GIS

GEOGRAPHIC INFORMATION SYSTEMS (GIS) STANDARD

Massachusetts Port Authority
May 2019

massport

Geographic Information Systems GIS Standard

Massachusetts Port Authority
May 2019

Prepared by Woolpert, Inc.
4454 Idea Center Blvd
Dayton, OH 45430
www.woolpert.com

This page intentionally left blank

Letter

This page intentionally left blank

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 FOREWORD

The Design Technologies Integration Group (DTIG) of the Massachusetts Port Authority ("MPA" or "Authority") developed this Geographic Information Systems (GIS) Standard for professionals working at MPA. The goal of the Standard is to assure consistency in processes and GIS development, produced at and for the Authority, from MPA's various service providers across multiple types of projects.

This document will be updated regularly and all professionals working on GIS data for MPA should verify they are using the latest version of this document.

1.2 PURPOSE OF THIS DOCUMENT

This GIS Standard document defines the requirements for all GIS work produced at and for the Authority. It specifies the minimum software requirements, data requirements, extract, transfer and load (ETL) tools and processes, metadata, and data submittal requirements for MPA GIS data.

These requirements assume that readers have a basic understanding of GIS concepts and terminology. Readers who are new to the Authority's GIS requirements may wish to review the document in its entirety. Those who are familiar with the requirements may wish to use the document as a reminder of the specifics to which they must adhere.

The content of this manual supersedes all previously published Authority GIS Standard versions and is subject to change without notice. The Authority shall not be liable for errors and omissions in this Standard.

1.3 REFERENCED STANDARDS AND DOCUMENTS

The Authority's GIS Standard is part of other standards with which consultants and Authority staff must comply. These documents can be provided by the Authority Project Manager (PM) and include the following:

- The Authority's BIM Guidelines for Vertical and Horizontal Construction
- The Authority's Site/Civil CAD Standard
- MPA Survey Unit's Survey Control Standards
- Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-16A "General Guidance and Specifications for Aeronautical Surveys: Establishment of Geodetic Control and Submission to the National Geodetic Survey", which can be found at https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_150_5300-16A.pdf
- FAA AC 150/5300-17C "Standards for Using Remote Sensing Technologies in Airport Surveys", which can be found at https://www.faa.gov/documentLibrary/media/Advisory_Circular/150-5300-17C-Chg1.pdf
- FAA AC 150/5300-18B "General Guidance and Specification for Aeronautical Surveys: Airport Survey Data Collection and Geographic Information System Standards", which can be found at https://www.faa.gov/documentLibrary/media/Advisory_Circular/150-5300-18B-chg1-consolidated.pdf
- Sensitive Security Information (SSI), Chapter 49, Section 1520, Code of Federal Regulations (CFR1520), which can be found at https://www.gpo.gov/fdsys/granule/CFR-2010-title49-vol9/CFR-2010-title49-vol9-part1520
- Open Geospatial Consortium's (OGC) Simple Geometry Definitions
- FGDC Data Accuracy Standards

1.4 UPDATE AND REVISION PROCEDURES

The Authority understands and expects that this GIS Standard will be updated over time. Consultants and Authority staff may submit requests for changes. These changes may be clarifications, additions, or deletions. Any proposed changes will not be implemented until approved by the Authority. Approved changes must be implemented before the first datasets of a project are submitted. Change requests shall be submitted by emailing the form provided in Appendix A to DTIG at dtig@massport.com.

1.5 *SOFTWARE REQUIREMENTS*

All GIS Data shall be compatible with Esri Shapefile or Geodatabase Version 10.4. It is the consultant's responsibility to ensure that all requirements defined in this document are met in the data they create and convert from other software, without any loss of quality or accuracy when they are opened in Esri software.

1.6 *RESOURCES*

In order to facilitate the implementation of this Standard, the Authority has created the following information which can be made available to Consultants and Authority Staff.

- Esri File Geodatabase 10.4 schema
- Esri ArcGIS Desktop 10.4 layer files
- Authority GIS data that may be available for the extent of the project area, see Section 5.1.2

This information is only available by request. To request this information, please send an e-mail to the Authority Project Manager (PM) and copy dtig@massport.com stating why this information is necessary, the Authority project number and a file geodatabase feature class named ConstructionArea that has a polygon showing the extent of the basemap area required, see Section 5.1.2. The Authority's GIS data shall only be used as an external reference file and shall not be altered.

