CORPORATE GIS STANDARDS
SPATIAL DATA

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I. Introduction

A. Purpose

Compliance with the GIS Spatial Data Standards will facilitate data sharing, integration, and compatibility within the GIS System. The objective of these standards is to provide guidelines for spatial data development within the City and County of Denver and for contractors thereof.

B. Reference

It is the responsibility of the user to ensure the most recent version of the Spatial Data Standards is referenced. The most recent version for all Corporate GIS Standards can be found on the intranet at http://mydenver, Agencies tab, Public Works DenverGIS option, Standards webpage. Inquiries should be directed to:

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II. Spatial Reference Information

A. Projection: Lambert Conformal Conic

B. Geographic Coordinate System

* Projection Colorado State Plane
* Fipszone 502
* Units US Survey Feet
* Horizontal Datum 83/92 (HPGN - High Accuracy Reference Network)
* Vertical Datum NAVD88
* Spheroid GRS1980

Ground survey data must have State Plane equivalent coordinates for all points.

III. Creation and Capture

All new data layers must follow the submittal requirements for Spatial Data outlined in this document.

A. Base Layers

Existing Corporate SDE data layers and Aerial Orthophotography should be used as references for the development of new data layers when appropriate.

Base layers include the following:
* April 2000 aerial photography with 6 inch resolution
* Lots
* Parcels
* Streets
* Survey Control

B. Field Collection

* Data collected in the field using GPS should follow the Spatial Reference Information as defined in Section II of this document. If latitude/longitude must be used, at least 10 significant digits must be collected using decimal degrees.
* Complete data collection documentation will be submitted and will include coordinate offsets when applicable.

Associated Standards:
Metadata Standards

IV. Delivery Formats

A. Coverages

Coverages are vector datasets depicting points, lines, polygons, regions, or routes.

1. Processing Tolerances – Coordinate Precision

Double Precision preserves up to 15 significant digits, while Single Precision preserves up to 7 significant digits. The precision of coordinates and attributes should be adequate to accurately represent the location and values of the data in question. They should also be standardized among datasets. Corporate GIS uses Double Precision. All data submitted to the Corporate GIS must meet the Spatial Reference Information as defined in Section II. Decimal Degrees are preferred over Degrees/Minutes/Seconds for the capture and storage of data because they are easier to calculate and convert into GIS coordinates. If decimal degrees are used they must be gathered at a minimum of 10 significant digits in order to maintain accuracy of less than one unit. ArcInfo coverages maintained using decimal degrees must have Double Precision. The following tolerances must be followed for all coverage datasets submitted to the Corporate GIS:

* Double Precision
* Fuzzy Tolerance 0.0001
* Dangle Tolerance 0.0
* Tic_Match 0.0
* Edit 0.5
* NodeSnap 0.0001
* Weed 0.5
* Grain 0.5
* Snap 0.5

2. Topology

Nodes or polygons must be present in an ArcInfo coverage in order to create topology. Topology can be built for any vector spatial data type and certain data conditions will prevent topology from being built without corrective editing. Topology allows GIS professionals to answer questions about adjacency, connectivity, proximity, and coincidence. Therefore topology is necessary for all polygonal and linear data sets submitted to the Corporate GIS. Identifying the potential uses of datasets will help determine which topological relationships are required for error checking, advanced analysis, and the associations maintained within datasets.

To create and maintain coverage topology, the following must be met:
* Correct arc directionality must be maintained on streets, facility data, and any dataset with flow.
* Polygons must close without overshoots or undershoots.
* Pseudo nodes must only exist where 1) a line closes on itself 2) only two lines intersect 3) there is a change in attribution along a line 4) to maintain the shape and measurements of an arc.
* Lines, polygons, points and annotation must not be duplicated.
* Streets and facility data do not break at overpasses and underpasses.
* There is a maximum of 500 vertices per arc limit with ArcInfo software.
* Polygons must have only one label per feature.
* Polygons must edge match without slivers.
* Polygons must not overlap

Associated References:
http://www.esri.com/news/arcuser/0401/topo.html

3. Delivery Formats

* All coverages must contain a projection (prj.adf) file and follow the naming convention, precision, topology, and spatial reference standards for spatial data outlined in this document. They must have a spatial index, and be accompanied by Metadata.

