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# STANDARD FOR DIGITAL PLAN SUBMITTALS TO MUNICIPALITIES

**Version 2.0**

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## PREFACE TO VERSION 2.0

This version replaces Version 1.0 from October 2006. Changes in version 2.0 include requiring use of a stronger and more explicit disclaimer when:

- 1) Distributing files submitted to municipalities as part of conforming to this standard. For example, distribution in response to a public records request; and
- 2) Displaying electronically GIS data updated using content from files submitted in complying with this standard.

The standard's key provision is requiring submittal of a Standard Digital File (SDF). The SDF contains features extracted from the source CADD file used to produce the plan for a proposed development. Version 2.0 of the standard also adds the requirement that the SDF be accompanied by a copy of the original CADD file in PDF format. Finally, some confusion concerning which requirements from Levels I and II of the standard also applied to Level III has been corrected.

# INTRODUCTION

Computer aided design and drafting (CADD) software is widely used by surveyors and civil engineers in preparing individual site plans submitted to cities and towns as part of the land development review and approval process. Digital files are created and maintained, and from these files, traditional paper or Mylar documents can be reproduced easily and efficiently.

In a parallel technology development, many cities and towns have adopted geographic information system (GIS) technology to store, manage and use the town-wide geographic/spatial information on which they rely. However, just like the traditional paper or Mylar maps and associated files or notebooks, a GIS database must be maintained to remain useful. Better maintenance of municipal GIS databases benefits all users of those databases, including those in the private sector.

Many cities and towns have realized that plans submitted for development review are usually produced using CADD software. Therefore, some communities now require that copies of the CADD files from which plans are printed be provided to them and many more are considering such a requirement. Municipalities recognize that implementing this kind of requirement will considerably facilitate maintenance of their GIS databases (e.g., parcel boundaries, pipe infrastructure, building outlines, etc.).

However, there are difficulties with using points and lines derived from CADD files in GIS software. Engineering design is typically completed in a CADD file that includes several, and sometimes many, plan and profile drawing sheets. When the CADD file used to produce the development plan is submitted, it will often not be easy to use in the GIS environment. For example, the number and organization of the plan drawings can be problematic; dashed lines from a CADD file may import into the GIS software as a series of small, unconnected, line segments; and conventions for organizing and naming CADD layers vary from one engineering and surveying firm to another. These kinds of issues complicate the use of CADD files in the GIS environment. Thus many municipalities are now implementing or considering implementing, standards for the format and content of required digital plan submittals.

## PURPOSE OF STANDARD

Rather than having each community develop its' own unique requirements for digital plan submittals, it makes sense to have a state-level standard. Therefore, this standard has two purposes:

1. Enabling municipalities to avoid the time consuming process of developing their own digital submission standard and to avoid the risk of creating a

standard that is flawed because they lack sufficient expertise in the issues involved.

2. Enabling those in the surveying and civil engineering communities to standardize their work processes, if this standard is being used<sup>1</sup>. To the extent that communities implement this standard, standardized requirements for digital plan submittals will save time and money.

## SUMMARY OF STANDARD

The standard supports the above purposes by defining a Standard Digital File (SDF) for plan submittals. The SDF is a subset of the graphic layers from the CADD file used to create development plans<sup>2</sup>. It is not simply a copy of the CADD file used to print development plans. The SDF does not include bearing information (distances are required), the title block, border, or notes from the CADD file. Only features present in the source CADD file for the project for which approval is sought need be included in the SDF – there is no requirement that features not present in the source CADD file be created.

As specified below, the SDF does have requirements for how map features are organized into layers, how those layers are named, and how features in those layers are symbolized. Compliance with the standard is not relevant if the development plans being submitted to a municipality are created using pen and ink. Neither MassGIS nor any other state agency requires this standard to be implemented; that decision lies entirely with individual cities and towns. If municipalities do implement this standard, they must understand the following two important points:

- 1) The SDF is an extract from a larger CADD file and is, therefore, not the equivalent of a copy of the original CADD file. The SDF is intended solely to support the needs of updating GIS databases.
- 2) Maps and other products from a GIS database are typically intended for planning, operational support, and graphic display purposes. However, to help prevent inappropriate uses of information derived from the SDF, distribution of any submitted SDFs as a public record OR electronic displays of information derived entirely or in part from one or more SDFs must include the disclaimer below:

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<sup>1</sup> Realistically, some municipalities may choose to use an existing standard or may develop their own, even if a state standard is issued. Nonetheless, a state standard will reduce the number of standards being implemented.

<sup>2</sup> Some existing municipal requirements call for a copy of the entire CADD file.

### **Required Distribution Disclaimer**

“In accepting and utilizing any drawings, reports and data on any form of electronic media generated and furnished by <municipality’s name>, the Consumer recognizes that all such electronic files are subject to undetectable alteration and that differences may exist between the signed and/or sealed hard copy drawings and the electronic version. The Consumer recognizes that the electronic documents are provided for convenience and informational purposes only and that the hard copy drawings, including the notes, must be reviewed for pertinent information. By accepting and utilizing any electronic drawings, reports or data, the Consumer agrees to waive any and all claims against the persons or entities who prepared the drawings, reports, and or data contained in the electronic files. The Consumer further recognizes that the electronic files contain information from documents which are instruments of service of the persons or entities that prepared them, and as the authors, those persons or entities retain all common law, statutory law and other rights including copyrights.”

