



THE COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF REVENUE
DIVISION OF LOCAL SERVICES

L. JOYCE HAMPERS
COMMISSIONER

EDWARD J. COLLINS, JR.
DEPUTY COMMISSIONER

BUREAU OF LOCAL ASSESSMENT
INFORMATIONAL GUIDELINE
RELEASE NO. 82-403

SUBJECT: Tax Mapping

GUIDELINE FOR TAX MAPPING

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I. Introduction.

The principal responsibility of the assessor is to locate, inventory and appraise all real property in the municipality. Accurately drawn to scale, tax maps are an indispensable aid in this task. They indicate the location of the property, the size and shape of each parcel, and its relation to features that affect value. Tax maps provide a complete inventory of all land parcels and thus minimize the problems of omitted parcels and duplication of listing.

Tax maps are prepared by photogrammetry, a technical process using aerial photography obtained under controlled conditions, ground control and stereoplotting compilation to produce base maps, from which the final maps are prepared. A parcel inventory is then conducted. This includes deed research, a review of all available plans and surveys and, in the cases where deed descriptions are vague or indefinite, follow-up contact with the land owner to help in pinpointing property lines. Finally, two sets of index cards are prepared: one, filed alphabetically by the last name of the property owner, the other filed numerically by the parcel number. These cards contain additional information about the property.

The mapping system should include a set of detailed assessment maps covering the entire city or town, and an index map showing the location of each individual assessment map. Because they have a limited purpose, tax maps show only boundaries, streets and roads, and important physical features such as lakes and rivers. They show the boundary lines of each parcel of property and include the dimensions or the acreage. Each parcel is identified by a unique number.

The costs of preparing tax maps vary according to the size and complexity of the project. Factors such as the size of the community, the number of parcels, and the information available for use by the tax mappers influence the cost. Although tax maps require a substantial initial investment, they will last indefinitely if the maps are maintained.

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Adequate tax maps are so fundamental to the valuation process that it is doubtful that any reasonable degree of assessment equality can exist in an assessing unit without them. Many old assessment maps were compiled from subdivision plats or other land records. If the boundary dimensions on existing maps do not agree with deed dimensions, a community should seriously consider remapping.

II. Preparation for the mapping project

Before undertaking a tax mapping project, assessors should make sure they understand the provisions of the law. They should then inventory the resources available for use by the tax mapping company and make basic decisions concerning the scope and timing of the project. It is suggested that the advice of a professional engineer or land surveyor be sought to assist in evaluating resources, preparing a request for proposals, and in overseeing the actual mapping program.

A. Inventory of existing resources

1. Present tax maps

a. There may be sections of existing maps which are accurate.

b. To evaluate maps see:

Greulich, G., "Procedures to Check and Qualify Local Property Maps," 1980, available from the Massachusetts Division of Community Services, 100 Cambridge Street, Boston, MA.

2. Recent aerial photography, if taken according to the specifications for this project

3. Maps and plans maintained by the city or town engineering department

4. Copies of deeds in assessor's office

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5. Documents on file at the county Registry of Deeds.

- a. Grantor - grantee indexes
- b. Deeds and land court records
- c. Plans of properties drawn by land surveyors

B. Basic decisions

- a. Are there any other municipal departments which might be interested in undertaking a joint mapping project?
- b. Are there any neighboring communities which might be interested in undertaking a joint project?
- c. What will be included on the maps?
- d. How will the maps be maintained?
- e. How will the mapping project be financed?

- 1 Tax maps may be funded fifty percent per year for two years in accordance with G.L. Chapter 44, Section 7, Clause 18.

C. List of mapping companies

The Bureau of Local Assessment is compiling a list of mapping companies who have indicated their willingness to do business in accordance with these specifications. This list and a copy of the technical specifications for a tax mapping project will be provided to assessors on request.

D. Requests for proposal

A request for proposal should be sent to a number of mapping firms. It should include:

- 1. The name, address and phone number of the town official to contact

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2. Information on the size and boundary limits of the community, the volume of annual transfers of property and the total number of parcels to be mapped
3. The proposed date of completion
4. Information required from the mapper:
 - a. A list of recent clients with specific information on the number of parcels, the area, the completion date and the duration of the project
 - b. Resumes of key personnel with identification of their current responsibilities
 - c. Staff and equipment to be used for this project
 - d. A narrative plan of procedure to be followed with a time schedule
 - e. A current financial statement
 - f. References, including those of any subcontractors
 - g. Total cost of the project
5. Special instructions such as:
 - a. A request that companies include a sheet index on the U.S.G.S. Quadrangle Map (Scale of 1' = 2000') to show the varying scales proposed and the sheet numbering system
 - b. Microfilming of records
 - c. Progress reports and payment schedule
 - d. Information on data which will be supplied by the town