2 DATA REQUIREMENTS

2.1 GEOMETRY REQUIREMENTS

All features should be represented as points, lines, or polygons, as defined in OGC's Simple Geometry Definitions and explained below:

- Points shall represent a specific coordinate in three-dimensional space.
- Lines shall represent a line segment (i.e. a straight line between two end points) or polyline (i.e. two or more connected line segments collectively with two end points and one or more vertices in between.
- Polygons shall represent areas enclosed by a polyline between two coincident (i.e. at exactly the same location in three dimensions) end points and two or more vertices in between. No two vertices of the polygon shall have the exact same location in three dimensions.

All geometry is defined by vertices, which represent points, end points, or intermittent vertices (i.e. points in between end-points). All vertices represent a specific coordinate tuple (i.e. X, Y and Z) in three-dimensional space. Each coordinate should be recorded to a tolerance of three decimal places or thousandths of a foot.

2.2 TOPOLOGY RULES

Topology refers to the positional relationship between features. All features are required to meet the following topology rules:

- Collocated Vertices – Collocated vertices must share the same X, Y and Z coordinates.

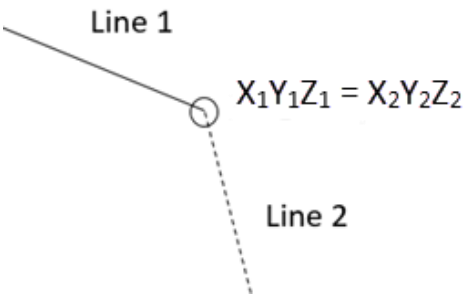

FIGURE 1 - COLLOCATED VERTICES

- Lines Meet at Endpoints – Line segments and polylines that join to represent one continuous string of linear features (e.g., a utility network) should have collocated vertices as endpoints.

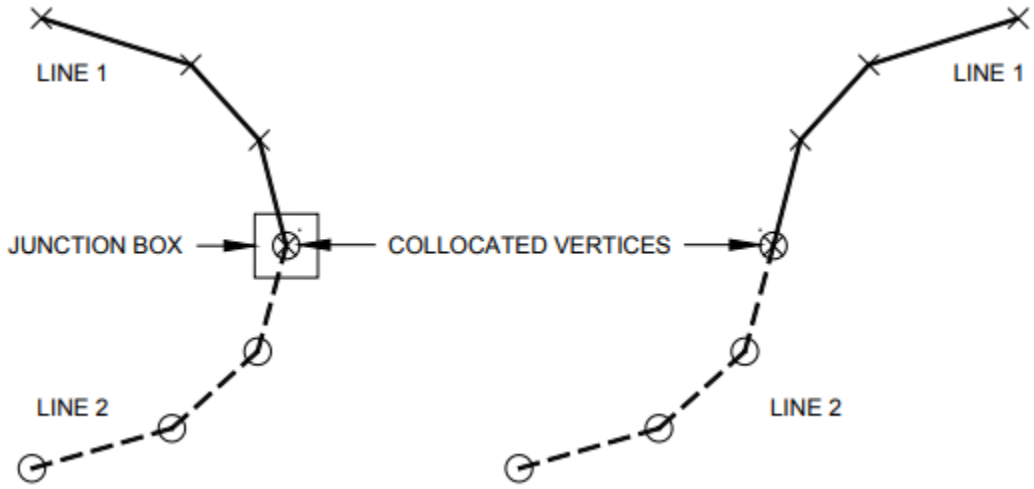

FIGURE 2 - LINES MEETING AT ENDPOINTS (SOURCE: FAA AC150/5300-18B, CHANGE 1)

- Sufficient Density of Vertices – Lines and polygon edges should contain one or more segments with vertices placed at intervals, so the feature does not stray from the actual object it represents by more than half of the defined accuracy limit.