* e00 - All ArcInfo export files must be non-compressed and the platform in which the file was generated must be documented.

Associated Standards:
Metadata Standards

4. Entity Naming

a) File and Layer Naming

File naming standards enable translation between data formats while ensuring that names are valid for each particular format.

* File names will contain only alphanumeric characters (i.e. letters, numbers)
* File names will start with a letter
* File names will be entirely in lowercase
* No spaces, dashes, underscores or special characters will be used
* File names will be 10 characters or less
* Common abbreviations should be used where applicable

Refer to Appendix A for a list of Common Abbreviations.

b) Attribute Item and Field Naming

Attribute item and field naming standards enable translation between data formats without truncation or conflicts.

* Item names will contain only alphanumeric characters (letters and numbers) and underscores
* Item names must start with a letter
* No spaces, dashes or special characters will be used
* Item names will be 10 characters or less
* Common abbreviations should be used where applicable

Refer to Appendix A for a list of Common Abbreviations.

* To insure successful SDE data loading, item and attribute names must not contain Oracle Reserved Words. The Oracle Reserved Word List can be found on the mydenver intranet site, under the Agencies tab, Public Works Denver GIS option, Standards webpage, Oracle Reserved Word List. If layers contain items or attributes matching any of the words in the Oracle Reserved Word List, they must be changed to a non-Oracle reserved word before being submitted to the Corporate GIS.
* Addresses will not be duplicated (i.e. two or more point, arc, or polygon features must not have the same street name, street number, and unit number or the same street name and address range).

B. Shapefiles

1. Processing Tolerances – Coordinate Precision

Tolerances for shapefiles will be applied by the Corporate GIS as defined in Section IV.A.1.

2. Topology

No formal topology exists within shapefiles. Even so, there are scripts that can be executed in ArcView to help identify overlapping, duplicate, sliver, and multipart polygons. These scripts can be downloaded from http://arcscripts.esri.com. Perform a search fro keyword "Topology" and look for the following scripts: Digitizing QA Tools and Shape Check v. 1.5. Please note that the Shape Check script is limited to polygons with 200 or fewer nodes. Help documents for each script are included with the downloads.

Refer to Section IV.A.2 of this document for detailed Topology standards.

3. Delivery Formats

All shapefiles must follow the naming convention, precision, topology, and spatial reference standards as defined in this document. They must have a spatial index and be accompanied by Metadata.

When submitting a shapefile to the Corporate GIS the following files must always be included: .SHP, .SHX, and .DBF. When applicable, the .SBN and .SBX should also be included. If there is an ArcView Legend file (.AVL) that is to accompany the shapefile, it should be included as well.

Associated Standards:
Metadata Standards

4. Entity Naming

a) File and Layer Naming

Refer to Section IV.4.a for File and Layer Naming standards.

b) Attribute Item and Field Naming

Refer to Section IV.4.b for Attribute Item and Field Naming standards.

C. Geodatabases

1. Processing Tolerances – Coordinate Precision

Refer to Section IV.A.1 for the Processing Tolerances Standards.

2. Topology

In geodatabase topology, the responsibility for maintaining topologically correct features falls on the user. This offers a more flexible environment than coverage topology. It also offers the ability to define and apply a wider set of integrity rules and constraints than is possible when using coverages. Topology in the geodatabase is supported in ArcEditor 8.3, ArcInfo 8.3, and later versions.

If topology has been assigned to a geodatabase submitted to the Corporate GIS, detailed definitions of the assigned topology rules must be submitted as well.

To ensure data integrity in the geodatabase, refer to Section IV.A.2 of this document for additional Topology Standards.

Associated References:
The URL below links to an informative ESRI White Paper describing geodatabase topology.
http://downloads.esri.com/support/whitepapers/ao_/geodatabase-topology.pdf.