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6. Technical specifications

- a. Model specifications may be obtained from the Bureau of Local Assessment
- b. Specifications should be a separate enclosure

E. The contract

When the Board of Assessors receives the proposals, they should review them for adherence to the specifications; analyze the firm's qualifications; check current and prior clients; compare cost; and, where necessary, conduct personal interviews. Mapping firms provide professional services and therefore should be chosen on the basis of qualifications, as well as cost. The contract should incorporate by reference all requirements of the specifications and any additional provisions recommended by your town counsel or city solicitor.

All contracts for tax mapping must be submitted to the Bureau of Local Assessment for review and approval.

III. The major components of a mapping project

A. Aerial photography

1. Explanation

Aerial photography is the process of taking precision photographs from aircraft using special cameras. The pilot flies on predetermined flight lines specially designed to obtain the necessary coverage with the least number of photographs. Overlapping photographs provide complete coverage of each section of the community from at least two positions of the aerial camera for stereoplotting. Because aerial photography for tax mapping purposes must be accurate, skilled technicians using precision equipment under carefully controlled conditions must be utilized.



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2. Specifications

- a. The area of coverage shall be the legal limits of the town. Complete stereoscopic aerial photographic coverage shall also include an area of two hundred feet (200') beyond the exterior perimeter of the town boundary line
- b. All aircraft should be maintained and operated in accordance with regulations of the Federal Aviation Administration and the Civil Aeronautics Board and operated by a well trained and experienced crew.
- c. Photography should be taken at a scale appropriate for the final map scale
 - 1) For a map scale of 1" = 400' the negative scale would be 1" = 2000'; for 1" = 100', the negative scale would be 1" = 500'
 - 2) The altitude shall not be more than 5% from the required altitude above mean ground to achieve the specified scale of photography
- d. The photographs should be taken without the obscuring effects of snow cover, tree foliage, flood waters, haze, smoke or long shadows
- e. Flight lines should be the mapper's responsibility
 - 1) They should be plotted and adhered to so as to provide the required photographic coverage
 - 2) 60 percent forward or end lap, 30-40 percent side lap are recommended
- f. Aircraft crabbing and tilt should be within reasonable tolerances
 - 1) Crab not to exceed 3°
 - 2) Tilt not to exceed 4°

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- g. Photography should be taken with a sufficient number of prominently marked ground control monuments to insure the final accuracy of the maps
- h. Photography should be taken with a precision mapping camera
 - 1) Zeiss RMK 15/23, Wild RC10 or Wild RC8 with a 6 inch focal lens
 - 2) An appropriate anti-vignetting filter should be used
 - 3) The camera must produce at least 4 fiducial marks on each negative for accurately locating the principal point of the photograph
 - 4) The contractor must furnish a certificate of calibration, for the camera he proposes to use, from the National Bureau of Standards or the U.S. Geological Survey which is not more than 3 years old.
- i. Film must be fine-grain, high speed photographic emulsion on a dimensionally stable safety base. Outdated film must not be used.
- j. The processing of all exposed photographic film shall result in negatives free from chemical and other stains, containing normal and uniform density and color tone.
 - 1) The film should not be rolled tightly on drums or in any way stretched, distorted, scratched or marked and shall be free from finger marks, dirt or blemishes
 - 2) Each negative should be clearly labelled with the date and scale of the photography, the camera data, the film roll number and sequential negative numbers

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- k. Ownership of the aerial negatives should remain with the town
 - 1) The mapper should not make additional copies of the aerial negatives without the written approval of the town
 - 2) Negatives should be stored by the mapper under proper conditions of controlled temperature and humidity
- l. Contact prints of the original negatives should be prepared on double weight semi-matte paper and delivered to the town
- m. The mapper should prepare a photo index by laying out prints made from all negatives of the aerial photography taken and accepted for the project
 - 1) The prints should be carefully matched and oriented
 - 2) Photographic copies of the index should be made at a scale not less than 1/3 the negative size
 - 3) The north arrow, the scale of the original photography, the scale of the index, the date of photography, the town name, the type of camera and lens and the name of the contractor should be shown on each index
 - 4) Indexes should be printed on double weight, semi-matte photographic paper and should be no larger than 24" x 36"
 - 5) Two copies of the index shall be delivered to the town



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B. Control

The mapping should be constructed from the Massachusetts State Plane Coordinate System using existing and supplemental ground control and analytical aerotriangulation methods. The ground control survey data for the compilation of planimetric maps is limited to horizontal control.