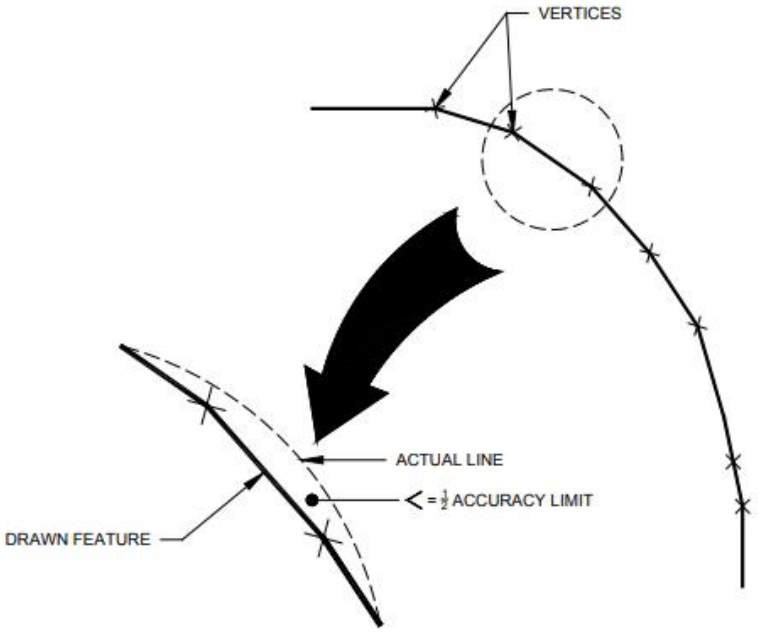

FIGURE 3 - DENSITY OF VERTICES (SOURCE: FAA AC150/5300-18B, CHANGE 1)

- Shared Vertices between Adjacent Features – Features that are intended to be adjacent to one another should share all collocated vertices along their common edge(s). This ensures that there are no unintentional gaps (empty space) or slivers (overlaps) between adjacent features.

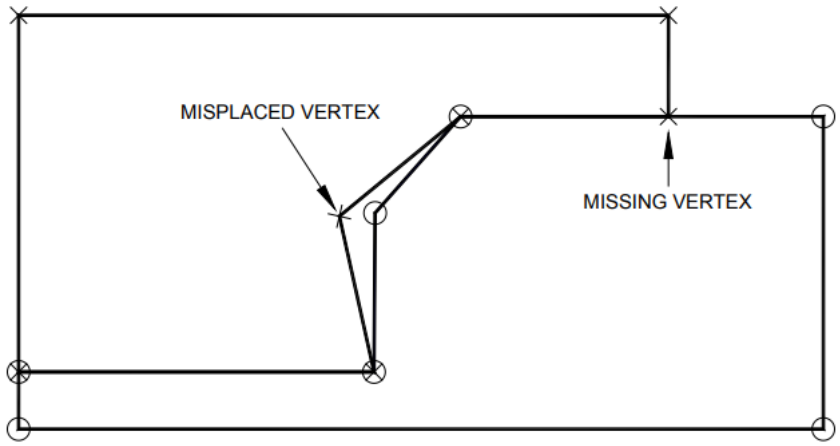

FIGURE 4 - SHARED VERTICES (SOURCE: FAA AC150/5300-18B, CHANGE 1)

- Polygons must be closed – The endpoints of line segments that form a polygon must be collocated and closed.

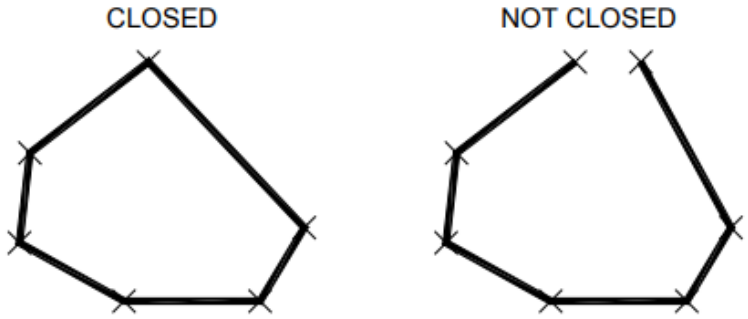

FIGURE 5 - CLOSED POLYGONS (SOURCE: FAA AC150/5300-18B, CHANGE 1)

2.3 COORDINATE SYSTEM & UNITS

The MPA horizontal coordinate system is North American Datum of 1983 (NAD83), Massachusetts State Plane (Zone 2001) US Feet. The EPSG (European Petroleum Survey Group) code for this horizontal coordinate system is 2249:

- Projection: Lambert_Conformal_Conic
- False_Easting: 656166.6666666665
- False_Northing: 2460625.0
- Central_Meridian: -71.5
- Scale_Factor: 1.0
- Latitude_Of_Origin: 41.0

The MPA vertical coordinate system is North American Vertical Datum of 1988 (NAVD88). The EPSG (European Petroleum Survey Group) code for this vertical coordinate system is 6360.