3. Delivery Formats

* All geodatabases must follow the naming convention, precision, topology, and spatial reference standards outlined in this document. They must have a spatial index, and be accompanied by Metadata.
* Personal geodatabases and SDE geodatabases can be submitted to the Corporate GIS.

Associated Standards:
Metadata Standards

4. Entity Naming

a) File and Layer Naming

Refer to Section IV.4.a for File and Layer Naming Standards.

b) Attribute Item and Field Naming

Refer to Section IV.4.b for Attribute Item and Field Naming Standards.

D. DXF Files

1. Processing Tolerances – Coordinate Precision

* All layers must be projected as defined in 38-52-102 of the Colorado Revised Statutes; the Colorado Coordinate System of 1983 Central Zone; further defined as a Lambert Conformal Conic Projection of the North American Datum of 1983.
* Non-geographic elements such as drawing borders, title blocks, north arrows, detail drawings, and title sheets shall not be included in DXF export files or shall be placed on Layer 0.
* All blocks shall be exploded prior to creation of DXF file.
* The "16 decimal places" option must be specified during the DXFOUT ("Save As" from the pull down menu) command. This will preserve double precision accuracy.
* DXF files must be saved in AutoCAD version r14 or later.
* An ASCII file listing individual layer names with descriptions shall be submitted in conjunction with each DXF file. The ASCII file shall conform to all naming convention standards, and have a .txt extension.

2. Topology

DXF files submitted to the Corporate GIS must follow the Public Works Development Engineering Services' Electronic Review Standards.

a) Annotation Requirements

* All annotation must use True Type Fonts.
* Universal font type shall be used and it shall be bolded.
* Layers: Annotation for each layer shall be placed in separate annotation layers.
* Width factors shall be 100 (100% of normal width) for all text.

All features submitted in AutoCAD (DXF) format must be free of symbology (text, symbols) that breaks line continuity.

Associated Standards:
PWDES Electronic Review Standards:
http://198.202.202.66/City_Engineering/template32467.asp.
Wastewater Management Division's AutoCAD standards:
http://www.denvergov.org/wmddesign/6169510template3jump.asp

3. Delivery Formats

All AutoCAD files will be submitted as a .DXF file.

4. Entity Naming

a) File and Layer Naming

Refer to Section IV.4.a for File and Layer Naming Standards.

b) Attribute Item and Field Naming

Refer to Section IV.4.b for Attribute Item and Field Naming Standards.

Associated References:
Refer to Appendix A for Common Abbreviations to be used in naming schemes.

V. Raster Data

A. Georeferenced Aerial Photography and Imagery Formats

MrSID - Images must be Version MG2
Image Catalogs – Submitted as .DBF or as an Embedded Raster Catalog if it is to be loaded into ArcIMS
JPEG – Must be accompanied by World File (JFW)
TIFF 4.0 – Must be accompanied by World File (TFW)

B. Digital Elevation Models (DEM) and Digital Terrain Models (DTM)

e00, GRID, or TIN
Must be accompanied by all ASCII source files

All elevation points submitted shall be delivered in a single, comma-delimited ASCII file. Each line of the file shall contain values in Colorado State Plane coordinates for a single point as follows:

Northing, Easting, Elevation
1672401.84, 3123140.72, 5324.23
1672534.15, 3123151.72, 5303.73
1672401.84, 3123163.72, 5297.29

C. Scanned Documents and Images (non-georeferenced)

Refer to Document Imaging Standards.

APPENDIX A

Common Abbreviations

Consistent usage of acronyms and abbreviations are encouraged. They should be used where applicable.

DIM	Dimension
ROW	Right-of-way
DIV	Division
NUM	Number
IDX	Index
TRS	Township, range, section
BLK	Block
DESC	Description
SUB_NAME	Subdivision
CIRC	Circle
PNT	Point
DIST	District
SECT	Section
COMM	Commercial
RES	Residential
APT	Apartment
BND	Boundary
CNTY	City and County
IMG	Image Name
QTR	Quarter