**GUIDANCE FOR PREPARING A REQUEST FOR QUOTES (RFP)**

**FOR PLANIMETRIC MAPPING SERVICES**

**September 2015, Updated January 2021**

**OVERVIEW**

*This document was originally created for procuring planimetric mapping services using a state contract that included vendors providing GIS services. That contract has since expired and been replaced by one (ITS74) that still includes GIS services. However, those services no longer included planimetric mapping.*

*This document’s purpose is twofold: it provides guidance on how to write a Request for Proposals (hereafter “RFP”) document while also providing content that, once customized for your community, is an RFP for planimetric mapping services.*

*With something as complex as planimetric mapping services, you will want vendors to provide full proposals in response to your RFP. Communities commonly use a consultant for developing their Request for Proposals (RFP) under Chapter 30B to procure these types of services. As described below, the intent of this combined guide and template is enabling you to develop your own RFP. This allows you to save your consulting budget for other services related to procuring a planimetric base map. For example, you might want someone to review the RFP you have written, assist with evaluating responses to your RFP, help you with developing your draft database design, advise you on working with your selected vendor, or provide you with quality assurance services on the data you receive from your mapping vendor.*

**HOW TO USE THIS GUIDE**

*Following the document outline, below, this document has a mix of guidance text (in italics) and example text (regular type face). If you remove the guidance text and then either outright adopt or, as appropriate, customize the example text, you will have an RFP for planimetric mapping services. Example text is preceded by the word “***Example:***”.*

**CREDITS**

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Sample text, tables and appendices included in this document have been adapted from Requests for Proposals (RFPs) from a handful of New England communities. The following consulting firms helped write these well-prepared RFPs: AppGeo and CDM Smith. All source documents are in the public domain. Individuals at the following firms answered technical questions that informed the development of this template RFP: Fugro Earthdata, James W. Sewall Company, Kappa Mapping, Sanborn, and WSP. Their assistance was invaluable and very much appreciated. Thanks also to staff at WSP for their contributions to this 2021 update.

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**<City/Town> of <municipal name>**

**Request for Proposals for Planimetric Mapping Services**

1. **INTRODUCTION**

**Example:**

* 1. **Project Overview**

*Provide a general description of the project. Purpose, goals, general scope of work, etc… Points to cover include:*

* + - *The deadline (date and time) by which proposals must be submitted*
		- *How the proposal must be submitted*
		- *Overview of scope of work*
			* *summary of products sought - required and optional, if any*
			* *source of the imagery from which planimetric compilation will occur*
			* *source of project funding*
		- *How products from this procurement will be used*
		- *Notation that all products become property of municipality*
		- *Other legal disclaimers or statements per municipal requirements, if relevant.*
	1. **Project Area**

*Describe, in detail, the area to be mapped in this project. What are the characteristics of the municipality to be mapped? Does the project area include a buffer (e.g. 200 ft) beyond actual project area boundaries? Summarize the GIS environment, providing links to websites, data, etc. Useful content for this portion of the RFP includes:*

* + - *Brief location description for your community*
		- *Map (or link to map) showing community location*
		- *Link to GIS website and online mapping capabilities, if available*
		- *The source of the municipal boundary used to define the project area*
		- *Boundary buffer, if desired (e.g., 200 feet beyond the project boundary)*
		- *Your community’s area, population, number of structures, road mileage total, and number of parcels*
		- *Concise summary of current GIS environment, including the version number of your GIS software*
		- *Counts for relevant datasets (e.g., number of sewer manholes, drain manholes, catch basins, fire hydrants, etc.)*
		- *History of past planimetric projects, if any*
		- *Directions for accessing community boundary file and sample data*
	1. **Procurement Requirements**

*Outline the required contents of proposals. What is the submission format? What are required contents? What is the contact information for proposal recipient? Specific items are detailed in section 5 so this item will include basic information such as:*

* + - *Reference to Section 5 for required contents*
		- *Name, address, and contact information of proposal recipient*
		- *Number of copies*
		- *Summary of RFP’s organization*
		- *Submission format details*
			* *delivery format (electronic and/or number of printed copies)*
			* *package labeling if proposals are to be mailed*
			* *disclaimer about delivery at the expense of bidder and all damages due to packaging or shipping will be the sole responsibility of the bidder*
	1. **Procurement Schedule**

*Provide dates and details for specific events in the procurement process, including submission deadline and contract award date. Include the following:*

* + - *Date RFP available*
		- *Deadline for written questions*
		- *Deadline by which question responses will be distributed*
		- *Proposal submission deadline*
		- *Proposal evaluations schedule*
		- *Short list interview date (If required)*
		- *Estimated date by which contract will be awarded*
1. **COMMUNITY RESOURCES**
	1. **Imagery**

*Planimetric map features (i.e., natural landscape features or features that are the product of human development or use of the landscape) are mapped using stereo-imagery. Stereo-imagery, when used on a computer with specialized software (“softcopy photogrammetry” software) and special viewing glasses, makes possible a three-dimensional (3D) view much as if you were viewing the terrain while looking straight down from the belly of an aircraft. Besides the 3D view, the specialized software also makes it possible to map features as points, lines, or polygons, with those features each being created in their correct location on the landscape in the 3D view. Orthoimagery displays the same view, but without the 3D effect; it’s a two-dimensional (2D) view. An analogous experience is viewing a movie in 3D as opposed to the ordinary, non-3D, version.*

*In preparing this section of the RFP, describe the specifications of the stereo imagery and orthoimagery available for planimetric development. While some planimetric mapping features can be compiled from orthoimagery and your vendor may choose to do that for some features, in general, planimetric mapping is completed using stereo-imagery and softcopy photogrammetry software. These aspects are vital to the planimetric cost estimate and data creation process. Specifications for stereo-imagery and orthoimagery will most likely be found in your imagery procurement documents, such as a scope of work, RFP, contract agreement, or list of deliverables. They may also be found in technical documents provided by the imagery vendor when the imagery was delivered. Common reports that may contain useful specifications are supplemental imagery reports, acquisition reports, and survey reports. Ask your orthoimagery vendor for all documents relevant to planimetric development, as they may be able isolate those documents easily. Another approach would be to include the entire imagery specifications from the imagery procurement as an appendix to your RFP.*

**Example:**

<MUNICIPALITY NAME> acquired its orthoimagery and related stereo-imagery as part of the MassGIS 2021 orthoimagery project. The specifications, for that imagery are included in Appendix A.

* 1. **Lidar**

 *Lidar, which stands for* ***Li****ght* ***D****etection* ***a****nd* ***R****anging, is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to point locations on the Earth. A Lidar instrument principally consists of a laser, a scanner, and a specialized GPS receiver. Airplanes and helicopters are the most used platforms for acquiring Lidar data over broad areas. Two types of Lidar are topographic and bathymetric. Topographic Lidar typically uses a near-infrared laser to map the land, while bathymetric Lidar uses water-penetrating green light to also measure seafloor and riverbed elevations.*

*Modern lasers send hundreds of thousands of pulses per second; thus Lidar data sets are very large. The point locations measured by these light pulses—combined with other data recorded by the airborne system—generate precise, three-dimensional information about the shape of the Earth and its surface characteristics. Lidar data can be used for a diverse array of purposes. The focus in this document is on the use of Lidar data for modeling elevations[[1]](#footnote-1).*