All features located by survey methods shall be based on the 2011 adjustment of NAD83 for horizontal coordinates. All survey grade positions shall derive from source control at the subject facility provided by the MPA Survey Unit. For questions, contact MPA Survey Unit at 617-561-1799.

All units for both horizontal and vertical data will be the U.S. Survey Foot (1,200/3,937 meters).

2.4 ACCURACY

If the Consultant's contract specifies a horizontal and/or vertical positional accuracy, all newly collected objects that represent real-world objects shall be located within the specified tolerance from the real-world object they represent (i.e., absolute positional accuracy). The tolerances specified must be achieved at a 95-percent confidence level, meaning that, statistically, 95 percent or more of the objects will be at this accuracy level or better. Coordinate values shall be recorded to a precision (i.e., number of decimal places in the coordinate value) that is at least sufficient to represent the accuracy level specified.

Prior to any data collection efforts beginning, consultants shall confirm that the accuracy of the collection effort is appropriate to the needs of the Authority's DTIG and Survey unit. The use of sub meter GPS or cellular based efforts are strongly discouraged for spatial data collection.

2.5 SENSITIVITY LEVEL

To keep sensitive airport data secure, this document includes a sensitivity level for each feature class (see Appendix A). Users of the data must be cautious when handling and sharing sensitive data. Some GIS feature classes are Sensitive Security Information (SSI) and must be handled in accordance with 49 CFR 1520.

2.6 COMMON ATTRIBUTES

Table 1 lists the attributes that are common to all feature classes. These attributes are organized by type, such as identifiers, system keys, and metadata. These attributes are required and should be completed within all feature classes.

TABLE 1 - ATTRIBUTES COMMON TO ALL FEATURE CLASSES

ATTRIBUTE	ALIAS	TYPE	LENGTH	DEFINITION
Identifiers				
AssetId	AssetID	String	50	A unique identifier associated with this feature for linking to an asset management system.
FacilityId	FacilityID	String	4	The 4-letter code identifying the facility. See the "MassPortFacilities" domain field in Appendix B for acceptable values.
Attributes				
Name	Name	String	50	Name of the feature.
Description	Description	String	255	Description of the feature.
System Keys				
Guid	Guid	String	40	A globally unique identifier applied to each feature in the database for reference.
Metadata Elements – Feature Tracking				
createdby	CreatedBy	String	255	Field automatically populated by user inputting data. Can also be populated as source provider.
DateCreated	DateCreated	Date	--	Date Field automatically populated when a feature was created in the database.

ATTRIBUTE	ALIAS	TYPE	LENGTH	DEFINITION
LastEditedBy	LastEditedBy	String	255	Field automatically populated by user that edits the geometry or attributes of the feature.
DateLastEdited	DateLastEdited	Date	--	Date Field automatically populated when a feature was created in the database.
Metadata Elements – Additional				
CollectionMethod	CollectionMethod	String	255	The method used to collect the data.
DataSource	DataSource	String	255	Project and/or task the feature is associated with.
DataStartDate	DataStartDate	Date	10	The first date on which the data represented by this feature reflects a current, real world condition.
DataEndDate	DataEndDate	Date	10	The last date on which the data represented by this feature reflects a current, real world condition.
Reference	Reference	String	255	Document/Data the feature came from.
Quality	Quality	String	255	Reliability and accuracy of the feature.
Sensitivity	Sensitivity	String	20	Sensitivity level of the feature.
FileLink	FileLink	String	255	File folder link to the project/task data folder for the feature information.
CAD Layer – Additional				
Layer	Layer	String	255	The CAD Layer the Feature corresponds to in the Authority's CAD Standard.
OldCadLayer	OldCadLayer	String	255	The original CAD Layer (pre-2018) that the feature corresponds to in the Authority's CAD Standard.