The standard has three levels. Each level builds on the prior one. Which level or levels of the standard a municipality implements is entirely up to each municipality. All levels require that the SDF be submitted and that it conform to format and content requirements. Providing a template SDF is a required part of implementing the standard. This document and a template SDF<sup>3</sup> in DWG and DXF format are available through the MassGIS web site at <http://www.mass.gov/mgis/standards.htm>.

Each level of the standard implements some or all of the following five requirements for the SDF:

1. A plan view of the affected construction area shall be submitted in one comprehensive drawing file.
2. File format shall be the AutoCAD DWG or, alternatively, ASCII Drawing Exchange File (DXF) format, delivered using a mechanism specified by the municipality, and with required companion information.
3. Required drawing specifications include layer names as well as standard line and point types (see the layer list in Table 1.)
4. The drawing submitted shall reference (“tie to” or “georeference”) at least two (a) point features (e.g., center of manhole, hydrant spindle, center of catch basin, or utility pole, present in the community’s GIS database (a community might also choose to provide points created from photo-identifiable locations on their orthophoto base map) or (b) Second Order, Class II (or better) monumented survey control (if available).

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<sup>3</sup> If a template is not provided, the individual or organization submitting the SDF would create it in compliance with Appendix A, Table 1.

5. A copy of the CADD file (PDF format<sup>4</sup>) from which features in the SDF were extracted must accompany the SDF.

The following graphic summarizes the required elements comprising each level of the standard (“R” = required, “O” = optional).

Element	Level I	Level II	LEVEL III
1) Plan View File in Standard Digital File (SDF)	R	R	R
2) SDF in DWG or ASCII DXF Format and accompanied by documentation	R	R	R
3) Graphic File Specifications	R	R	R
4a) Reference a minimum of two point features present in GIS database (if provided by the municipality)		R	
4b) Coordinates in Massachusetts Coordinate System, NAD83, units of U.S. Survey Feet		O	R
5) Copy of source CADD file in PDF format	R	R	R

## IMPLEMENTATION RECOMMENDATIONS

When implementing this standard, MassGIS strongly recommends that cities and towns consider:

1. Incorporating requirements for complying with this standard directly in municipal ordinances/review processes.
2. Specifying a mechanism for ensuring that the SDF submitted meets the requirements of this standard, including the basic capability of being able to read media on which the SDF is delivered. Depending on the review process involved, communities might consider specifying, a time period during which the department/commission/board requiring use of the standard, or its designee, will review and verify the content of the data submitted in the SDF to make sure it meets the requirements of this standard.
3. Ensuring the SDF conforms to this standard by using the checklist in Appendix A.
4. Implementing the standard for a variety of processes requiring municipal review or oversight (subdivisions, ANRs, approval of building occupancy or of building permits, release of a bond required as part of installing pipe infrastructure, etc)

<sup>4</sup> CADD files can be saved to PDF format from their native format.

5. Consulting with the department and/or the individual with direct responsibility for GIS data update. This is particularly relevant in deciding what level of this standard to implement for different kinds of projects requiring municipal oversight (see “Municipal Requirements” section, below).

## **COPYRIGHT FOR SURVEYING AND ENGINEERING DRAWINGS**

The engineering and surveying community provided many comments on drafts of this standard; some of these comments concerned copyright. These comments stated that information on surveying/engineering drawings, whether provided on mylar or as a single digital file (SDF) as required by this standard, were protected by copyright. Because of these comments and concerns about copyright being violated if the digital plan standard is implemented, MassGIS asked Linda Hamel and Stephanie Ziertan, the General Counsel and Deputy General Counsel, respectively, of the Commonwealth of Massachusetts’ Information Technology Division (ITD), for advice on this issue. The full text of their advice, which includes discussion of the relevant case law, is Appendix C of this document; it can be found as a separate file on the MassGIS website in the page devoted to standards (<http://www.mass.gov/mgis/standards.htm>).

ITD’s memos conclude that survey data may include a mixture of expressive data in which the surveyor holds copyright and factual data in which he does not. For instance, a surveyor has no copyright interest in the pre-existing facts contained in his survey, such as the location of lot boundaries that existed before he drafted his survey. He does, however, have copyright interest in the data he creates about proposed boundaries for and improvements in a subdivision that does not yet exist.

The copyrighted survey data uploaded into a GIS may lose its copyright protection when and if it becomes “fact”. For instance, the data showing the surveyor’s depiction of the location of a sewer line as yet un-built will lose its protection when the line is actually installed in the ground. Boundaries for lots to be subdivided clearly lose copyright protection once those lots are sold and the boundaries are described in deeds filed with the Registry of Deeds, and may even lose copyright protection when those boundaries are approved by the local planning board and the plan is registered at the Registry of Deeds.