*The light pulses from a Lidar sensor produce multiple measurable returns: a portion of a single pulse might bounce back off the corner of a building roof, off a tree lower down, and then off the ground. These pulse returns collectively produce a “point cloud” and points in the cloud can be classified as to their type. That classification typically includes points identified “bare earth”; these bare earth points can serve as a “mass” of elevation points needed for modeling the earth’s surface. When mass points are combined with “breaklines”, topographic contours can be developed using software tools. Breaklines are lines representing abrupt changes (retaining walls, bridge abutments, crowns of roads, ridge lines, bottoms of gullies, pond edges, and stream banks) on the earth’s surface. Breaklines are typically mapped (“compiled”) in the 3D mapping environment described in Section 2.1. The smaller the desired contour interval the more mass points needed and the greater the vertical accuracy required for those points.*

*Massachusetts communities are fortunate in that MassGIS has been able to partner with other state and with federal agencies to complete statewide elevation mapping using Lidar. Mass points are available from various elevation mapping projects for every part of the state. Based on their vertical accuracy specification these mass points, once combined with breaklines (these would need to be acquired as part of your planimetric mapping project), are suitable for producing topographic contours with a two foot interval. Anyone interested in obtaining these Lidar mass points can do so from the*  [*Lidar Terrain Data*](http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/lidar.html) *layer page on MassGIS’ website; the data are available at no charge.*

*For areas west of Worcester County and also for the Blackstone River Valley, detailed mass points with accuracy matching or exceeding what’s available for the rest of the state were acquired in 2015; these additional data are also be available through the MassGIS web site. Note that for a large portion of approximately the northern two-thirds of the Connecticut River Valley in Massachusetts, the mass points being acquired are sufficiently detailed and accurate that, if paired with suitable breaklines, they would support mapping contours with a one-foot interval.*

**Example:**

Through this procurement, <Municipality name> seeks a map layer of topographic contours with a two-foot interval. The elevation mass points for this mapping will be those available from the MassGIS  [Lidar Terrain Data](http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/lidar.html) layer web page. The MassGIS web page includes information concerning the accuracy and other specifications of the Lidar data.

* 1. **Other Resources**

*Mention products that are available in general terms. Mention resources that your community may have available to support planimetric mapping, including any existing planimetric mapping data, locations of existing monumented survey control point locations (be sure to consult with your surveyor on how to describe these points), and, if applicable, the ability to survey locations as additional control points for the mapping work.*

**Example:**

As part of developing their approach to delivering the products sought through this RFP, vendors should consider using the following resources in developing their approach to this project: MassGIS’ statewide mapping of impervious surfaces in the [2016 land cover/use data](https://docs.digital.mass.gov/dataset/massgis-data-2016-land-coverland-use), MassGIS’ [statewide roof prints](http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/structures.html) mapping, and statewide [wetlands mapping](http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/depwetlands112000.html) from the Department of Environmental Protection.

1. **TECHNICAL REQUIREMENTS**
	1. **Required and Additional Features**

*Indicate whether a limited or comprehensive set of planimetric features is to be developed. Establish the set of desired features through discussion with city departments. Does the Public Works or Engineering Department need hydrants? Do you need impervious surface features mapped? Is it worth collecting wetlands or do you have better sources? Be flexible and strategic in developing this list since it is a direct cost driver. Describe any special projects for which the planimetric mapping will be used. In general, you should only include a feature on your feature capture list if there is a specific operational need. These needs can range from features your map users want to see on a general purpose base map to items needed for a specific operational function, such as hydrants because having them mapped will be key for your fire department.*

*Consider breaking the feature list into required and optional groupings and requesting that vendors price the required features and each of the optional grouping separately. Table 1 below is an example of how this might look. Add, delete, or prioritize features as needed to meet your requirements.*

*Consider planimetric updates rather than capturing all new features if:*

* *You have recent (within 8 years), high-quality (spatially accurate) planimetric data and are willing to provide a copy to prospective bidders. (Note: 8 years is a good timeline for municipalities that are mature without much new development. For communities where development is continuing, 5 years may be a better timeline for updating.)*
* *Previous imagery is very similar in specifications to the current imagery*
* *The amount of change in your community is relatively low (less than 25%) and you can provide information on where changes have occurred (e.g., polygons indicating subdivisions or redevelopment and/or building permit locations for new construction or additions to existing structures)*
* *You do not intend to change the database schema (or planned changes are minimal)*

*There is often little cost savings in doing an update to planimetrics since your entire community still has to be reviewed using your stereo-imagery to evaluate and identify where change has occurred. Consider asking vendors to submit a price for full compilation as well as a price for updating feature classes.*

**Example:**

The Town/City requires a robust set of planimetric features on which to develop its GIS database. These features will be mapped from stereo-imagery that will be provided by <MUNICIPALITY NAME>; the specifications for this imagery are in Appendix A. All feature compilation must take place using softcopy photogrammetry software and the stereo-imagery. <MUNICIPALITY NAME> is willing to consider an option under which some features are compiled from orthoimagery in two dimensions only; however, proposals must respond fully to the requirement for stereo compilation before providing an alternative approach based on compiling some features in two dimensions.

Appendix B: Geodatabase Design is a complete list of features that are to be compiled. The list also specifies the digital feature type requirements (e.g. points, lines, polygons), as well as those features that are expected to have annotation and Z coordinates captured. Some planimetric features will only be mapped within public rights-of-way and on public properties. These features are discussed in the draft database design.

Table 1, below, is a complete list of features that are to be compiled planimetrically through this project. The list is divided into three sections: 1) required features, 2) optional features, first priority, and 3) optional features, second priority. Each set of features is to be priced separately.

**Example optional addition to above:**

<MUNICIPALITY NAME> has existing 40-scale planimetrics from <YEAR>. <MUNICIPALITY NAME> hopes to reduce costs by updating some feature classes rather than capturing all new data. Table 1 indicates which features are to be updated and which are to be captured in entirety. <MUNICIPALITY NAME> will provide the selected contractor with a copy of its current planimetric database. The contractor will be responsible for adding new features, deleting demolished features, and modifying features that have changed.

<MUNICIPALITY NAME> will provide a GIS layer depicting where most major changes have occurred since the previous planimetric mapping project. Though not all changes are shown in this layer, new roads, subdivisions, and commercial developments are highlighted. The vendor will be expected to find and digitize all significant changes in the feature classes identified below and as detailed in Appendix B Geodatabase Design.