2.7 *DATASETS*

MPA uses the Esri geodatabase format to store its GIS data. In a geodatabase, all features are stored in feature classes and multiple feature classes can be stored in feature datasets. Feature Datasets are similar to folders on a hard drive and are used to better organize the data. Note that no two feature classes in a geodatabase can have the same name, regardless of whether or not they are in separate feature datasets. MPA's GIS database is organized into the following feature datasets:

- Basemap_*
- Building_Interior
- Projects
- StateAndLocal
- Utilities_*

2.7.1 *BASEMAP_* FEATURE DATASETS*

The Basemap_* feature datasets contain features specified in FAA's AC 150/5300-18B (18B) along with other MassPort features that are part of the basemap. All feature classes and attributes required by 18B are in these feature datasets. These cover the spectrum of FAA's airport data requirements, including but not limited to runway and stopway data, navigational aid data, obstruction data, and data on various airport features, including taxiways, aprons, and landmark features. Most of this information is source data, acquired by field survey and/or remote sensing methods. These datasets will need to be maintained and updated along with FAA updates to the standards of 18B. The following feature datasets are included:

- Basemap_Airfield
- Basemap_Airspace
- Basemap_Cadastral
- Basemap_Environmental
- Basemap_Geodetic
- Basemap_Navigational_Aids
- Basemap_SeaPlane
- Basemap_Security
- Basemap_Structures
- Basemap_Surface_Transportation
- Basemap_Maritime – This feature contains no FAA features or data

NOTE: For FAA submittals features will need to utilize ETL tools to convert basemap features to required FAA features for submittal. For example, BarrierLine will need its name changed to Fence, CodeBridgeType Domain values ENHANCED ROAD and RAMP will need to be changed to ROAD, CodeSegmentType Domain will need BOAT value changed to CONNECTING. Additionally, Utility Feature Datasets below will need to be converted to UtilityPoint, UtilityLine, and UtilityPolygon.

2.7.2 *PROJECTS*

The Projects feature dataset is based on current MPA managed GIS Data. The features consist of Location Codes, Survey Project Boundaries, Project Limits, and Project Cranes. These features are utilized for MPA to visualize and manage current projects and project data at MPA Facilities.

2.7.3 *STATEANDLOCAL FEATURE DATASET*

The StateAndLocal feature dataset contains data that is collected and distributed by others through the MassGIS Data Portal or obtained from other entities and that are needed for airport basemaps or additional analysis.

2.7.4 *UTILITIES_* FEATURE DATASETS*

The Utilities_* feature datasets are based on the latest Esri Utility Network Configurations. The Esri utility networks now contain five key features (Assembly, Device, Junction, Line, and SubnetLine) and utilize domains and subtypes to attribute features correctly. Using this data model allows MPA to take advantage of the robust schema and tools Esri has developed to edit and monitor its utility network. The following feature datasets are included:

- Utilities_Electric
- Utilities_Fuel
- Utilities_Gas
- Utilities_Sewer
- Utilities_Stormwater
- Utilities_Structure
- Utilities_Water

NOTE: At the time of this writing, Esri is still finalizing the Utility Network schemas and the intention is to have one utility dataset that will contain Domain Networks that can interact with each other. The estimated date for finalization is the Summer of 2019. Below is an example of a Utility Network with multiple domains.