Case law clearly indicates that copyright protection is not lost when a municipality requires that a surveyor provide some survey data for a municipal GIS. Survey data in municipal or state GIS is also public record to which the public has unrestricted access under our state’s public records law. Information can be both public record and subject to U.S. Copyright Law. Some of the survey data uploaded to municipal GISs is therefore subject both to a surveyor’s copyright interest under U.S. law and subject to public access under the public records law.



Copyright law protects the copyright owner's right to control the copying of their expressive work. One exception to the copyright holder's rights is called "fair use". Fair use permits people who have not been given a license by the copyright holder to copy the owner's work for purposes like criticism, comment, news reporting, teaching, scholarship, or research. The Federal courts have said that public access to and copying of documents that are both public record and subject to copyright falls under this exception to the copyright law. Thus, survey data that is part of a municipal GIS and is also subject to copyright can be accessed and copied by people under the state's public records law without diminishing the surveyor's copyright interest. That data cannot, however, under U.S. copyright law be copied for sale to a third party, because copying for that purpose exceeds the "fair use" exception under U.S. copyright law.

Because survey data uploaded into municipal GIS systems may include a mix of data subject to and data not subject to surveyor copyright interests, GIS managers/administrators should post a notice of this fact and a statement regarding the limitations imposed by US copyright law on the copying of such data. Municipalities implementing this standard can avoid having to post such notices by declining to post survey data that reflects something other than existing facts.

## **AUTHORITY**

As the Commonwealth's Office of Geographic and Environmental Information, MassGIS has the legislatively assigned authority and mandate to "set standards for the acquisition and management of geographical and environmental data by any agency, authority or other political subdivision of the Commonwealth" (Ch. 21A, §4B, MGL 1999). MassGIS is issuing this standard and is responsible for its content. As noted above, whether or not this standard is implemented is entirely up to individual municipalities; there is no state requirement that this standard be used.

## **DEVELOPMENT PROCESS**

A member of the MassGIS staff wrote and edited the drafts of this document and facilitated the review process. However, much of the actual standard is based on a draft standard developed by the Town of Weymouth's Department of Public Works, Engineering Division.

Standards produced by GIS staff at the Central Massachusetts Regional Planning Commission, the Northern Middlesex Council of Governments, and at the Merrimac Valley Planning Commission were also consulted in developing this standard. The report, "Submission of Plans in Digital Format Compatible with the

Towns Geographic Information System”, submitted by Applied Geographics to the Town of Mashpee in 1999 also provided useful background information in preparing this document.

Drafts of this document were reviewed by a large group of GIS and Surveying professionals (see Appendix B)<sup>5</sup>. This group included GIS staff from many cities and towns, GIS staff from regional planning agencies, and individuals representing most of the Massachusetts based GIS consulting firms. In addition, representatives of most chapters of the Massachusetts Association of Land Surveyors and Civil Engineers (MALSCE), as well as members of its GIS Committee and members at large, reviewed and commented on drafts of the standard. Comments, concerns, and questions concerning the drafts of this document were discussed at length with staff from the Towns of Weymouth and Wayland (see Appendix B). They drew on their expertise with CADD and GIS software and their knowledge of surveying, civil engineering, and local government practices, in explaining comments and questions from reviewers; they also assisted with crafting or recommending changes to accommodate those comments and questions. Without the contributions of all these participants, this standard would not have been possible.

Many questions were asked and many issues were raised during the development and review process. A summary of these questions and issues and how they were resolved is included in Appendix D, which is distributed as a separate document. If after reviewing Appendix D you have questions about or suggestions for this standard, please contact:

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<sup>5</sup> The presence of someone’s name in Appendix B does not mean that they endorse the standard. Instead it simply acknowledges that they provided feedback on the standard during its development.

## REQUIREMENTS OF THE STANDARD

The requirements are broken into two parts: 1) those that apply to municipalities, and 2) those for each level of the standard that apply to surveyors and engineers. As discussed above, which level of the standard applies would be decided by the municipality.

### REQUIREMENTS FOR MUNICIPALITIES

In implementing any level of this standard, municipalities must:

1. Identify the standard correctly in their ordinances or regulations.
2. Identify which level of the standard applies to a specific development project.
3. Provide a template SDF.
4. Make provisions for an appeal process.
5. Provide GIS data points that are candidate geo-referencing points for the SDF “locked layers” when implementing Levels II and III of the standard.
6. When requiring Level III, specify the vertical datum.
7. Specify how the SDF will be delivered