**Table 1. Planimetric Features To Be Mapped**

|  |  |
| --- | --- |
| **Feature Description** | **Geometry** |
| **GROUP 1 - REQUIRED FEATURES** |  |
| **Building Features** |  |
| Building roof prints (all visible buildings, out buildings, mobile homes greater than or equal to 100 sq ft) | Polygon |
| **Hydrographic Features** |  |
| Streams | Line |
| Lakes, Rivers, Ponds | Polygon |
| Wet Areas, Marshes, Swamps | Polygon |
| Dams | Line |
| **Transportation Features** |  |
| Road surface area | Polygon |
| Road Centerlines | Line |
| Bridges | Polygon |
| Railroads | Line |
| Airport Edge of Pavement (runways, taxi ways) | Polygon |
| **GROUP 2 - OPTIONAL FEATURES, PRIORITY 1** |  |
| **Building Features** |  |
| Foundations | Polygon |
| Decks, Porches | Polygon |
| Water Storage Tanks | Polygon |
| Gas Storage Tanks | Polygon |
| **Hydrographic Features** |  |
| Detention / Retention Basins | Polygon |
| Drainage Ditches | Line |
| **Transportation Features** |  |
| Driveways | Polygon |
| Parking Lots (greater than 4 spaces) | Polygon |
| Sidewalks (on public land & adjacent to public roads) | Polygon |
| Pavement Markings (on roads and parking areas) | Line |
| **Land Cover and Boundary Features** |  |
| Large Vegetation Areas (forest, brush, cultivated fields) greater than 0.25 acres | Polygon |
| Street Trees (adjacent to public ways) | Point |
| Fences | Line |
| Retaining Walls | Line |
| Stone Walls | Line |
| Hedges | Line |
| **Utilities** |  |
| Catch Basins | Point |
| Manholes | Point |
| Fire Hydrants | Point |
| Utility Poles | Point |
| Street Lights | Point |
| **Recreation Features** |  |
| Parks and Playgrounds | Polygons |
| Athletic Fields | Polygon |
| Golf Courses | Polygon |
| Footpaths & Bike Paths (artificial surface for a formal recreational purpose; greater than <distance> feet wide) | Polygon orLine |
| **GROUP 3 - OPTIONAL FEATURES, PRIORITY 2** |  |
| **Building Features** |  |
| Building Firewalls | Line |
| Patios | Polygon |
| **Hydrographic Features** |  |
| Headwalls, Wingwalls, Floodwalls | Line |
| Docks, Piers, Jetties | Polygon |
| **Transportation Features** |  |
| Curbs | Line |
| Guard Rail | Line |
| Private Walks | Polygon |
| **Land Cover and Boundary Features** |  |
| Cemetery Boundaries | Polygon |
| Shorelines | Line |
| Land Use | Polygon |
| Quarries, Gravel Pits, Landfill | Polygon |
| Trees on public lands (with large, distinct crowns) | Point |
| **Utilities** |  |
| Traffic Signals | Point |
| Transmission Towers (cellphone towers, radio towers, electrical towers) | Point |
| Electric or Telephone Vaults | Point |
| Power Substations | Polygon |
| Treatment Plants | Polygon |
| Pad-Mounted Transformers | Point, Line or Polygon |
| Signs | Point |
| Gate Valves | Point |
| **Recreation Features** |  |
| Running Tracks | Polygon |
| Tennis Courts | Polygon |
| Basketball Courts | Polygon |
| Skateboard Parks | Polygon |
| Swimming Pools (above ground, inground) | Polygon |
| **Miscellaneous Features** |  |
| Cemetery Headstones, Markers, Monuments | Point |
| Smokestacks | Point |
| Flag Poles | Point |
| Monuments (not in cemeteries) > 4’ X 4’ | Polygon |
| Standpipes | Point |
| Coastal and Marina Features | Point, Line or Polygon |
| Rooftop Solar Systems  | Point or Polygon |

* 1. **Elevation Mapping (*if applicable*)**

*This section will likely vary from town to town, depending on the source imagery used. The text below is applicable for communities interested in acquiring elevation mapping using topographic contours with a two-foot interval. Some communities require contours with a one-foot interval and acquire sufficiently detailed and accurate elevation mass points to support this interval. See the discussion in Section 2.2 of Lidar-derived elevation data available through MassGIS; this same section also discusses the data requirements for producing elevation contours.*

*Finally, the previously mentioned MassGIS web page is also a source for digital surface models (DSMs). These DSMs are a "bare earth" digital elevation model raster dataset without buildings or vegetation. These DSMs are a useful way to represent elevation information in a GIS. These DSMs can be used for depicting shaded relief and for conducting drainage area and line of sight analysis. These DSMs are an alternative to, or useful adjunct data set, for depicting elevation using topographic contours and, depending on your needs, may be sufficient to use in place of contours. If used in place of topographic contours, this approach would also lower your planimetric mapping project costs. You may find it helpful to download some of the DSM files for your community and experiment with them. Also, not all mapping software can use DSM files so be sure to know whether all the mapping software used in your community can work with raster elevation models before selecting this option.*

**Example:**

<MUNICIPALITY NAME> requires topographic contours with a two-foot interval. In addition, spot elevation points shall be mapped as appropriate to indicate local high points (“peaks”) and low points (“depressions”, “ridge saddles”), and street intersections; see the attached geodatabase design attachment for further details and for the required attribute coding as it pertains to contours and spot elevations.

Mass points available through MassGIS (see section 2.2) along with breaklines acquired through this RFP, will be used in developing this topographic mapping. For purposes of this project, breaklines are understood to be lines representing distinct changes in the earth’s surface. Breaklines include, but are not limited to, changes such as the edge of paved roads, the crowns of road (the road “centerline”), retaining walls, bridge abutments, the banks of streams/rivers and ponds/lakes, as well as other features needed to correctly model the elevation of the earth using topographic contours.

* 1. **Database Design and Feature Compilation Rules**

*This section describes your preliminary database design and the rules that will apply as map features are compiled. At this stage, you should think of the database design as preliminary because as you work with your vendor you may find that you may change some elements of the design. Settling on the final database design should be one outcome from your pilot project. Also, describe the feature compilation rules for ensuring that the data are topologically clean and consistent (an example is shown below).*

*An existing planimetric dataset is often your best source for the database specification. If your current planimetric dataset works, stick with that database design or modify it slightly to serve any new needs. If you are starting from scratch, review database designs for other communities and/or work with a consultant to develop a database that meets your needs. Appendix B to this RFP template will be a useful starting place for your design. Finally, you may find it useful to review the applicability of ESRI’s* [*Local Government Information Model*](https://solutions.arcgis.com/local-government/help/local-government-information-model/get-started/) *as well.*

*Just as with developing the set of planimetric features to be captured, develop your database design to support current and future projects and thematic mapping needs. For example, does the street centerline feature class need a field for paved/unpaved or is street name sufficient attribution? The complexity of the database design - both the number of different features included and the number of attributes populated - will impact the cost of your project. Limit the content of your preliminary database design to features that are generally useful as a base map (e.g., building outlines, pavement edge, sidewalks, water features) or that support a specific operational need (e.g., catch basins, fire hydrants, manhole covers).*

*Some vendors use semi-automated feature extraction. Some vendors subcontract planimetric (or topographic) feature compilation offshore. Require the vendor to be explicit on these two points if your community has a preference.*

*Planimetric features are typically developed in 3D using stereo-compilation equipment. The municipality should be explicit whether 2D compilation from orthoimagery (heads-up digitizing) is acceptable for some features, e.g. street centerlines. 2D compilation is less expensive and less accurate, but may be perfectly fine for the uses you need to support.*

**Example:**

<MUNICIPALITY NAME> and the contractor will develop a final database design into which attributes will be placed, following the guidelines in Appendix B Geodatabase Design, and based on the results of the pilot. All data delivered will comply with the final database design as agreed upon with the selected vendor after the pilot project. Any files that contain incorrectly coded data or data that does not adhere to the database design will be returned to the vendor for correction. The Town/City will provide attribute and/or annotation source materials to the contractor where appropriate, e.g. hydrographic features. Vendors are encouraged to provide relevant information on planimetric feature compilation and data layer formatting for ESRI geodatabases in their technical proposal.