The quantity of horizontal control must be sufficient to ensure that the base maps will meet National Map Accuracy Standards. Photographic targets used to mark horizontal control points shall be of sufficient size and material to assure that measurable images of the targets will appear on photographs of the smallest scale used for aerial triangulation and/or compilation of base manuscripts.

C. Base maps

Although precision aerial photography is used as the foundation for preparing the tax maps, certain scale discrepancies occur due to inherent radial and topographic distortions in the uncontrolled aerial photographs. To eliminate these discrepancies on the final maps, base manuscripts are compiled using special instruments with the control secured under these specifications.

Base maps are large, color coded drawings compiled on matte surface, stable based polyester drafting film with a minimum thickness of 0.004 inches. They provide the framework upon which the final tax maps are plotted. Features shown shall include but not be limited to:

- (a) All roads and trails
- (b) Railroads
- (c) Viaducts and bridges
- (d) Main drainage features including streams, rivers, ponds, lakes, canals, reservoirs and swamps
- (e) Wooded areas, orchards, and tree plantations
- (f) All cross country power and transmission lines
- (g) All identifiable cross country underground lines such as buried cables and pipe lines

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- (h) Cemeteries, quarries and borrow pits
- (i) All main and minor fences, walls, tree lines and field boundaries

Base maps must meet National Map Accuracy Standards. These state that ninety per cent (90%) of all definable planimetric features shall be plotted within 1/30 of an inch of their true coordinate positions. Base maps are either the same scale as, or larger than the finished maps. All manuscripts should be delivered to the town; all work in plotting property data should be done on overlays to the manuscripts.

There are two types of base maps. "Orthophotos" are actual prints of the aerial photography from which the distortions, which occur because of changes in the elevation of the topography, have been removed. Planimetric maps are two dimensional line drawings drawn to scale on which physical and cultural features are symbolized. Each type of base map has advantages, depending on local needs and requirements. The orthophoto map, which displays a photographic image of all features, often provides the most economical means of subsequently producing the property map as an overlay. As changes occur, however the photo image will appear increasingly out of date. By contrast, the line drawn maps which show symbols of selected features, are not as easy to interpret, but are less subject to obsolescence than orthophotos.

D. Deed research and plotting

No matter how accurately a base map is prepared, final maps will be inaccurate if improper research procedures are used. Preparing tax maps involves researching all the deed records and gathering together all known surveys, highway maps and town and state maps.

Deed searching should be conducted to determine the deed, will, or other instrument of conveyance for every parcel of property in the town. The deed research should be coordinated with the current assessment roll. A copy of the current deed, marked with the parcel identification number, should be on file (or microfilm) in the town.

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If no copies of deeds are available it is suggested that the mapper provide them as part of the mapping project.

Deeds should be plotted using all available resources. Boundary dimensions should match those of adjoining parcels. If there is a problem, the mapper must attempt to reconcile it using the aerial photographs and possibly contacts with the owners.

2. Errata list

If any parcel cannot be logically and correctly located or its ownership determined, it should be recorded on an errata list along with all accumulated data concerning the parcel. Any property for which no instrument of conveyance can be found should also be included. The contractor has the responsibility to report these problem areas to the town and to attempt to resolve them with the assistance of the town. The contractor normally is not entitled to extra compensation for this work except where the town orders actual field measurement or surveys to resolve the problem areas. The errata list at the completion of the project should not usually exceed five percent of the total number of parcels in the town.

E. Tax maps

1. Explanation

Tax or cadastral maps are special purpose maps showing the boundaries of all real property parcels within a community. They are prepared as overlays to the base maps.

The tax map system consists of a set of detailed maps covering the entire community and an index map showing the location of each individual tax map. Each map sheet or page covers one specific area or section which is assigned a unique number.



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State Plane Coordinate grid lines should be the boundary lines of the area covered by each map sheet. When it is necessary to show portions of a single parcel on two or more map sections, the parcel and its match lines should be clearly labeled on each map sheet with a note as to where the remainder of the parcel appears.

2. Sheet size and format

- a. All completed tax map sheets shall be prepared on stable based polyester drafting film with a minimum thickness of 0.004 inches, or material of equivalent quality.
- b. Map sheet size shall be twenty-four inches (24") high by thirty-six inches (36") wide overall. There shall be a "neat" image area of twenty inches (20") by thirty inches (30").
- c. The layout of map sheets should be standardized. Basic map information should be shown at the bottom of the map sheet. It should include the dates of the aerial photography and the original maps, the scale, the legend, the index diagram, a space for revision dates, the name of the mapper and the name of the town.