Each of these are discussed in more detail below

1. Correctly Identifying the Standard - To avoid any confusion, the standard must be referred to as the “current version of the MassGIS Standard for Digital Plan Submission to Municipalities”
2. Level of the Standard - Specifying which level of the standard is required is important as different levels have different requirements. Different kinds of documents (for example, approved plan, as-built plan, occupancy or building permits, pipe infrastructure plans, condition for releasing construction bond, etc) may warrant a different level of the standard. Another reason that different levels of the standard might be used is to reflect project complexity. So, for example, one possible application of the standard is to require that “small” or “simple” projects require adherence to requirements for Level I. Following that logic, “large” or “complex” projects would be required to follow requirements for Level III. Projects falling into a middle ground would be assigned to Level II. With this approach, a community would have to clearly define what constitutes a small/large or simple/complex project and which level of the standard applies. This definition might be included directly in municipal ordinances. Alternatively, the standard could be implemented with a default requirement for a specific level, with a provision for an appeal (see below) to comply with a lower level of the standard based on the merits of a specific project.
3. Template SDF - The template SDF (DWG or ASCII DXF format) must comply with the requirements for the SDF in that the coordinate system,

layer naming, and symbols must meet the requirements of this standard. The template file must contain empty layers for each of the layers identified in the Graphic File Specifications in Table 1. It is expected that these layers will be populated (by those submitting the SDF) with the appropriate survey/engineering data. The purpose of providing this template file is making it as easy as possible to comply with this standard. A template SDF can be found at [www.mass.gov/mgis/standards.htm](http://www.mass.gov/mgis/standards.htm). Note that a knowledgeable user of CADD software can also readily create a blank or template SDF based on the specifications in this standard and in Table 1.

4. Provisions for Appeal – Municipalities must consider making provisions for an appeal of and possible deviation from SDF requirements or waiver of the required SDF submittal. While many people have reviewed this standard it is not possible to predict all scenarios that might be affected by its requirements. Any appeals must be on a project-by-project basis.
5. Provide GIS Data - When requiring Levels II of the standard, provide project-specific GIS data for the “locked layers” in the template file (See Table 1) and, for Level III of the standard, “reference features” at no charge to firms/individuals that will be submitting SDFs; the practical effect of this for some communities may be that it makes sense to regularly provide complete portions (e.g., parcel boundaries, sewer manholes, fire hydrants) of their GIS database at no charge to firms that do a lot of work in their community.
6. Vertical Datum - When requiring an SDF that meets Level III of this standard, specify the vertical datum that must be used in the SDF. If the vertical datum is not NGVD29 or NAVD88, but a local vertical datum, then a conversion factor between the local datum and NAVD88 must be provided. An assumed datum must NOT be used in the SDF. See document on the MassGIS web site at [www.mass.gov/mgis/standards.htm](http://www.mass.gov/mgis/standards.htm) for a copy of conversion factors for local datums provided by the MassHighway Department’s Survey Section.
7. Delivery Media - Specify the delivery media (e.g. CD-ROM) or mechanism (e.g., FTP, email) for the SDF.

## **REQUIREMENTS FOR SURVEYORS/ENGINEERS**

In implementing this standard, municipalities will require compliance with one of the levels below. Levels II and III incorporate all the elements of Level I, unless otherwise noted.

### **Level I Requirements**

Under this standard, plans produced using computer aided drafting and design (CADD) software, must be accompanied by a digital file containing a subset of the features in the CADD file. This subset of features is referred to as the

Standard Digital File or SDF. The SDF is not simply a copy of the CADD file used to print development plans. It does not include information about bearings (distances are required), the title block, border, or notes from the CADD file. As specified below, the SDF does have requirements for how map features are organized into layers, how those layers are named, and how features in these layers are symbolized. The SDF cannot be required if the development plans being submitted to a municipality were prepared by hand. Only features present in the source CADD file for the project for which approval is sought must be included in the SDF.

The SDF will be used as a source for maintaining map features and associated information in the GIS database of any municipality using this standard. The printed plan will remain the official document.

Communities implementing this standard understand the following:

- 1) The SDF is an extract from a larger CADD file and is, therefore, not the equivalent of a copy of the original CADD file. The SDF is intended solely to support the needs of updating GIS databases.
  
- 3) Maps and other products from a GIS database are typically intended for planning, operational support, and graphic display purposes. However, to help prevent inappropriate uses of information derived from the SDF, distribution of any submitted SDFs as a public record OR electronic displays of information derived entirely or in part from one or more SDFs must include the disclaimer below:

#### **Required Distribution Disclaimer**

“In accepting and utilizing any drawings, reports and data on any form of electronic media generated and furnished by <municipality’s name>, the Consumer recognizes that all such electronic files are subject to undetectable alteration and that differences may exist between the signed and/or sealed hard copy drawings and the electronic version. The Consumer recognizes that the electronic documents are provided for convenience and informational purposes only and that the hard copy drawings, including the notes, must be reviewed for pertinent information. By accepting and utilizing any electronic drawings, reports or data, the Consumer agrees to waive any and all claims against the persons or entities who prepared the drawings, reports, and or data contained in the electronic files. The Consumer further recognizes that the electronic files contain information from documents which are instruments of service of the persons or entities that prepared them, and as the authors, those persons or entities retain all common law, statutory law and other rights including copyrights.”

## Level I Summary

At Level I the SDF must meet three requirements:

1. It must contain a plan view of the affected construction area in one comprehensive drawing file.
2. The file format must be AutoCAD DWG (alternatively ASCII DXF) transferred on a CD-ROM or other computer storage medium (as specified by the municipality) and with appropriate documentation.
3. It conforms to the graphic and layer naming specifications of this standard.
4. An Adobe PDF format file containing a copy of the source CADD file from which the features in the SDF were extracted must be submitted with the SDF.