All data shall be clean. Clean data means that adjacent features should be contiguous with no overlap, e.g. paved area polygons adjacent to buildings shall not overlap, nor shall there be gaps between the features if none appear in the imagery. The vendor shall propose explicit feature compilation rules. The standards below shall be used unless a modified set of rules is agreed upon with the selected vendor.

|  |
| --- |
| **Feature Compilation Rules** |
| Edge Matching | All data that crosses a tile edge will be edge-matched and coordinate connectivity present. |
| Point Duplication | No duplicate structures or graphic entities will be allowed. No points will be duplicated within a data string. |
| Connectivity | Software checkable digitizing errors such as overshoots and undershoots will be eliminated as specified. Lines that intersect will join precisely. |
| Line Quality | All straight lines will contain only two points: beginning and end. A high graphic appearance shall be achieved. Transitions from straight lines to arcs shall be smooth. |
| Segmentation | Linear elements will not be broken unless the break reflects a visual or attribute code characteristic. |
| Precision | All data capture will be accomplished in double precision. |
| Polygon Quality |  No polygon-label errors will exist. Dangles and intersect errors may exist under certain circumstances in the line data but not in the polygon data. |
| Annotation Criteria | Placement, where required, will be visually consistent and uniform. |
| Spatial Continuity | All delivered files will represent the specified data as spatially continuous. The data will be topologically structured and all polygons will be mathematically closed. All polygons have centroid label points. |

Data shall be developed for the entire area of the Town and shall extend 200’ beyond the Town boundary.

All mapping shall be compiled using direct digital data capture using softcopy photogrammetry software that uses the relative and absolute orientation derived from the FAAT results. Photogrammetric project work will be accomplished under the direct supervision of an American Society of Photogrammetry and Remote Sensing (ASPRS) Certified Photogrammetrist. The photogrammetrist shall make maximum utilization of his/her professional experience to select the technique or methods conducive to superior results.

Data shall be compiled in stereo unless mutually agreed otherwise.

* 1. **Coordinate System**

*Massachusetts communities typically use the Massachusetts State Plane Coordinate system, the North American Datum of 1983, and the North American Vertical Datum of 1988. In most communities, the mapping units will be U.S. Survey Feet; a few communities have GIS data in units of meters, matching the MassGIS database.*

**Example:**

All data should be delivered in Massachusetts State Plane Coordinate System, Mainland Zone, US Survey Feet. The horizontal datum shall be the NAD1983(2011 update) datum. The vertical datum shall be the NAVD1988.

* 1. **Capture Rates**

*Feature capture rates differ by the type of feature. Features may be obscured by vegetation, parked cars, sand or gravel on the street, overhanging roofs, etc. You should compare feature capture rates between competing vendors. While high feature capture rates are preferred, a low capture rate for a particular feature class may indicate an honest assessment on the part of the vendor rather than a cause for alarm. Discuss this with the vendors. Plan to use the pilot data to calculate actual feature capture rates for key feature classes.*

*The feature capture rate form (see sample in Appendix C) may include a subset of key feature classes rather than the complete list of feature classes to be collected. Feature captures are to be provided as a percentage of visible features and therefore you should see proposed feature capture rate percentages that are very high.*

**Example:**

The vendor should estimate the photo-identifiable capture rate for each feature class described in Appendix C. Capture rates must be provided as a percentage of features visible on the stereo-imagery or the orthoimagery. The City intends to calculate feature capture rates achieved during the pilot project. The vendor may be asked to adjust their methodology and/or reduce their cost proposal if feature capture rates fall below estimates. Vendors are encouraged to provide a discussion of factors that influence capture rates for visible features that can be expected on this project.

* 1. **Scale / Accuracy**

*In 2014, the American Society of Photogrammetry and Remote Sensing (ASPRS) issued its* [*Positional Accuracy Standards for Digital Geospatial Data*](http://www.asprs.org/a/society/divisions/pad/Accuracy/Draft_ASPRS_Accuracy_Standards_for_Digital_Geospatial_Data_PE%26RS.pdf)*. This document provides a single standard for specifying both horizontal and vertical accuracy while also reflecting the latest technology developments that have made it easier to map features on the earth’s surface, particularly those related to elevation, for less cost and more accurately than ever before. This new ASPRS standard also relates its new horizontal and vertical accuracy classes to previous standards (NSSDA, ASPRS 1990, and NMAS) so that it is possible to understand how out-of-date but familiar standards relate to the new accuracy classes.*

*Horizontal Accuracy -* The surveyed ground control acquired for the MassGIS 2021 orthoimagery was upgraded so that the imagery meets the horizontal accuracy specification of the ASPRS Class 1 standard. If this document is being used to acquire planimetric mapping using some other imagery, then the horizontal accuracy of that imagery should be inserted here.

*Vertical Accuracy - The Lidar derived mass points available through MassGIS (see Section 2.2) have a variety of vertical accuracies as noted in the detailed specifications summary on the MassGIS web site. As with horizontal accuracy, the 2014 ASPRS standard correlates a specific “accuracy class” with older, familiar, standards. Municipalities typically seek elevation mapping with a two-foot contour interval. In the 2014 ASPRS standard, this corresponds to vertical accuracy statement for non-vegetated areas (NVA) at the 95% confidence interval of 29.4 cm and an RMSE of 15 cm; these levels of accuracy are referred to in the 2014 ASPRS standard as the “15 cm vertical accuracy class”. All of the relevant Lidar-derived mass points available through MassGIS meet this vertical accuracy specification and, therefore, are suitable for contributing to mapping topographic contours with a two-foot interval. Note that with the availability of the 2013 “Post Hurricane Sandy” Lidar acquisition, many of the older less accurate Lidar data sets available through MassGIS are obsolete. Besides the 2013 acquisition, the Lidar data sets that do meet the accuracy requirements of mapping two-foot contours are:*

* *2010 Concord River*
* *2010 Charles River*
* *2010 Narragansett River*
* *2010 Blackstone River*
* *2011 Merrimack River*
* *2011 Nashua River*
* *2011 Lidar for the Northeast*

*The 2015 Lidar project covering areas of Massachusetts west of Worcester County and in the Blackstone Valley also meet or exceed the requirements for the 15 cm vertical accuracy class.*

**Example:**

The accuracy of planimetrically compiled features delivered for this project will meet the requirements of the American Society of Photogrammetry and Remote Sensing (ASPRS) 2014 “Positional Accuracy Standards for Digital Geospatial Data”. For this project the accuracy requirements are those for the 15 centimeter horizontal and 15 centimeter vertical accuracy classes.

* 1. **Pilot Project**

*Describe the purpose for the pilot project, the area to be included, the deliverables, and the schedule. Choose an area that includes the major different land uses found in town, e.g. an industrial area, a retail area, a residential area, plus open space. Also include some topographic relief if possible (steep areas). The pilot area should have within it most of the feature classes that will be developed. Depending on the size of the community, a pilot project could be ½ mile by ½ mile, 1 mile x 1 mile, or four tiles (two over two) that match the orthoimagery tiles. Four tiles that match the communities tax maps are another possibility. It will probably be easier if the pilot area is one that you can define in terms of tiles based on the tile index for your orthoimagery.*

*Some communities may request paper check plots, however, QA/QC is now typically done digitally by overlaying the delivered planimetrics on the orthoimagery from which they were developed.*

**Example:**

In order to assure that the vendor can successfully create all required deliverables, a pilot project will precede the creation of any final deliveries. This pilot will cover an area of four contiguous orthoimagery tiles (two over two). The pilot area will be selected by the Town in consultation with the vendor. The pilot is intended to test all production methodologies, to finalize the database design (including decisions about what, if any annotation will be feature linked), and to establish successful procedures to follow throughout the rest of the project. It is imperative that the pilot project be completed on-time, according to the winning vendor’s schedule.

During the pilot, the contractor will work with the <MUNICIPALITY NAME>:

1. Finalize the database design for the geodatabase with any required minor modifications. Adraftdatabase design is included as Appendix B.

2. Develop a check plot design (if applicable)

3. Finalize the delivery schedule based on the results of the pilot.

The above tasks will be undertaken with the cooperation of Town/City personnel. Upon successful completion of the pilot, the Town/City will authorize full production of all project deliverables.