3. Drafting standards and quality

- a. Maps shall use standardized symbols.
- b. All lettering and numbers shall be drawn using mechanical lettering equipment such as "Leroy" templates or an approved equal. Lettering sizes shall not be less than "Leroy" template size 80.
- c. All line work shall be uniform and consistent as to width and symbolism.
- d. Only "Pelican TN" ink or an approved equal shall be used. "Stick-up" or "paste-on" drafting is not acceptable.

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4. Scale

The proper scale is one which covers the largest possible area and at the same time shows the necessary detail. Map scales should generally be as follows:

Rural areas - 1" = 400' or 1" = 200'; areas having an average per parcel acreage of less than 100 acres and more than fifty percent of the parcels average one acre or more.

Semi-rural areas - 1" = 100' or 1" = 50'; areas having a concentration of parcels of one acre or less.

Dense areas - 1" = 50'; areas where twenty percent or more of the parcels have frontage of forty feet or less.

However, nothing shall prohibit the mapping of an area at a larger scale than that indicated above. (i.e., 1" = 100' in place of 1" = 200').

5. Dimensions and acreage

Dimensions of property lines and acreages (for parcels of one acre or more) shall be shown on the maps. Dimensions shall be those obtained from the deeds. Where no such dimensions exist, a scaled dimension may be shown followed by the letter "s" to indicate that the dimension is scaled. Where deed dimensions do not agree with the amount of distance available on the ground as plotted on the base manuscripts, the discrepancy should be noted by placing the letter "d" following the deed dimension and then showing a scaled dimension. This should only be done where there is a significant variation.



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6. Information to be shown

- a. Boundaries of individual parcels
- b. Parcel (lot) numbers
- c. Parcel areas for parcels of one acre or more.
Parcels of less than one acre will have all dimensions shown
- d. The original lot lines of filed subdivisions should be shown by means of a fine dashed line so that they will be readily visible but subdued from the rest of the data on the maps. Lot numbers from the subdivision plans should be shown in a manner distinct from other numbers on the maps.
- e. School, fire, water or other service district lines with their designations
- f. The location and designations of streets, highways, roads, railroads, rivers, lakes etc.
- g. Major easements and rights-of-way
- h. Popular names of wholly tax exempt property
- i. Adjacent map numbers
- j. X and Y coordinates from the Massachusetts State Plane Coordinate System.
Massachusetts State Plane Coordinate grid intersections are to be plotted at 5" intervals and shown throughout the "neat area" as white lines (1" overall).

7. Optional information

- a. Location of improvements
- b. Street number
- c. Wetlands

8. Parcel numbering

Every parcel of land should be assigned a unique parcel identification number. The parcel number will consist of three parts: the map number, the block number and the lot number. Block numbers can be up to two digits in length. Lot numbers initially consist of a maximum of two digits. The numbering of blocks and parcels begins in the upper left corner and proceeds consecutively in a clockwise direction.



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If parcels are subdivided after the property map has been numbered, each piece of land then carries the same parcel number as before, but with a suffix. The retained parcel is designated by the suffix 1, while the sold off portions are suffixed starting with the number 2. A maximum of three digits to the right of the decimal point in the lot number will be allowed. After that it may be necessary to renumber the entire block.

Another system of parcel numbering is to use the geographic coordinate locator number as the unique parcel identification number. Coordinate identifiers provide superior information about a parcel's geographic location and can be used directly in computerized sales ratio analysis and property appraisal. The geographic coordinate based system derives its numbers from a combination of the easting (X) and northing (Y) coordinates from the Massachusetts State Plane Coordinate System recorded to the nearest ten feet of the approximate visual center of each parcel. The easting reading is always written before the northing reading. The coordinate locator numbers can be measured from the original stable map using an engineer's scale or more rapidly with an electronic digitizer.

Assessors are urged to have the X and Y coordinates from the Massachusetts State Plane Coordinate System placed on each map sheet, even if they choose the more conventional block and lot system of numbering. As long as the X and Y coordinates are shown on each map, the coordinate locators, may be put in place in the future at a moderate cost.

For further explanation the following booklet is available from:

Massachusetts Division of Community Services
100 Cambridge Street
Boston, Ma. 02204

Foster, R.W., "Guidelines for the Assignment of Parcel Index Numbers and Parcel Locator Numbers, 1980.