Details on these four required elements are below.

### Plan View

The required subset of CADD file layers of the affected construction area shall be submitted, in plan view, as one comprehensive drawing file. Plan view is defined as all “entities” on the same plane of zero elevation in the drawing coordinate space.

At Level I of this standard, the SDF is not required to use a geographic coordinate system (e.g., Massachusetts Coordinate System, NAD83); coordinates based on drawing units are expected. However, in the event that the submitter of the SDF wishes to create it with coordinates from the Massachusetts Coordinate System, they may do so. See details concerning this topic in Level III of the standard.

### File Format and Documentation

File format shall be the AutoCAD DWG (alternatively ASCII DXF) file format; most GIS software can read DWG or DXF file format. DXF files can be created by all the major CADD and GIS packages. The SDF shall be delivered on a CD-ROM disk or other media as specified by the municipality implementing this standard. The delivery medium must be labeled with:

- Submission date
- Municipal project number or ID
- Project or subdivision name, and
- Name and version of the computer operating system on which the media was written.

Documentation accompanying the SDF as a printed document or, preferably, as a plain text file on the same media as the SDF must include:

- The name of the land owner and of the preparer of the plan/SDF
- The same project identifying information as on the delivery media.
- The name and version of the CADD software used to create the SDF
- Project address or, if no address, a descriptive location
- A list of the file names on the delivery with a description of what each file contains.
- The vertical datum of the SDF, if relevant.
- The date or dates when the survey work was performed.
- Disclaimer (see discussion immediately below)

In addition, either in the same text file as the above documentation OR embedded in a separate layer in the SDF (G-ANNO-NOTE, the “SDF Disclaimer” layer in the template (Table 1), the following disclaimer must appear:

“This SDF is submitted solely for meeting the requirements of the \_\_\_\_\_ (city/town name) as described in the current version of the MassGIS Standard for Digital Plan Submission to Municipalities. The information contained on this SDF is derived from a CADD file containing the results of original field survey work and related research. The information in this SDF must not be used for authoritative boundary or elevation determination, or for the authoritative location of physical objects without an actual field survey.”

NOTE: The above disclaimer is different from the one that must be used by municipalities implementing the standard. See earlier discussion under “requirements”.

## Graphic Specifications

The SDF must conform to the graphic file specifications shown in Table 1. These specifications include layer names as well as standard line and point types; a template is available through the MassGIS website at <http://www.mass.gov/mgis/standards.htm>.

In addition, the submitted SDF must conform to the following requirements:

- a) The features shall be submitted in the layers specified in Table 1. For systems using numbered levels, such as MicroStation, include a conversion table in the DXF file creation process that can be used to specify named layers.
- b) Reference to external CADD layers (“XREF”) must be removed and the referenced information included directly in the SDF<sup>6</sup>.

<sup>6</sup> An alternative that was discarded was to “bind” XREF files to the SDF; however for this to work, there would have to be no duplicate entities and map features would have to appear on (cont.)

- c) The SDF must be created in the “World Coordinate System” in model space (or the Massachusetts Coordinate System, see below), it must have a one-to-one (1:1) DWG scale, where one (1) drawing unit = one (1) U.S. Survey Foot. The coordinate system base must be the same as the AutoCAD system coordinate base or equivalent with the north rotation up. In other words the project (N,E,Z) should equal the CADD (Y,X,Z). The North Rotation must be 0°.
- d) When the SDF is in the Massachusetts Coordinate System, all of requirement ‘c’ above applies.
- e) Features added that do not have a layer specified in Table 1 shall be placed on a separate, unique layer and identified in accompanying documentation.
- f) When creating line features that represent polygons (see FEATURE TYPE in Table 1) in a GIS, CADD users must snap end points of lines together and must make sure polygons close (e.g. property boundaries).
- g) All line features (see FEATURE TYPE in Table 1) shall be of a continuous line-type, such that each individual line/pipe feature (i.e. each segment) is only broken at the ends where a node/structure is located.
- h) Straight lines must be represented by only the beginning and ending x- and y-coordinate points. The exception to this is a line developed from multiple traverses on the same bearing where the coordinates differ only in the “z” values. Line strings must not cross back on themselves or have a zero length (i.e., points).
- i) All point features (see FEATURE TYPE in Table 1) shall be entered using standard point/node symbols.

### **Adobe PDF Format File**

A copy of the original CADD file that was the source of the layers in the SDF file must accompany the SDF; this copy must be in Adobe PDF format. This requirement ensures that the municipality receiving the SDF has an electronic reference copy of the original CADD File that cannot be altered electronically and that fully and appropriately credits the source of the SDF.

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the appropriate layers as presented in Table 1; this would defeat the purpose for which the XREF was created.



## **Level II Requirements**

At Level II, all the requirements of Level I persist. There are two additional requirements, one each for the municipality implementing this level of the standard and for the company or individual submitting the SDF.