* 1. **Technical Alternatives**

*This section can be used to describe any technical alternatives that the community is interested in - perhaps adding more detail to items mentioned in the sections above. It may also be left wide open to encourage vendors to offer alternative methodologies or deliverables. Examples of technical alternatives would include: 40-scale mapping (if 100-scale is specified above), additional feature classes, optional project areas such as a water supply district outside the community boundary, 1-foot contour generation, etc. Prices for each technical alternative should be included in the price proposal. If optional items are solicited or encouraged, the RFP must make it clear that vendor proposals must respond to the required elements of the RFP and only then include clearly options with discussion of both their impact on the project scope and price.*

**Example:**

The Proposal must respond to all requirements in this Request for Qualifications as written. However, vendors are encouraged to propose innovative and/or alternative methods for accomplishing portions of the work, or to suggest supplemental work to enhance the project. These alternatives should be described and justified in a section of the proposal titled “Technical Alternatives” in which both the change to scope and impact on price are clearly identified. As appropriate, references to applicable alternatives should be made in the Plan for Services.

1. **DELIVERABLES**

*Use this section to detail the required deliverables. Describe the delivery format, media, and any metadata requirements. Describe any Quality Assurance / Quality Control methods you will employ to either accept or reject the deliverables, and how rejected deliverables will be corrected.*

* 1. **Format**

All final data (feature classes, metadata, reports, etc…) shall be delivered on portable hard drive, USB flash drive or by secure FTP protocol, or as mutually agreed upon at time of transfer. Seamless feature classes in the final geodatabase design shall be delivered in ESRI File Geodatabase format. All deliverables will become property of the Town/City of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* 1. **Metadata**

All GIS data deliverables shall have Federal Geographic Data Committee (FGDC) compliant metadata in File Geodatabase and/or XML format readable within ArcCatalog.

* 1. **Acceptance (QA/QC)**

In addition to any quality assurance / quality control (QA/QC) checks performed by the vendor, the Town/City will review final deliverables to ensure conformance with the final geodatabase design, verify that the vendor has met anticipated feature capture rates, and to check the data against the feature compilation rules outlined in Section 3.3, above. Any errors and/or omissions will be detailed by the Town/City in a memo and reported to the vendor. Affected products will be returned to the vendor for correction.

1. **RESPONSE REQUIREMENTS**

*This section includes instructions to vendors concerning their proposals. The focus of these instructions is making sure that all proposals respond to the same requirements in a similar format, thus facilitating proposal evaluation.*

**Example:**

Responses to this RFP must include the following sections, preferably in the order listed:

1. Transmittal Letter
2. Project Team and Qualifications
3. Technical Proposal
4. References
5. Schedule of Milestones and Deliverables
6. Communication Plan
7. Price Proposal

Further detail on the requirements for each of these individual elements in the requested proposal are provided below. In preparing responses to this RFP, the emphasis should be on completeness and clarity of content over length. Padding proposals with glossy marketing documents or other content not directly related to conveying the capabilities of your firm as it relates to completing the requested work is to be avoided.

* 1. **Transmittal Letter**

**Example:**

The proposal transmittal letter must be signed by an individual able to also sign a contract on behalf of the respondent. The letter must:

* Identify what organization is submitting the proposal.
* Identify the name and title of the person or persons authorized to sign a contract on behalf of the responding organization
* Identify the name, title, telephone numbers, and email address of the person to contact for clarification about the proposal being transmitted.
* Identify the name, title, telephone, and email address of the individual who will serve as the project manager.
* Agree to the terms of this RFP.
	1. **Proposed Project Team and Qualifications**

*A key part of any proposal is the individuals that will do the work on your project. You will interact principally with the vendor’s project manager so the qualifications of that person are obviously particularly important. However, other individuals will also make key contributions to your project so you will also want information on their qualifications and, in less detail, on other staff.*

**Example:**

Respondents must describe the pertinent professional qualifications and experience of the proposed project team. Of specific interest is how the proposed team will ensure that the project deliverables identified in Section 4 will satisfy both the ordinary and the unique requirements of this project. More complete information is required for key project staff, defined as the project manager, the certified photogrammetrist, the production supervisor, and the QA supervisor/lead.

Identify the specific project manager that would be assigned to this project. For purposes of responding to this RFP, a project manager is the individual responsible for day-to-day contact with the client who has ultimate responsibility for ensuring that the products sought through this RFP are delivered on schedule and to the satisfaction of the client.

In addition, briefly describe the relevant qualifications and experience of the other key staff as identified above. Proposals must include resumes for these key staff roles and those resumes must identify how long the person has been employed by the bidder. A brief identification of other staff likely to work on this project and a brief summary of their qualifications must also be included (if relevant qualifications can be summarized in tabular form that would be a favorable way to provide this information).

In addition, the following project information must be provided:

* A chart that cross-references proposed project manager, certified photogrammetrist, production supervisor, and QC supervisor/lead team members and the reference projects listed in the response on which they each performed substantive work.
* A statement as to the likelihood (definite, highly likely, somewhat likely) each of the key project staff will actually work on this project if it is awarded based on the procurement schedule in Section 1.4.

* 1. **Technical Proposal**

*The objective of this sub-section is both to help you understand more about these types of projects and how they proceed, while also providing each vendor an opportunity for explaining how they conduct planimetric mapping projects.*

**Example:**

Provide a description of the proposed approach to this project. Detail the steps you will take in proceeding from project initiation to the final delivery of the products requested through this RFP. Topics covered must at a minimum include:

* Project initiation
* Setting up the compilation environment and the process for compiling and identifying features requested through this RFP,
* Applying compilation rules as spelled out in the preliminary geodatabase design (note these are subject to final confirmation prior to project start)
* Assigning attributes to features in compliance with the database design
* Creating a seamless project-wide geodatabase, and
* Client communication, particularly as it pertains to data QA.

Elevation Mapping (if part of the procurement)

This procurement includes elevation mapping consisting of contours, spot elevations, and break lines (see Sections 2.2 and 3.2 of this RFP and the geodatabase design in Appendix B). Describe how the requirements of Section 3.2 and the geodatabase design will be met, specifically covering 1) what breaklines will be acquired through the stereo imagery and 2) the possibility of using the existing Lidar-derived data mass points available through MassGIS’ Lidar Terrain Data web page ([https://docs.digital.mass.gov/dataset/massgis-data- Lidar-terrain-data](https://docs.digital.mass.gov/dataset/massgis-data-lidar-terrain-data)) as part of producing the desired elevation mapping products. If these existing mass points cannot be used for this project, please explain why and propose an alternative as described in Section 3.8.

Proposals additionally must address the issue of how topographic contours look. Does your process produce consistently smooth contours that “look right” with no angular elements or will there sometimes be angular or irregular elements? What is the relationship between either of these results and the information provided by the source mass points and breaklines?

Feature Capture Rates

Finally, using the Feature Capture Rate Form in Appendix C, the proposal must provide information on what feature capture rates the vendor will achieve and a discussion of the factors that influence those rates. For each feature listed, these rates must be provided as percentage of the visible features. Unless otherwise negotiated, these percentages will be binding once the contract is signed as are the figures that will be used as part of quality assurance by the [Municipality Name].

Project Communication

Your proposal must include your approach to project communication. In particular discuss preferred mechanism and tools, as appropriate, for communicating about QA issues.

