Appendix: Configuring Spatial Data for the StateMod GUI

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1. Overview

This appendix describes how to configure the spatial data files for the StateMod GUI. Files that are configured according to current standards will be consistent with the **GeoView Mapping Tools Appendix**. The following section describes the current conventions for spatial data. A later section discusses how to update old files to new conventions.

2. Current StateMod Spatial Data Conventions

The current spatial data conventions for the StateMod GUI allow for flexible use of spatial data, integration with StateMod data files, and continued enhancement of the software.

The spatial data are controlled by a GeoView Project File (**.gvp*), which is specified in the free-format StateMod response file using the `GeographicInformation` property. The **GeoView Mapping Tools Appendix** provides a detailed explanation of the *gvp* file, which can be edited with a text editor. Currently the StateMod GUI does not provide capabilities to configure the file and a text editor is the only approach. The *gvp* file is the same format used in other CDSS tools, including StateView and TSTool. In fact, any of these tools can open *gvp* files created for the different applications. However, in practice, the files cannot often be shared because they have different purposes (e.g., StateMod GIS files contain features that are not present in the general data used with StateView). Ideally the spatial data that are displayed in the various CDSS software programs should use common symbols, but this may not be practical.

The following *.gvp* file from the Rio Grande Decision Support System (RGDSS) StateMod data set illustrates the format of the file. No firm standard has been put in place for the naming of gvp files, especially because there may be several StateMod response files as part of a StateMod data set. A rough guideline is to use the data set base name followed by *_StateMod.gvp* as the GeoView Project file name (e.g., *rgTW_StateMod.gvp*). Another guideline is to place all spatial data in a *gis* directory under the StateMod data set directory and place the *gvp* file in the *gis* directory. Sharing spatial data for modeling between StateMod, StateCU, and other software minimizes redundant.

```
# GeoView project file for Rio Grande basin.

# Main GeoView properties.

[GeoView]

# Main home for data
# If a directory is not specified, the directory will be determined when the
# GeoView project file is selected.
#GeoDataHome = "C:\cdss\statemod\data\rgtwday\gis"
# ArcView/ArcExplorer Default...
#SelectColor = Yellow
# Arc 8...
#SelectColor = Cyan
# All-purpose (magenta/pink)
SelectColor = "255,120,255"
MaximumExtent = "266400,4090475 503060,4260700"
```

```
# Now list the layer views.  A layer view consists of specifying a data layer
# (e.g., shapefile) and view information (e.g., symbol).  This is equivalent to
# the ESRI "theme" concept.  The layers specified first are drawn on the bottom.
# Start with number 1 and increase the layer number sequentially as layers are
# added on top.
#
# Important properties are:
#
# GeoLayer - file name for layer data
# Name - Name to show in legend
# SkipLayerView - if true, don't display (but keep in file to maintain layer
#                 numbering)
# AppLayerType - this is "hardcoded" in software to allow recognition in
#                 specific displays.  The value is "softcoded" here to
#                 allow flexibility.
# AppJoinField - attribute field(s) in the GIS data that are used to link to
#                 the StateMod data.  The number of fields must match what
#                 is needed for the AppLayerType (e.g., diversions
#                 require a wd,id).

[GeoLayerView 1]
GeoLayer = div3_districts.shp
Name = "Water Districts"
# tan
Color = "255,240,190"
OutlineColor = black
ReferenceLayer = true
AppLayerType = "BaseLayer"

# The following layer is currently skipped.  It can be turned on.  Additional
# classification/symbolization is being implemented.
[GeoLayerView 2]
SkipLayerView = true
GeoLayer = div3_irrig.shp
#Name = "Irrigated Parcels"
Name = "Crops"
AppLayerType = "BaseLayer"
# Draw as single color...
#SymbolClassification = "Single"