### **Municipality Provides Features for Spatial Reference**

The municipality must provide GIS data for use in the SDF “locked” layers. The data provide must be specific to the particular project. These locked layers shall include point features from the Town’s GIS database suitable for spatial referencing in the plan view contained in the SDF (see further discussion of reference features below). The point features in these locked layers must each be uniquely identified with a “GIS ID”; this will facilitate references to these points. In addition to the points for spatial reference, there will be a locked layer (“map reference features”) containing simple large scale mapping features (e.g., town boundary, street network, street names, surface waters, building outlines, etc.) to be used as a quick reference for those preparing the SDF.

### **Spatial Reference in the SDF**

The plan in the SDF shall be submitted with a minimum two points<sup>7</sup> of spatial reference. While the SDF for Level II can remain in drawing units<sup>8</sup>, it must reference (“georeference” or “tie to”) a minimum of two features identifiable in the Town GIS as provided in the locked layers of the template SDF (see above); the two points of spatial reference for the SDF are only required if useable reference points are within 750 feet (via survey traverse) of the project’s boundaries.

These reference points will be one or both of the following types, depending on what is available in a community:

1. FGDC Second Order, Class II (FGDC-STD-007.4-2002 Table A-1) or better survey control monument locations<sup>9</sup>.
2. The centers of manholes, fire hydrant spindles, or catch basins; utility poles may also serve as reference points. Alternatively or in addition, a municipality may choose to provide photo-identifiable points (e.g., ends of specific parking stripes, junctions of lines painted on publicly accessible outdoor basketball or tennis courts) from their orthophoto base map that are currently visible on the ground. To be referenced in the SDF, these

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<sup>7</sup> Only two points are required to correctly orient the features from the SDF because in the GIS environment other information is available that will help resolve any ambiguity concerning the SDF’s orientation.

<sup>8</sup> Note that, at the discretion of the individual or business submitting the SDF, the Massachusetts Coordinate System may be used in the SDF at Level II; in that situation, the requirements of Level III of this standard apply.

<sup>9</sup> Some communities have systematically developed a network of such control points.

features must be provided by the municipality for import into the template SDF in the “Secondary Control Points” (V-CTRL-HCPT) locked layer.

Features being referenced must appear in the SDF; their locations must be determined as part of completing the field survey work for the project depicted in the SDF. It is not expected that locations for these reference features would come from the GIS data. However, the same unique “GIS ID” provided in the template SDF must identify the surveyed reference features in the SDF. Including the “GIS ID” for reference features in the SDF is needed to facilitate finding the two reference points in the GIS environment.

The points selected for reference in the SDF must be separated by as much distance as is possible given the features available to choose from. The accuracy of any ties in the SDF to features in the locked layers must be consistent with the location accuracy of other features provided in the SDF. If there are not two points for spatial reference within 750 feet of the project, then requirements for the SDF submittal revert to Level I of this standard.

### **Level III Requirements**

At Level III, all the requirements of Level I persist. At Level III the spatial reference requirement of Level II is replaced by the coordinate system requirement below. At Level III there is also one optional component. However, the community should provide a template SDF that includes the map reference features layer (town boundary, roads, etc.) as these features can be helpful in orienting those developing the SDF.

### **SDF Coordinate System**

The coordinate system of the SDF at Level III must be the Massachusetts Coordinate System, North American Datum 1983, with units of U.S. Survey Feet. The vertical datum must be North American Vertical Datum 1988, unless the municipality using this standard requires that the local vertical datum be used. If the local vertical datum is required, the city or town must provide a conversion factor between the local vertical datum and NAVD88. This conversion factor should be developed using the North American Vertical Datum Conversion (VERTCON) algorithm. If a temporary benchmark (TBM) is created, it must be shown and labeled in the SDF. The horizontal and, as applicable, vertical accuracy of the features in the SDF must match those of the surveyed locations depicted on the printed plan to which the SDF is a companion submission.

### **Additional SDF Documentation (optional)**

At this level of the standard, suggested<sup>10</sup> additional documentation accompanying the SDF includes:

- A list of the control points used and held.
- Information about the method used to bring the control points to the project site (GPS, traverse resection, etc.).
- The source benchmark held to derive temporary benchmarks created for the project, if any.
- Data derived from GPS, terrestrial traverse, or by geo-referencing to existing GIS features.

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<sup>10</sup> Feedback from some MALSCE members included the suggestion that this additional documentation might willingly be provided by some surveyors because of its value to surveyors following after them.

## TABLE 1: GRAPHIC FILE SPECIFICATIONS

NOTE: layers in bold are “locked” layers that would be provided in a template SDF (Levels II and III) for reference purposes. Except for those names followed by an asterisk (\*), the layer names below are all taken from the A/E/C CADD Standard. Not all the features listed below appear in the A/E/C standard. Missing features have been assigned a name that is constructed in a way that matches the A/E/C Standard. Note that Autodesk Land Desktop 2006 includes a standard drawing template that incorporates the A/E/C Standard’s naming conventions.