* 1. **References**

**Example:**

Respondents must provide at least three (3) references from the last four (4) years of clients for whom services are similar to the ones sought through this RFP have been provided. For each reference provide:

* The name, address, email address and telephone number of the client contact
* The project’s beginning and ending dates
* A concise description of the work performed, and a list of the products or services delivered

Reference projects will be scored both for the quality of the reference as well as for their relevance to the services sought through this RFP. Relevance is defined as project size and the mix of planimetric features mapped. The project manager’s success in delivering the project, adherence to schedule (for schedule elements under the vendor's control), and quality of the initial delivery relative to the final delivery will also be assessed through references**.**

* 1. **Proposed Schedule of Milestones and Deliverables**

**Example:**

Provide a proposed project schedule, showing timing of individual elements and deliveries in days or weeks, as appropriate, from a hypothetical authorization to proceed. The schedule must include:

1. An initial in-person project kick-off meeting
2. A preliminary database design reflecting discussion in the kick-off meeting
3. Delivery of a pilot project and related meeting as agreed upon as part of project planning
4. A review period for the pilot
5. Delivery of the final database design
6. Following acceptance of the pilot and the database design, initial delivery of the draft final data for review
7. The final data delivery after client review is completed.

The proposal should identify any factors that might affect the proposed schedule.

* 1. **Proposed Communication Plan**

**Example:**

Provide a proposed strategy to ensure communication between vendor and customer is timely, consistent, and effective. Provide the name and title of the point of contact, email, phone number, preferred contact method, typical work hours with time zone, capability and use of screen sharing, video conferencing, or other means of interaction, and when communication should be expected, i.e. prior to reaching milestone, when a problem arises, when review and local input is needed, etc. The communication plan should include items in the Proposed Schedule of Milestones and Deliverables, as well as communication that occurs remotely throughout the project. Also included could be expectations of the customer to describe an expected an appropriate level of communication throughout the project.

* 1. **Price Proposal and Invoicing**

Price Proposal

 Price for Group 1, required features $ \_\_\_\_\_\_\_\_\_\_\_

 Price for Group 2, optional features $ \_\_\_\_\_\_\_\_\_\_\_

Price for Group 3, optional features $ \_\_\_\_\_\_\_\_\_\_\_

If alternatives that impact price are provided in Section 6.1, then a separate price proposal, consistent with the above requirements for price must be provided.

Invoicing

The Contractor will receive payment on the following payment schedule:

* 20% after delivery of the pilot project
* 20% after acceptance of the final database design
* 40% after delivery of the complete draft database
* 20% after review and acceptance of the completed project

The final 20% payment will only be made after review and acceptance by <MUNICIIPALITY NAME> of \_\_\_\_\_\_\_\_\_\_\_\_ of all deliverables listed in Section 4 of this RFP.

1. **PROPOSAL EVALUATION CRITERIA**

*The first step in using the evaluation criteria below is assigning points to each category.* *These point assignments should reflect your priorities; more points should be assigned to the evaluation criteria that are most important to you. Second, you should not do any scoring until after all those evaluating the proposals have read through all the proposals. And, yes, you should have multiple people (ideally at least three) reading and scoring all the proposals. You may find that one person’s evaluation is very different from another's. You can either try to reach a consensus score or you can take the average of all scores for each proposal being evaluated*.

**Example:**

Responses to this RFP will be evaluated in the following areas:

1. Technical Proposal
2. Qualifications of key project team members
3. Proposed approach to project communication
4. Proposed schedule
5. References (both their relevance to this project and their quality)
6. Price
	1. **Technical Proposal**

**Example:**

The technical proposal will be evaluated on:

* The overall quality and completeness of the proposal including the extent to which it addresses all technical elements of the project as identified in this RFP
* Discussion of any issues related to using stereo-imagery provided by a third-party vendor
* Discussion of proposed database design, compilation rules, data accuracy, and feature capture rates
* Approach to quality control
* (*If applicable*) Discussion of conducting an update of planimetric features versus a complete remap
* (*If applicable*) Approach to mapping topographic contours using Lidar mass points available through MassGIS
	1. **Qualifications and Contributions of Key Project Team Members**

**Example:**

The qualifications and experience of the key members of the proposed project team (as identified in Section 5.2) will be assessed in the scoring for this portion of the proposal. Factors will include relevant professional certifications (Certified Photogrammetrist, Certified Photogrammetric Technologist, certified mapping scientist (GIS/LIS), GISP), years of professional experience, years with the current company, depth of experience with similar projects, and the match between individuals and the reference projects

* 1. **Proposed Approach to Project Communication**

**Example:**

Elements evaluated will be purpose and frequency of scheduled project meetings (in-person or by telephone); how meetings will be documented, and the recommended approach to transmission of and response to client communication concerning QA for the pilot and the final project. Vendor expectation should be that the client will be including field work in their QA review.

* 1. **Proposed Project Schedule**

*Schedule can have a significant impact on project price. If it is necessary to have a project completed by or before a certain time, whether due to operational needs or financial requirements, then you should make that clear up front. If, on the other hand, having a longer project schedule is not a problem, then that can work to your advantage because a vendor may be willing to lower the price if they can work more slowly on your project. If your project schedule can be slower, it may enable a vendor to balance their workload, thus increasing their willingness to lower their price for your project because of that balance.*

* 1. **References**

**Example:**

References will be evaluated in two ways. First is their relevance to the project that is the subject of this proposal. Second is the quality of the reference. These are each described below.

Relevance of references (defined as similar client, e.g., municipal or military base; equivalent planimetric feature set; equivalent source imagery, e.g., 6” pixel resolution or less; accuracy requirements; and project size or population density)

Quality of references (score based on adhering to project development and completion as described in original proposal, to schedule/delivery in timely manner; data quality, both as delivered and post-delivery; quality of project communication; whether or not the reference would use the vendor again

* 1. **Price**

**Example:**

The price for each group of required map features and for each group of optional figures will be scored separately and the final score for price will be based on those group-level scores. Prices will be scored on a graduated scale such that a price that is slightly lower or higher than a competing proposal will not result in a big jump or drop in points awarded for price.

**APPENDIX A**

**MassGIS 2021 Orthoimagery Project Specifications**

The stereo imagery available for planimetric development was acquired by MassGIS as part of their statewide spring 2021 project. Stereo image pairs were delivered to MassGIS organized in folders, one per city or town; each folder contains the analytical triangulation information relevant for those image pairs. The specifications in this Appendix will aide planimetric data developers understand methods used to capture and process the imagery, as well as provide insight into imagery accuracy and resolution. These aspects are vital to the planimetric cost estimate and data creation process.

### Acquisition Window and Conditions

Provided the conditions below are met, the acceptable window for acquiring imagery for the leaf-off products detailed in this RFR shall generally be between March 15 and April 30, depending on region of the state. With prior written (email) MassGIS approval, the acquisition window may be extended through the first week of May.

Imagery shall be acquired only when conditions meet the following specifications**:**

1. Skies are generally clear with no areas obscured by clouds or cloud shadows.
2. Deciduous trees are bare (“leaf off”)
3. Sun angle is greater than 33° above the horizon. For “Street View” areas, every effort should be made to acquire at or near the highest solar angle possible on that day.
4. No smoke, dust, or haze
5. Streams and water bodies are in their normal banks
6. Ground is free from snow
7. Sun reflectance from water shall not obscure shorelines or land surface features.
8. There will be no tidal coordination for the image acquisition.

MassGIS’ Technical Project Manager or Project Manager may issue written (email) waiver to the snow free requirements for certain locations, such as: ski slopes, snow piles in parking lots, small (approximately ¼ acre or less) patches of snow in deeply shaded areas. Other elements of the above specifications may be modified at the sole discretion of MassGIS. Each such waiver shall be granted on a case-by-case basis.

