygonZ) for single-line hydrographic features (narrow streams not collected as double-line, culverts, etc.), including appropriate integration into delivered DEMs
11. Breaklines (PolylineZ and PolygonZ) for other features (TBD), including appropriate integration into delivered DEMs
12. Extracted Buildings (PolygonZ): Footprints with maximum elevation and/or height above ground as an attribute.
13. Other products as defined by requirements and agreed upon in advance of funding commitment.

APPENDIX 2

HYDRO-FLATTENING REFERENCE

The subject of modifications to lidar-based DEMs is somewhat new, and although authoritative references are available, there remains significant variation in the understanding of the topic across the industry. The following material was developed to provide a definitive reference on the subject only as it relates to the creation of DEMs intended to be integrated into the USGS NED. The information presented here is not meant to supplant other reference materials and it should not be considered authoritative beyond its intended scope.

The term “**hydro-flattening**” is also new, coined for this document and to convey our specific needs. It is not, at this time, a known or accepted term across the industry. It is our hope that its use and acceptance will expand beyond the USGS with the assistance of other industry leaders.

Hydro-flattening of DEMs is predominantly accomplished through the use of breaklines, and this method is considered standard. Although other techniques may exist to achieve similar results, this section assumes the use of breaklines. The USGS does not require the use of any specific technique.

The Digital Elevation Model Technologies and Applications: The DEM Users Manual, 2nd Edition (Maune *et al.*, 2007) provides the following definitions related to the adjustment of DEM surfaces for hydrologic analyses:

1. **Hydrologically-Conditioned (Hydro-Conditioned)** – Processing of a DEM or TIN so that the flow of water is continuous across the entire terrain surface, including the removal of all spurious sinks or pits. The only sinks that are retained are the real ones on the landscape. Whereas “hydrologically-enforced” is relevant to drainage features that are generally mapped, “hydrologically-conditioned” is relevant to the entire land surface and is done so that water flow is continuous across the surface, whether that flow is in a stream channel or not. The purpose for continuous flow is so that relationships/links among basins/catchments can be known for large areas. This term is specifically used when describing EDNA (see Chapter 4), the dataset of NED derivatives made specifically for hydrologic modeling purposes.
2. **Hydrologically-Enforced (Hydro-Enforced)** – Processing of mapped water bodies so that lakes and reservoirs are level and so that streams flow downhill. For example, a DEM, TIN or topographic contour dataset with elevations removed from the tops of selected drainage structures (bridges and culverts) so as to depict the terrain under those structures. Hydro-enforcement enables hydrologic and hydraulic models to depict water flowing under these structures, rather than appearing in the computer model to be dammed by them because of road deck elevations higher than the water levels. Hydro-enforced TINs also utilize breaklines along shorelines and stream centerlines, for example, where these breaklines form the edges of TIN triangles along the alignment of drainage features. Shore breaklines for streams would be 3-D breaklines

with elevations that decrease as the stream flows downstream; however, shore breaklines for lakes or reservoirs would have the same elevation for the entire shoreline if the water surface is known or assumed to be level throughout. See figures 1.21 through 1.24. See also the definition for “hydrologically-conditioned” which has a slightly different meaning.

While these are important and useful modifications, they both result in surfaces that differ significantly from a traditional DEM. A “hydro-conditioned” surface has had its sinks filled and may have had its water bodies flattened. This is necessary for correct flow modeling within and across large drainage basins. “Hydro-enforcement” extends this conditioning by requiring water bodies be leveled and streams flattened with the appropriate downhill gradient, and also by cutting through road crossings over streams (culvert locations) to allow a continuous flow path for water within the drainage. Both treatments result in a surface on which water behaves as it physically does in the real world, and both are invaluable for specific types of hydraulic and hydrologic (H&H) modeling activities. Neither of these treatments is typical of a traditional DEM surface.

A traditional DEM such as the NED, on the other hand, attempts to represent the ground surface more the way a bird, or person in an airplane, sees it. On this surface, natural depressions exist, and road fills create apparent sinks because the road fill and surface is depicted without regard to the culvert beneath. Bridges, it should be noted, are removed in most all types of DEMs because they are man-made, above-ground structures that have been added to the landscape.

Note: DEMs developed solely for orthophoto production may include bridges, as their presence can prevent the “smearing” of structures and reduce the amount of post-production correction of the final orthophoto. These are “special use DEMs” and are not relevant to this discussion.

For years, raster Digital Elevation Models (DEMs), have been created from a Digital Surface Model (DSM) of masspoints and breaklines, which in turn were created through photogrammetric compilation from stereo imagery. Photogrammetric DSMs inherently contain breaklines defining the edges of water bodies, coastlines, single-line streams, and double-line streams and rivers, as well as numerous other surface features.

Lidar technology, however, does not inherently collect the breaklines necessary to produce traditional DEMs. Breaklines have to be developed separately through a variety of techniques, and either used with the lidar points in the generation of the DEM, or applied as a correction to DEMs generated without breaklines.

In order to maintain the consistent character of the NED as a traditional DEM, the USGS NGP requires that all DEMs delivered have their inland water bodies flattened. This does not imply that a complete network of topologically correct hydrologic breaklines be developed for every dataset; only those breaklines necessary to ensure that the conditions defined in Section III exist in the final DEM.

APPENDIX 3
SAMPLE METADATA TEMPLATE

[to be added]

DRAFT

APPENDIX 4

REFERENCES

Maune, D.F., 2007. Definitions, in *Digital Elevation Model Technologies and Applications: The DEM Users Manual, 2nd Edition* (D.F. Maune, editor), American Society for Photogrammetry and Remote Sensing, Bethesda, MD pp. 550-551

National Digital Elevation Program, 2004. *Guidelines for Digital Elevation Data—Version 1*, 93 p., available online at:
http://www.ndep.gov/NDEP_Elevation_Guidelines_Ver1_10May2004.pdf
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FEMA, 2003. *Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix A: Guidance for Aerial Mapping and Surveying*, 59 p., available online at: <http://www.fema.gov/library/viewRecord.do?id=2206>
(last date accessed 29 September 2009)

USGS NED Website: www.ned.usgs.gov

USGS CLICK Website: www.lidar.cr.usgs.gov

MP-Metadata Parser: <http://geology.usgs.gov/tools/metadata>