<b>SDF LAYER NAME</b>	<b>DATA OR FEATURE</b>	<b>FEATURE TYPE<sup>11</sup></b>
G-ANNO-NOTE*	SDF DISCLAIMER	Text
<b>V-CTRL</b>	<b>Geodetic Control Points</b>	<b>Point, Locked Layer</b>
<b>V-CTRL-HCPT*</b>	<b>Secondary Control Points<sup>12</sup></b>	<b>Point, Locked Layer</b>
<b>V-SITE-OTLN</b>	<b>Map Reference Features<sup>13</sup></b>	<b>Polyline, Locked Layer</b>
V-PROP-LINE	Property Boundary	Line
V-ANNO-DIMS*	Property Dimension, Survey Calls	Text
V-PROP-ESMT	Easement	Line or Polyline
V-PROP-RWAY	Right-of-Way Boundary	Line or Polyline
V-SURV-DATA	Survey Monuments <sup>14</sup>	Point
V-PVMT-ROAD	Edge of Pavement	Line or Polyline
V-PVMT-WALK*	Edge of Sidewalk	Line or Polyline
V-BLDG-OTLNF*	Building Footprint Outlines	Line or Polyline
V-BLDG-OTLNR*	Building Roofprint Outlines	Line or Polyline
V-SITE-EWAT	Stream, River & Pond Edges	Polyline
V-SITE-BVW*	Wetland Boundaries	Polyline
V-TOPO-MINR	Topographic Contours - Interval	Line or Polyline
V-TOPO-MAJR	Topographic Contours - Index	Line or Polyline
V-TOPO-MAJR-IDEN	Elevation Value - Index	Text
V-TOPO-SPOT	Spot Elevations	Point

<sup>11</sup> While it is expected that feature type line will usually be chosen for linear features, polyline is also acceptable and is even preferred; see discussion of required graphic specifications

<sup>12</sup> Secondary reference points are features from a municipal GIS database such as manhole and catch basin centers and fire hydrant spindles for which locations and the unique GIS ID would be provided for this layer by the municipality (Levels II only).

<sup>13</sup> Map reference features are features from a municipal GIS database such as street centerlines, surface waters, town outline, and building outlines that may be useful as background orientation.

<sup>14</sup> This layer is for features such as corner bounds, points of curvature, and other locations recovered by the surveyor.

V-TOPO-SPOT- <i>IDEN</i> *	Spot Elevations Value	Text
L-SITE-RTWL	Retaining Walls	Line or Polyline
C-RAIL-CNTR	Rail Road Line	Line or Polyline
V-SITE-FENC*	Fence Line	Line or Polyline
L-PLNT-BUSH	Shrub or Shrubbery	Point
C-ROAD-CNTR	Road Centerline	Line or Polyline
L-PLNT-TREE-LINE	Forested or Large Vegetation Area	Line or Polyline
L-PLNT-TREE	Tree (>= 6" diam)	Point
C-PKNG-OTLN	Parking Area Outlines	Line or Polyline
V-DOMW-MAIN	Water Mains	Line or Polyline
V_DOMW-SERV	Water Services	Line or Polyline
V-DOMW-HYDR	Fire Hydrant	Point
V-DOMW-DEVC*	Water Valves	Point
V-DOMW-FTTG*	Water Reducer or Fitting	Point
V-DOMW-WELL	Water Well	Point
V-DOMW-METR*	Water Meter Pit	Point
V-DOMW-TANK	Water Storage Unit	Point
V-DOMW-PUMP	Water Pump Station	Point
V-DOMW-MISCPT*	Water Miscellaneous Points	Point
V-SSWR-MAIN	Sewer Mains	Line or Polyline
V-SSWR-SERV	Sewer Service Lines	Line or Polyline
V-SSWR-JBOX	Sewer Manholes	Point
V-SSWR-PUMP	Sewer Pump Station	Point
V-SSWR-LEAC	Sewer Wet Well	Point
V-SSWR-DEVC	Sewer Valve	Point
V-SSWR-MISCPT*	Sewer Miscellaneous Points	Point
V-STRM-MAIN	Storm Drain Mains	Line or Polyline
V-STRM-JBOX	Storm Drain Manholes	Point
V-STRM-CB*	Catch Basin	Point
V-STRM-CULV	Culvert	Point
V-STRM-HDWL	Storm Drain Headwall	Line
V-STRM-INLT*	Storm Drain Inlet	Line
V-STRM-OTFL*	Storm Drain Outfall	Line
V-STRM-LAGN	Retention/Detention Basin	Line or Polyline
V-STRM-MISCPT*	Drain Miscellaneous Points	Point
F-ALRM-MANL	Fire Department Call Box	Point
V-POLE-UTIL	Electric Poles	Point
V-LITE-FIXT	Street Lights	Point

V-ELEC-JBOX*	Electric Manhole	Point
V-COMM-JBOX*	Telephone Manhole	Point
V-COMM-CBOX*	Telephone Switching Station	Point
V-ELEC-HBOX*	Hand Hole	Point
V-ELEC-PAD*	Padmount	Point
V-ELEC-CBOX*	Electric Switching Station	Point
V-MISC-JBOX*	Manholes, other	Point
V-SPCL-TRAF*	Traffic Light	Point
V-SPCL-TCBOX*	Traffic Light Control Box	Point
C-PVMT-SIGN*	Traffic Sign	Point