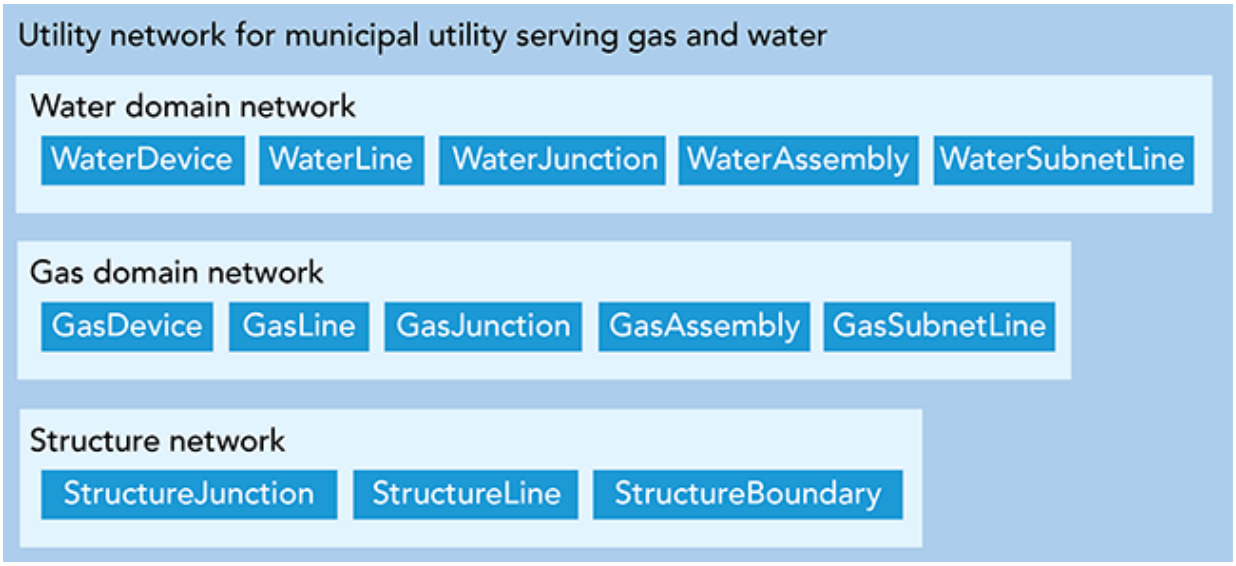

FIGURE 6 - UTILITY NETWORK EXAMPLE

- Utilities_Telecom
- Utilities_Steam

The Utilities_Telecom feature dataset is based off the old Esri Utility Network Configuration, since the new Telecommunication data model will not be available until late 2019 or early 2020. The Utilities_Steam feature dataset was created from industry standards and diagrams along with the MPA CAD Standards.

This page intentionally left blank

3 EXTRACT, TRANSFER, AND LOAD (ETL)

3.1 ETL TOOLS AND PROCESSES

An ETL process and related tools will be utilized to keep the spatial data in BIM, CAD, and GIS up-to-date. The ETL process and tools will consist of the following:

- ETL Process document describing the process to convert and maintain data, along with a timeline for how often data is updated and who is responsible for updating the data.
- ETL Tools that can automate the data conversion process from GIS, CAD, and BIM deliverables for spatial data and most attributes.
- Administration Guidelines for maintaining the process document and keeping the ETL tools up to date as current and concise as possible.

3.2 CROSSWALK DOCUMENT

A crosswalk document describes how the CAD layers and GIS feature classes are translated between each other. CAD uses layer names and object data while GIS uses feature classes with attribution. The CAD crosswalk document details how the CAD layers correspond to the feature classes and how the CAD object data corresponds to the GIS attribution. This document will be maintained for and used by the ETL tools and processes.

This page intentionally left blank

4 METADATA

Metadata is information about the data itself. Metadata typically contains information such as how the data was created, when it was created, its accuracy, what it represents, its attributes, etc. Having accurate metadata helps ensure that users use the data appropriately.

Metadata can be stored in various ways and at various levels. It can be specific to an individual feature or about an entire feature class. When specific to an entire feature class, it typically follows a well-known standard, such as ISO or FGDC, and is structured into multiple sections detailing the how, what, when, where, and who of the data. Feature-specific metadata is stored at the feature level. In the case of MPA, feature-specific metadata is stored as attributes. Table 1 contains the metadata attributes that are common to all MPA feature classes. Table 2 details the metadata information that should be provided to MPA, along with the data format and level. Note that some of the elements listed in this table may not be required for every project. For example, a FAA Airports GIS data development project has additional requirements.

TABLE 2 - METADATA SUBMISSION REQUIREMENTS

Element	Description	Form	Level
Project Number	The MPA, TAA, or Survey project number associated with the task.	PDF Document	Project
Project Extent	The geographic extent of the data collected by this project.	Feature Class	Project
List of Feature Classes and Attributes	A tabular list of feature classes and attributes that conform to these MPA data standards that indicates which features and attributes will be developed and adds additional comments or caveats related to each.	XLS Spreadsheet	Project
FAA Statement of Work	The statement of work required by the FAA at the beginning of an Airports GIS data development project (see AC150/5300-16).	PDF Document	Project
FAA Geodetic Control Plan	The Geodetic Control Plan required by the FAA at the beginning of an Airports GIS data development project (see AC150/5300-16 & 18)	PDF Document	Project
FAA Remote Sensing Plan	The Remote Sensing Plan required by the FAA at the beginning of an Airports GIS data development project (see AC150/5300-17)	PDF Document	Project
FAA Survey & Quality Control Plan	The Survey & Quality Control Plan required by the FAA at the beginning of an Airports GIS data development project (see AC150/5300-18)	PDF Document	Project
FAA Final Project Report	The final report document required by the FAA at the end of an Airports GIS data development project (see AC150/5300-18).	PDF Document & ZIP	Project
Tested Vertical Accuracy	The vertical positional accuracy of project data at the 95% confidence level of the data as determined by tests described in the FGDC's National Standard for Spatial Data	PDF Document	Project
Data Source	The organization that developed the data	Attribute	Feature