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IV. Other components of the tax mapping project

A. Index

Two sets of index cards should be prepared as part of the tax mapping program. One set should be filed alphabetically by the owner's last name. These cards should give the owner's name and current mailing address, the location of the property, the parcel number, and the book and page of the deed. The other set should be in numerical order by the parcel numbering system used. These cards give the parcel number of the property; the coordinate locator number (if these have been included on the maps); the property's location; its area and/or dimensions; the subdivision lot number and name; the school, improvement or service district; and the ownership history (showing the names, addresses and the book, page and date of conveyance) starting with the owner at the time the property map was prepared. A computer listing may be used as an alternative to the card system.

B. Public review

Provisions should be made for a public review session to enable taxpayers to view the maps for accuracy. Representatives of the tax mapping firm should be available to hear complaints. The contractor should correct in ink on the original sheets all errors of delineation brought to their attention by the Board of Assessors or by property owners. New prints should be furnished without additional charge.

C. Training for assessors

Provisions for the training of assessors and other town officials in the use and maintenance of the tax map system shall be included in the contract. The date, duration and place of the training as well as the number of personnel to be trained should be specified.



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D. Maintenance

To protect the initial investment of the community, tax maps and index cards must be updated at least annually. Maintenance involves recording description changes and making map corrections. It may even include remapping certain areas at a larger scale to satisfactorily depict new subdivisions.

Most property transfers do not require map revisions. On receiving a copy or an abstract of the deed from the county clerk, assessors make the changes on the affected index cards. When property transfers do require map revisions, it is recommended that most assessors seek assistance. Not only must new boundary lines be drawn, but also new parcel numbers must be assigned and new acreage or dimensions must be computed.

Most tax mapping companies offer annual maintenance and updating services at a reasonable cost. In some communities, the town engineer may be able to make necessary changes.



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V. Glossary

Assessment Roll - an official listing of all the parcels of real property located in the community, giving the name of the taxable owner, the location and the assessed valuation of the land and improvements. It is commonly known as the valuation book.

Block - a segment of a city or town preferably bounded by natural boundaries such as streets, roads, waterways and other prominent features.

Book and Page - the number of the book at the County Registry of Deeds which contains the complete deed, and the number of the page on which the deed is found.

Crab - the amount of sideways twist in a series of photographs resulting from high wind or misalignment. This is usually expressed in degrees of deviation from the correct direction.

Deed - a legal instrument in writing by which the title to land is transferred from one person to another.

Digitizers - precision electronic machines which can measure the position (using the X and Y axis) of points on maps or drawings. These positions are used to generate coordinate locator numbers and to calculate area acreage.

End Lap - the amount of overlap between consecutive aerial photographs. It is usually expressed as a percent.

Errata List - a compilation of the problem or unsolvable situations accumulated during the tax mapping program.

Flight Lines - rows or lines of aerial photography. The lines are specially designed to obtain the necessary overlapping coverage with the least number of photographs. They are the pilot's guide when flying for aerial photography.



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Grantor and Grantee Index - separate books listing the names of all buyers and sellers of land alphabetically and the book and page number of all deeds recorded in the county Registry of Deeds. The grantee books are indexed by the buyer's last name.

Ground Control - carefully established markers visible in aerial photography which are used to ensure accuracy in preparing base manuscripts. Control points may be derived from the following sources.

- a. United States Coast and Geodetic Survey monuments and points
- b. United States Geological Survey monuments and points
- c. Massachusetts Geological Survey monuments and points
- d. Prominent landmarks
- e. Existing surveys
- f. New surveys

Index Map - a map prepared to serve as a key by which a section map may be readily located.

Lot - a distinct portion of land in one ownership.

Massachusetts State Plane Coordinate System - describes and defines a mathematical system of locating points. It is a projection of the curved surface of the earth on a flat surface over which a coordinate grid is laid. The X coordinate is the easting, the Y coordinate the northing reading.

Orthophoto - map is a scale representation of the earth's surface depicted by a photographic image.

Photogrammetry - the making of maps from overlapping aerial photographs using stereoplotting instruments under rigidly controlled conditions.

Planimetric - a line drawing.

Plat - a map intended to show the division of land into lots or parcels.



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Section Map - a map covering a specific area which may be mapped on one sheet or page.

Side Lap - the amount of overlap between adjacent lines of aerial photography. It is usually expressed as a percent.

Stereoplotting Instruments - are precision stereoscopic machines used to prepare base manuscripts from aerial photographs.

Tilt - the angular departure of the aerial camera axis from a vertical line at the instant of exposure. It is usually expressed in degrees.