# APPENDIX A: ITEMIZED CHECKLIST FOR SDF SUBMITTALS

## File Format and Documentation

- Delivery media labeled with project information
  - Submission date
  - Municipal project number or ID
  - Project or Subdivision name
  - Name and version of computer operating system on which the media was written
  
- Documentation submitted with media in electronic format
  - Name of landowner and the preparer of the plan/SDF
  - Same information identifying the project as on the delivery media
  - Name and version of the CADD software used to create the SDF
  - Project address or, if no address, project description
  - A list of the file names with a description of what is in each file
  - The vertical datum of the SDF, if relevant
  - The date or dates when the survey work was performed
  - Disclaimer statement (may be included directly in the SDF; see Level I requirements in standard)

## Plan View Requirements

- Entire project area submitted in plan view as one comprehensive drawing file.
  - SDF used town template (if required)
  
- Drawing submitted in Massachusetts Coordinate System
  - NAD83 MA Coordinate System \_\_\_\_\_ (US Survey Feet)
  - Two control points for georeferencing
    - Geodetic Control points
    - Other approved GIS utility or photo-identifiable features
  - Vertical Datum specified (either local datum or NAVD88)

## Required Graphic Specifications

\_\_\_\_\_ SDF features submitted in the layers specified in Table 1. Systems using numbered levels, such as MicroStation include a conversion table in the DXF file creation process that can be used to specify named layers.

\_\_\_\_\_References to external CADD layers (“XREF”) removed and the information included directly in the SDF

\_\_\_\_\_ Created in the “World Coordinate System” in model space or the Massachusetts State Plane Coordinate System

\_\_\_\_\_ Features added that do not have a layer specified in Table 1 are placed on a separate, unique layer and identified in accompanying documentation

\_\_\_\_\_ Polygons boundaries “close”.

\_\_\_\_\_ Straight lines have been drawn with a continuous line-type represented by only the beginning and ending x- and y-coordinate points. The exception to this is a line developed from multiple traverses on the same bearing where the coordinates differ only in the “z” values.

\_\_\_\_\_ Line strings must not cross back on themselves or have a zero length (i.e., points).

\_\_\_\_\_ Point features are drawn with standard point/node symbols.



## APPENDIX B: PARTICIPANTS IN STANDARD DEVELOPMENT

The individuals listed below participated in the development process either by contributing their expertise on a specific topic (e.g., CADD, Surveying, GIS) or by commenting on drafts of the standard. The presence of a particular individual's name and that of their employer in this Appendix does not necessarily signify an endorsement of this standard. Rather it simply acknowledges their participation in the development process. Without the contributions of these individuals, this standard would not have been possible. The professional positions and affiliations may no longer be current.

### From Cities and Towns

Lien Alpert, GIS Manager, Town of Wellesley  
Shaun Anderson, GIS Coordinator, City of Westfield  
Alf Berry, Town Engineer, Town of Wayland  
Chip Fontaine, Town Engineer, Town of Weymouth  
Kim Honetschlager, GIS Coordinator, Towns of Reading and North Reading  
Jim McGrath, Surveyor, Town of Weymouth  
Mike Olkin, GIS Manager, Town of Amherst  
Jamie Portolese, GIS Coordinator, Town of Weymouth  
Garret Walsh, GIS/CADD Specialist, Town of Weymouth

### From Regional Planning Commissions

John Matley, GIS Manager, Northern Middlesex Council of Governments  
Mike Morin, GIS Analyst, Central Massachusetts Regional Planning Commission  
Jerrard Whitten, GIS Manager, Merrimack Valley Planning Commission

### From GIS Consulting Firms

Steven Anderson, Applied Geographics, Inc.  
Jason Brennen, Camp Dresser McKee  
I-Jen Chen, DesLauriers Municipal Solutions  
Mike Doyle, Chas. H. Sells  
Kevin Flanders, PeopleGIS  
Rajan Nanda, Full Circle Technologies

### From The Massachusetts Association Of Land Surveyors And Civil Engineers

Richard F. Gosselin, Northeast Engineers & Consultants; President, Eastern Mass Chapter  
Wayne Harrison, Cullinan Engineering; President, Central Mass Chapter  
Mark A. Joy, Coastal Engineering; President, Cape Cod Chapter  
Brian E. Koczela, BEK Associates; President, Berkshire Chapter  
Edward O'Brien, Chas. H. Sells; MALSCS GIS committee  
Russ Sackett, Sackett Survey Services, MALSCS GIS Committee  
Mark Violette, Schofield Brothers of New England, MALSCS GIS Committee  
Mary Ann Corcoran, Hill Engineers, Inc.  
John A. Hammer III, MassPort  
Patrick Healey, private surveyor  
David Humphrey, Schofield Brothers of New England  
Bob Staples, DGT Survey Engineering Group  
Paul Gay, private surveyor  
Professor Knud Hermansen, Department of Civil Engineering Technology and Survey Engineering, University of Maine at Orono.