Element	Description	Form	Level
Sensitivity	The sensitivity level of the data from a security perspective, which defines how the data should be handled and distributed.	Attribute	Feature
Collection Method	The method used to collect the data	Attribute	Feature
Quality	The absolute horizontal positional accuracy at the 95% confidence level of the data as determined by tests described in the FGDC's National Standard for Spatial Data	Attribute	Feature
Data Start Date	The earliest date that the data is known to reflect actual conditions	Attribute	Feature
Data End Date	The latest date that the data is known to reflect actual conditions	Attribute	Feature

5 DATA SUBMITTAL

If an MPA project requires GIS data to be delivered, it must follow the requirements listed below.

5.1 DELIVERABLES

5.1.1 SPREADSHEET OF FEATURE CLASSES AND ATTRIBUTES

At the start of a project, an Excel spreadsheet listing the GIS feature classes, along with attributes that will be populated, shall be provided to MPA. All feature classes and attributes shall follow the standard defined in this document.

5.1.2 EXTENT OF PROJECT AREA

At the start of a project, a map showing the extent of the project area shall be provided to MPA. The project extent shall be stored in a ConstructionArea polygon feature class in an Esri file geodatabase. Attributes for the ConstructionArea feature class shall be populated. See Appendix A for details. At minimum, the projectName field should be populated with the Project or Task Title. The name field should be populated with the MPA assigned project or task number. The coordinating Contact field should include the individual's name, company name, and direct phone number for the primary point of contact for this project.

To request the Authority's data for a specific project area, see Section 1.6.

It is the responsibility of the consultant or contractor to provide this information for MPA review and approval before work commences. Once approved, the matrix of feature classes and attributes, matrix of data requirements, mapped project extent, and associated limitations, restrictions, and deviations will be attached to the scope of work and become a binding requirement of the contract or agreement.

5.1.3 GIS DATA FORMAT

Once the GIS data is complete and has been verified to ensure it complies with this Standard, it shall be submitted to MPA in a file geodatabase format following the data model detailed in Appendix A.

5.2 DATA TO BE SUBMITTED TO THE FAA

This section pertains to projects requiring data to be submitted to the FAA.

5.2.1 GIS DATA FORMAT

If data must be submitted to the FAA Airports GIS (AGIS), it must be provided in Esri shapefile format complying with FAA AC 150/5300-18b. Shapefiles must be uploaded to the AGIS website in a ZIP file format. Consultants who are authorized FAA Airports GIS users should run their data through the AGIS website and resolve all critical errors, unless there is a valid explanation for an error.

Where required by the FAA, the consultant shall prepare a project final report and supporting data as defined in AC150/5300-18B and supporting documentation published by the FAA and NGS. The designated Airport Sponsor at MPA will perform the final upload of the data to the FAA Airports GIS site or the designated Airport Sponsor can delegate this task to a consultant if they should choose to on a project by project basis.

5.2.2 LIST OF PROJECT TYPES

If FAA data is required, a spreadsheet that lists which type of project(s) (as defined by the columns in Table 2-1 of FAA AC 150/5300-18B) will be carried out by the Consultant and which of the data requirements (identified as rows in this table) are applicable. Comments or notes should be added to indicate where requirements will be partially satisfied based on the scope of the project and where the requirement will be met by data provided from another project. Any limitations, restrictions, deviation from FAA requirements, or assumptions shall be listed as a part of this matrix.

5.2.3 *SUPPORTING DOCUMENTATION*

If data is to be submitted to AGIS as specified in the scope of work, additional documents including an FAA Statement of Work, Remote Sensing Plan, Survey & Quality Control Plan, Geodetic Survey Plan, and Final Report along with supporting data will also be required.