### Sensor / Camera

The Contractor must provide a sensor system that shall have the following characteristics:

1. The entire mission in a given flying season, at a given GSD, shall be flown with the same digital camera model using the same configuration.
2. The sensor shall capture imagery with at least 12-bits per pixel radiometric resolution.
3. The sensor shall capture bands corresponding to natural color (red, green and blue - RGB) and near-infrared (NIR), resulting in 32-bit 4-band (16-bit per band) RGB-NIR orthoimages.
4. Bands shall be saved in the following order: 1) Red, 2) Green, 3) Blue, and 4) Near-Infrared.
5. Following image capture, no lossy compression of any kind shall be applied to the image data.
6. The sensor shall be designed to eliminate any "fringing" or misalignment between the near infrared band and the other three bands. For each exposure, all bands shall be captured simultaneously.
7. The camera shall use electronic Forward Motion Compensation and be properly installed on a Gyro-Stabilized Mount.
8. The Contractor shall provide proof that all aerial sensors/camera(s) used to acquire project imagery have current USGS certification. The Contractor shall also provide calibration certificates for all sensor systems.
9. 16-bit radiometric resolution shall be maintained throughout production. Up-sampling from a lower bit depth to a higher bit depth is permitted only in the case of resampling 12-bit data from a sensor to 16-bits for further processing.

### ABGPS and IMU

Camera position (latitude, longitude, and elevation) shall be recorded at the instant of exposure with Airborne Global Positioning System (ABGPS). ABGPS data shall be differentially corrected and organized as individual data sets grouped by corresponding flight line. Differentially corrected ABGPS positional data shall be delivered in a non-proprietary format mutually agreeable to MassGIS and the Contractor. The vertical RMSE of the Airborne GPS control shall not exceed 30 cm. The Contractor shall produce a statistical report summarizing the results of the ABGPS adjustment.

The contractor shall also record the camera altitude at the instant of exposure. These Inertial Measurement Unit (IMU) data shall be adjusted and organized as individual data sets grouped by individual flight line. The Contractor shall produce a statistical report summarizing the overall accuracy of the adjusted IMU data.

### Flight Plan

All flight lines shall be oriented generally North-South. MassGIS shall approve planned flight lines before imagery acquisition for that season. No East-West lines shall be flown except when necessary to acquire image data for the ‘Street View’ areas. All imagery within a single flight line shall be acquired with the same sensor, and with the sensor oriented in the same direction.

Overlapping imagery in each flight line shall provide full stereoscopic coverage of the area to be mapped. The imagery shall have an average endlap of sixty percent, (60%) with a maximum of +/- 10% between images; sidelap between adjacent parallel flight lines shall average thirty percent (30%) with a maximum of +/- 10% between images; crab shall not exceed three (3) degrees; and tilt of the camera from verticality at the instant of exposure shall not exceed three (3) degrees.

Source imagery shall be captured at a Ground Sample Distance (GSD) sufficient to produce digital orthoimagery that meets the accuracy standard specified in Section 3.3.16. The extent of image coverage over the project area shall be sufficient to ensure void areas do not exist in resulting orthophoto tiles.

### Orthoimage Format

The orthoimagery format will conform to the following requirements:

* Uncompressed, untiled, GeoTIFF format.
* Multispectral with four bands.
* Bands shall be ordered as: Red, Green, Blue, and Near Infrared (1,2,3,4).
* Data type shall be unsigned, 16-bits per band.
* GeoTIFF files shall include the following GeoTIFF tags and keys:
* ModelTiepointTag
* ModelPixelScaleTag
* GTModelTypeGeoKey
* GTRasterTypeGeoKey
* ProjectedCSTypeGeoKey
* PCSCitationGeoKey
* ProjLinearUnitsGeoKey

All GeoTIFF tagged data shall be validated by the Contractor to ensure proper loading and performance before being archived. This validation procedure ensures correct physical format and field values for tagged elements.

In addition, the Contractor shall expect MassGIS to test the sample GeoTIFFs in various software packages (ArcGIS Pro, ArcMap, ERDAS IMAGINE, QGIS) to insure appropriate performance across all packages.

### Projection

Orthorectified images shall be referenced to Universal Transverse Mercator (UTM), Zone 18 or 19, as appropriate, NAD 1983 (2011), NAVD88 (Geoid model 12B or newer). Coordinate units shall be in meters.

Pixel corner coordinates shall be evenly divisible by 0.15 meters.

Projection Type: Universal Transverse Mercator (UTM)

Spheroid Name: GRS 1980

Spheroid Axis: 6378137.000000, 6356752.314140

Flattening Ratio: 298.257222101

Datum Name: NAD83 (NSRS 2011)

Datum Parameters: -0.995600, 1.901300, 0.521500, -0.000000, -0.000000, -0.000000. -0.000000

UTM Zone(s): 18 or 19

Scale factor at central meridian: 0.999600

Longitude of central meridian 69.000000 or 75.000000 W

Latitude of origin of projection: 0.000000 N

False easting: 500000.000000 meters

False northing: 0.0000000 meters

Axis Order: E,N

EPSG Codes: 6347 or 6348

Any vertical datum shall be referenced to the North American Vertical Datum of 1988 (NAVD88). The geoid model used shall be the latest hybrid geoid model of NGS, supporting the latest realization of NAD 83 (currently GEOID18 model)

### Orthoimage Quality

Images shall meet the following requirements:

* Minimal intensity clipping in any band so that detail in shadows and highlights is preserved.
* Pixel color shall closely resemble the color of the ground at the time of image capture. This requirement is particularly important for pavement and rooftops.
* Free of artifacts and blemishes.
* Minimal sun glint and specular reflection from water surfaces.
* No edge enhancement shall be applied to the imagery
* There shall be no artifacts due to pan sharpening or other processing at all viewing resolutions.
* Orthoimagery shall have a generally consistent radiometric appearance across AT blocks and seam line boundaries, without over-adjusting for factors such as acquisition date, time of day, environmental conditions, and land cover.

### Mosaicking

Mosaicking shall not affect the positional accuracy of the orthoimagery. Additionally:

* Seam lines shall not pass through structures, bridges, or other objects to create obvious visual distractions.
* Elevated features such as building rooftops, bridges, elevated highways, water towers, and radio towers, shall not be clipped at seam lines or between individual tiles. These features shall be corrected for viewing (not for accurate 3D modeling).
* If feathering is used along an edge line, it shall not create any blurring or double imagery.

### Orthoimage Radiometry

Orthophotos shall be tonally balanced to produce a uniform contrast and tone across the image tiles of the entire project.

Slight systematic radiometric differences may exist between adjacent seams due to differences in source image capture dates.

Color balancing may be performed over a group of images during the mosaicking process, which may serve to lighten or darken adjacent images for better color tone matching.

Changes in color balance across the project, if they exist, must be gradual. Abrupt tonal variations between tiles are not acceptable. Color balancing shall be performed with as little loss of original data as possible. In addition, a full seamless mosaic shall then be produced and used for visual assessment of the radiometric processing.

### Completeness

The project area shall be based on the tile indexes developed by and available from MassGIS (see Section 1.1 of this RFR). The tile index shape files for the MassGIS project are:

Eastern MA: (UTM Zone 19): 2021\_tile\_index\_Zone19.shp

Western MA: (UTM Zone 18): 2021\_tile\_index\_Zone18.shp

To ensure complete coverage, the Contractor shall mosaic multiple images tiles and visually inspect the derived imagery for completeness to ensure that no gaps or image misplacements exist within and between adjacent images.

All tiles shall be completed to their full extent. Voids are unacceptable and shall be sufficient reason for rejection of a portion of, or the entire data delivery lot or, if necessary, the entire project.