# Green
#Color = "0,255,0"
# black
OutlineColor = "0,0,0"
# ---- OR draw as unique values -----------
#SymbolClassification = "UniqueValues"
#SymbolClassField = "wd"
#Color = "red;blue;green;yellow;pink;cyan;orange;magenta"
# ---- OR draw as class breaks -----------
SymbolClassification = "ClassBreaks"
#ColorTable  = "Custom;3;red;green;blue"
ColorTable = "YellowToRed,10"
#ColorTable = "BlueToCyan,10"
#SymbolClassField = "wd"
#SymbolClassBreaks = "20,22,24,26,30"
# Try acres for testing
SymbolClassField = "ACREAGE"
SymbolClassBreaks = "1,10,20,40,100,150,200,300,400,500"

[GeoLayerView 3]
GeoLayer = div3_lakes.shp
#GeoLayer = div3_lakes.shp
Name = "Lakes"
```

```
# - blue
Color = "165,250,254"
OutlineColor = "0,130,254"
AppLayerType = "BaseLayer"

[GeoLayerView 4]
Name = "Rivers"
GeoLayer = div3_rivers.shp
#GeoLayer = div3_rivers.shp
# RGB - blue
Color = "0,188,253"
AppLayerType = "BaseLayer"

[GeoLayerView 5]
GeoLayer = div3_highways.shp
Name = "Roads and Highways"
Color = "255,0,0"
AppLayerType = "BaseLayer"

[GeoLayerView 6]
GeoLayer = div3_cities.shp
Name = "Cities and Towns"
SymbolStyle = "Square-Filled"
SymbolSize = 6
Color = "red"
LabelField = "Name"
LabelPosition = RightCenter
AppLayerType = "BaseLayer"

[GeoLayerView 7]
#SkipLayerView = true
GeoLayer = rgtw_user_well.shp
Name = "Wells (WDID)"
# brown
Color = "164,134,77"
SymbolStyle = "Square-Filled"
SymbolSize = 6
AppLayerType = "Well"
AppJoinField = "ID_LABEL"

[GeoLayerView 8]
#SkipLayerView = true
GeoLayer = rgtw_user_dw.shp
Name = "Div & Well (Other)"
# brown
Color = "164,134,77"
SymbolStyle = "Square-Filled"
SymbolSize = 6
AppLayerType = "DiversionWell"
AppJoinField = "ID_LABEL"

[GeoLayerView 9]
#SkipLayerView = true
GeoLayer = rgtw_dw.shp
Name = "Div & Well (WDID)"
# brown
Color = "164,134,77"
SymbolStyle = "Square-Filled"
SymbolSize = 6
AppLayerType = "DiversionWell"
AppJoinField = "ID_LABEL_6"

[GeoLayerView 10]
```

```
#SkipLayerView = true
GeoLayer = rgtw_user_other.shp
Name = "Diversions (Other)"
# Green
Color = "0,255,0"
SymbolStyle = "Square-Filled"
SymbolSize = 4
AppLayerType = "Diversion"
AppJoinField = "ID_LABEL"

[GeoLayerView 11]
#SkipLayerView = true
GeoLayer = rgtw_user_div.shp
Name = "Aggregate Diversions"
# Green
Color = "0,255,0"
SymbolStyle = "Square-Filled"
SymbolSize = 4
AppLayerType = "Diversion"
AppJoinField = "ID_LABEL"

[GeoLayerView 12]
#SkipLayerView = true
GeoLayer = div3_diversions_2001-10-24.shp
Name = "Diversions (WDID)"
# green
Color = "0,255,0"
SymbolStyle = "Square-Filled"
SymbolSize = 4
AppLayerType = "Diversion"
AppJoinField = "ID_LABEL_6"

[GeoLayerView 13]
#SkipLayerView = true
GeoLayer = outco_flowstations_2000-06-02.shp
Name = "Stream Gages (Outside-CO)"
# orange
Color = "254,167,0"
SymbolStyle = "Circle-Filled"
SymbolSize = 6
AppLayerType = "Streamflow"
AppJoinField = "STATION_ID"
#LabelField = "STATION_NA, STATION_NA"
#LabelFormat = "%s, %s"

[GeoLayerView 14]
#SkipLayerView = true
GeoLayer = rgtw_user_gage.shp
Name = "Stream Gages (Other)"
# orange
Color = "254,167,0"
SymbolStyle = "Circle-Filled"
SymbolSize = 6
AppLayerType = "Streamflow"
AppJoinField = "ID_LABEL"
#LabelField = "STATION_NA, STATION_NA"
#LabelFormat = "%s, %s"

[GeoLayerView 15]
#SkipLayerView = true
GeoLayer = div3_flowstations_2001-10-24.shp
Name = "Stream Gages"
# orange
```

```
Color = "254,167,0"
SymbolStyle = "Circle-Filled"
SymbolSize = 6
AppLayerType = "Streamflow"
AppJoinField = "STATION_ID"
#LabelField = "STATION_NA, STATION_NA"
#LabelFormat = "%s, %s"

[GeoLayerView 16]
#SkipLayerView = true
GeoLayer = rgtw_user_mf.shp
Name = "Instream Flow"
# RGB 255 0 0 - red
Color = "0xFF0000"
SymbolStyle = "InstreamFlow"
SymbolSize = 6
AppLayerType = "InstreamFlow"
AppJoinField = "ID_LABEL"
#LabelField = "ID_LABEL"
#LabelFormat = "%s"

[GeoLayerView 17]
#SkipLayerView = true
GeoLayer = rgtw_user_res.shp
Name = "Reservoirs (Other)"
# black
Color = "black"
SymbolStyle = "Triangle-Up-Filled"
SymbolSize = 6
AppLayerType = "Reservoir"
AppJoinField = "ID_LABEL"

[GeoLayerView 18]
#SkipLayerView = true
GeoLayer = div3_reservoirs_2001-10-24.shp
Name = "Reservoirs (WDID)"
# black
Color = "black"
SymbolStyle = "Triangle-Up-Filled"
SymbolSize = 6
AppLayerType = "Reservoir"
AppJoinField = "ID_LABEL_6"
```