APPENDIX A – DATA DICTIONARY

The following information lists the specifications for each feature class. It is important that these specifications are followed to ensure data integrity. Please refer to the supplemental Appendcies.xlsx for the data dictionary.

This page intentionally left blank

APPENDIX B - DOMAIN VALUES

The tables in this appendix are acceptable domain values within the Massport geodatabase. For these fields it is intended for these items to enforce hard constraints, ensuring data integrity. Please refer to the supplemental Appendcies.xlsx for the domain values.

This page intentionally left blank

APPENDIX C – UTILITY NETWORK ASSETS

The tables in this appendix describe what Asset groups are available for features utilizing Esri's utility network. Asset types are features implemented within Asset group classifications through attribute domains. The Asset Groups and Types enforce hard constraints, ensuring data integrity for the Electric, Water, Sewer, Stormwater, Gas, and Fuel Utility Networks. Please refer to the supplemental Appendcies.xlsx for the Utility Network Assets.

This page intentionally left blank

APPENDIX D - CHANGE REQUEST FORM

The form on the following page shall be used by airport staff or consultants that wish to propose a change to this standard. One form shall be used for each change requested, although similar changes to a series of layers or attributes can be provided on one form. A thorough description of why the existing standard does not accommodate a need should be provided. Additional pages can be submitted along with each form.

Completed forms shall be emailed to MPA at with "Requested Change to GIS Standard" in the subject line. Requested changes will be evaluated by MPA stakeholders. The result of this evaluation will be communicated via a response to the request email. Approved changes may be implemented by data developers upon receipt of this email. Approved changes will be reflected in subsequent versions of this document.

Completed forms shall be emailed to MPA at with "Requested Change to GIS Standard" in the subject line. Requested changes will be evaluated by MPA stakeholders. The result of this evaluation will be communicated via a response to the request email. Approved changes may be implemented by data developers upon receipt of this email. Approved changes will be reflected in subsequent versions of this document.

Requested Change to MPA GIS Standards

Date:

From:

Requestor	
Company/Department	
Phone	

To: Design Technologies Integration Group (DTIG), Massachusetts Port Authority (MPA)

Attention: GIS Data Coordinator

MPA GIS Standard:

Section		Sub-Section	
Page		Subject	

Justification for Change:

Existing Provisions are:

	Incomplete		Inaccurate		Redundant
	Conflicting		Obsolete		Other:

Staff Name/Title		Date	
Disapproved		Approved	
Reason for Disapproval			

Detailed Justification:

Description of Change:

Reviewed By:

APPENDIX E – GLOSSARY

Term	Definition
Feature	A Feature is a cartographic point, line or polygon object which is a representation of a real-world object on a map. GIS features have "spatial" information such as location, length, area, elevation, etc.
Feature Class	A feature class, often called a layer, contains geographic features that have the same geometry (point, line, polygon), attributes, and spatial reference.
Table	A GIS table contains tabular information organized in rows and columns. A column represents a certain type of attribute while a row represents a different item. A table does not contain geometry (point/line/polygon). This is not to be confused with the more standard definition of a table, which could contain geographic information.
Attributes	Attributes are description information about a feature in a GIS. Attribute data is typically not geographical or spatial in nature but provides descriptive information about the feature itself.
Domain	A domain defines and limits each distinct attribute value allowed to be entered in as data for each feature. This limitation reduces the amount of error in entering data by enforcing hard data constraints and ensuring data integrity.
Geodatabase	A geodatabase refers to a database that stores geographic data. A geodatabase holds a number of objects, including features, feature classes, tables, attributes and domains.
Data Dictionary	Information describing the contents, format and structure of a database containing details on the data format, relationships, meaning, source and usage.
ETL	Short for Extract, Transform and Load. Extract is the process of reading data from a database. Transform is the process of converting data from one form to another to be placed into another database. Load is the process of writing the target data into the database.
Layer	Mechanism to display geographic data that references a dataset and specifies how it is portrayed using symbols, colors and text labels.
Schema	A model for storing geospatial attribute data that uses simple tables and well-defined attribute, domains, rules, and relationships.

This page intentionally left blank

GEOGRAPHIC INFORMATION SYSTEMS (GIS) STANDARD

Massachusetts Port Authority

May 2019