### Image Rectification

Bilinear interpolation shall be used to produce imagery with clear well-defined edges. If the Contractor determines that a different technique produces imagery with higher visual quality, MassGIS will be open to discussing an alternative technique.

### Ground Resolution

Orthorectified Image ground resolution (pixel size) shall be 15 cm.

### Orthorectified Image Tiles

Orthorectified GeoTIFF tiles shall be 1500 m x 1500 m, or 10,000 pixels x 10,000 pixels. All tiles intersecting the project area shall be fully processed.

The tiling scheme is defined in the index shapefiles: 2021\_tile\_index\_Zone18.shp and 2021\_tile\_index\_Zone19.shp provided by MassGIS. The index sheet shows the tile boundaries and tilenames.

Tiles that straddle UTM zones shall be delivered in full for each of the UTM Zones where they fall. In other words, any tile that is split by the UTM zone boundary shall be delivered as a full image tile in each of the two UTM zones. Pixel corner coordinates shall be evenly divisible by 0.15 meters.

### File Naming Convention

The orthorectified GeoTIFF files shall be organized as representing square tiles arranged in a grid matching the 15 cm tiling index established by MassGIS (see Section 1.1). The individual image files shall be named based on the tile name attribute in the project index shapefiles.

### Street View

‘Street View’ imagery shall be acquired at a density in the designated “high-rise” urban areas such that all road networks are as visible as possible, and buildings show minimal signs of excessive tilt or lean.

The three MA “Street View” areas shall be the extents of the following tiles:

Zone 18

 Springfield (2 tiles):

 18TXM975635

 18TXM990635

Zone 19

 Worcester (2 tiles):

 19TBG685830

 19TBG685815

 Boston (6 tiles):

 19TCG270920

 19TCG270905

 19TCG285920

 19TCG285905

 19TCG300920

 19TCG300905

### Horizontal Accuracy of Orthoimagery

Horizontal accuracy shall be reported in terms of compliance with the RMSE thresholds and other quality and accuracy criteria outlined in:

[ASPRS Positional Accuracy Standards for Digital Geospatial Data](http://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf)

[EDITION 1, VERSION 1.0.0, November 2014](http://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf)

MassGIS requires reporting the estimated accuracy at a 95% confidence level in accordance with the FGDC NSSDA standard.

Accuracy statements shall specify that the data are “tested to meet” the stated accuracy.

The orthoimagery shall have a 15 cm pixel size, shall meet the horizontal accuracy requirements for ASPRS Class 1 according to the ASPRS Positional Accuracy Standards cited above.

### Aerial Triangulation

The Contractor shall use fully analytical, softcopy procedures to extend the horizontal control from relatively few ground survey control points to additional supplemental control points or pass points. Additionally:

* The Contractor shall follow accepted softcopy aerial triangulation procedures and utilize equipment that shall achieve the aerial triangulation accuracy required to meet or exceed required orthoimagery accuracy standards.
* Each stereo model is to be scaled and leveled using the adjusted coordinate values of the pass points located in the stereo model.
* The use of airborne GPS (ABGPS) in combination with ground survey is required.
* An aerial triangulation solution shall never be extended beyond the ground control of the project area.
* In conducting the aerial triangulation, the Contractor shall perform a fully analytical simultaneous bundle adjustment using a weighted least squares adjustment to meet accuracy requirements.
* Aerial triangulation data shall consist of a minimum of refined plate coordinates, adjusted ground coordinates, and a statistical summary report shall be submitted in both hardcopy and softcopy format as a deliverable.

### Accuracy Reporting

A complete quantitative analysis of the data shall be performed, and a report provided showing the final RMSE and accuracy information using the NSSDA and ASPRS (2014) guidelines for product testing and reporting which are available at:

[ASPRS Positional Accuracy Standards for Digital Geospatial Data](http://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf)

[EDITION 1, VERSION 1.0.0, November 2014](http://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf)

<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3>.

At a minimum, statements concerning source materials and production processes used must be provided at the project level sufficient to meet the requirements for horizontal accuracy.

### Digital Elevation Model (DEM) and Vertical Accuracy

Any elevation data (DEM) created for use in the orthorectification process shall be submitted as a deliverable in ERDAS .img format. If necessary, a new, digital elevation model shall be produced for the entire project area. The DEM shall be free of artifacts and data voids. The vertical accuracy of the DEM(s) developed to support production of the digital orthophotos shall be sufficient to guarantee the horizontal accuracy specified in Section 3.3.16. Accuracy testing should comply with FGDC Geospatial Positioning Accuracy Standards, National Standard for Spatial Data Accuracy (NSSDA), and ASPRS (2014) guidelines.

The DEM shall be tiled to match the tiles of the orthoimagery. The individual DEM file names shall be based on the tile name attribute in the project index shapefiles.

A copy of the statewide DEM dataset created for prior statewide orthoimagery production in Massachusetts is available for use by the contractor for this project. MassGIS does not guarantee that the available DEM will be adequate to meet the final product accuracy specifications being required in this RFP. If it is found to be adequate, then it must be used. Otherwise, it will be the Contractor’s responsibility to update the supplied DEM as necessary to support the orthoimagery production specifications and accuracy standards of ASPRS (2014) as defined in this Statement of Work. The bidder must include all costs associated with the necessary DEM development in their cost proposal.

The existing bare-earth DEM is available for download and evaluation here:

[http://download.massgis.digital.mass.gov/ Lidar/ LIDAR\_DEM\_32BIT\_FP.gdb.zip](http://download.massgis.digital.mass.gov/lidar/LIDAR_DEM_32BIT_FP.gdb.zip)

(67 GB, 32-bit floating point)

[http://download.massgis.digital.mass.gov/ Lidar/ LIDAR\_DEM\_16BIT\_INT.gdb.zip](http://download.massgis.digital.mass.gov/lidar/LIDAR_DEM_16BIT_INT.gdb.zip)

(3 GB, 16-bit integer)

Updates to the existing DEM only need to support orthorectification and are not required to support contour modeling or other DEM applications.

The DEM data shall not be stored as a record (Z component) for each pixel of the orthoimagery.

Elevation data created or modified for use in the orthorectification process shall be submitted as a deliverable in a non-proprietary format. FGDC compliant metadata for the final DEM must also be provided at delivery.

### Stereo Viewable Imagery

These images may be used for planimetric mapping for municipal mapping needs. Additionally, this imagery could be used for topographic map compilation, map revision, and quality checking of the accuracy and completeness of 3D vector data by superimposing the 3D vector data over the stereo model.

One set of statewide digital imagery frames shall be prepared from the original digital exposures. This stereo imagery shall be in uncompressed image format containing 16 bits per band pixel values for each of the four bands. A small sample of this imagery I for an area identified by MassGIS’ Technical Project Manager will be provided for review after image acquisition is completed.

The stereo viewable imagery must be developed so that it can be used with common softcopy photogrammetry tools typically used for stereo map compilation. Bidder proposals must discuss this requirement and identify the softcopy software environments in which the stereo imagery and accompanying files they will deliver can be used. Those accompanying files must also be identified.

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**Appendix B: Geodatabase Design**

See separate spreadsheet document “PlanMappingRFP\_AppendixB\_ GeodatabaseDesign”

Details on features to be mapped, provided as a data dictionary (feature names and organization, definition and domain values)

**Appendix C: Feature Capture Rate Form**

See separate spreadsheet document “PlanMappingRFP\_AppendixC\_ FeatureCaptureRate”

1. Adapted from http://oceanservice.noaa.gov/facts/ Lidar.html [↑](#footnote-ref-1)