The example *gvp* file shown above illustrates several important points (see the **GeoView Mapping Tools Appendix** for detailed information on the properties in the file):

- Comments are allowed anywhere in the file using lines that start with `#`.
- The main sections of the file are indicated by using the [Section] notation. In particular, the `[GeoView]` and `[GeoLayerView N]` section headings are important. The first specifies global properties for the map and the second indicates properties for a layer on the map.
- The numbers in the `[GeoLayerView N]` sections should be consecutive, starting with `1`. If a break is detected, layers numbered after the break will not be displayed on the map.
- Currently, one layer (e.g., a shapefile) can be displayed in one "layer view". If a different view of the layer is needed with different symbols, the file is reread.
- Each layer view can have different properties, as per the **GeoView Mapping Tools Appendix**.
- Rather than renumbering layers each time a change is made, the `SkipLayerView=true` property can be used to turn a layer view on/off.

- The `AppLayerType` property is used to tell an application (like the StateMod GUI) the basic data type for the layer and the `AppJoinField` is used to tell the application how to join its data with the spatial data. This information is used by the StateMod GUI to relate a StateMod's data set features with spatial data features. The above example illustrates values that are consistent with shapefiles generated from HydroBase. Once a map is displayed in the StateMod GUI, a layer can be highlighted in the layer list, and the right click ***Show Attribute Table*** choice can be used to display the attributes. This information may need to be reviewed to determine appropriate values for the `AppJoinField`.

The StateMod GUI recognizes the following values for `AppLayerType`:

AppLayerType Value	How Used in the StateMod GUI
BaseLayer	Indicate base layers that can be ignored by specific displays.
Baseflow	Used when displaying stream estimate stations.
Diversion	Used when displaying diversion station information.
DiversionWell	Used when displaying diversion & well (D&W) station information.
InstreamFlow	Used when displaying instream flow station information.
Precipitation	Used when displaying precipitation station information.
Reservoir	Used when displaying reservoir station information.
Streamflow	Used when displaying stream gage station information.
Well	Used when displaying well station information.

Spatial data layers can be specified as a comma-separated-value file. The format of the file is illustrated below. If X and Y are specified, the projection is indicated in the **.gvp* file. This simple format can be generated by database queries or exported from Excel.

```
# File generated by...
# program:      StateModGUI 07.03.01 (2009-06-19)
# user:         sam
# date:         Tue Dec 21 17:51:02 MST 2010
# host:         AMAZON
# directory:    C:\CDSS\data\cm2009\statemod
# command line: StateModGUI -home
#            C:\Develop\StateModGUI_SourceBuild/StateModGUI/test/operational/CDSS
#
# pln has 4 out of 6 locations with missing spatial data.
#
# A couple of locations are filled in using lat/long for the coordinates
#
"ID","Name","Lon","Lat","X","Y","Note"
954683OOPPLN,Con-Hoosier_OOP_Plan,,,,,"GUI Detected no coordinates"
363570OOPPLN,Upper_Blue_OOP_Plan,-106.100863,39.385722,-106.100863,39.385722,
364684OOPPLN,Roberts_Tun_OOP_Plan,,,,,"GUI Detected no coordinates"
364512OOPPLN,Dillon_OOP_Plan,-106.067855,39.620327,-106.067855,39.620327,
HUPLimitPLN,Replacement_Limit_Pln,,,,,"GUI Detected no coordinates"
CSULimitPLN,Replacement_Limit_Pln,,,,,"GUI Detected no coordinates"
```

3. Configuring Spatial Data for StateMod

Spatial data files in CDSS are typically distributed on a Water Division extent, and as statewide layers. Non-point features like rivers are typically clipped to a water division's boundaries. Data for trans-basin and out of state structures are also available. Spatial data layers are distributed with HydroBase releases on CD/DVD and are available on the CDSS web site.

For StateMod modeling, it is best to use the available data whenever possible. However, these spatial layers often do not satisfy all the needs of a modeler for a number of reasons:

- Locations in HydroBase may not be correct or may be missing.
- StateMod data sets may include additional features that are not in HydroBase (e.g., aggregate diversions).
- Features in HydroBase may not be available in spatial data (e.g., instream flow reaches).

For these reasons, spatial data used with a StateMod data set often consist of some "official" data corresponding to HydroBase and some model-specific data that may be generated in various ways (e.g., by digitizing locations within ArcView and then saving as a shapefile). If an older data set is available that has spatial data, the associated shapefiles can serve as a starting point for a data set, but the locations may not be consistent with the current HydroBase data. Otherwise, the official data from the State can serve as a starting point. In either case, it is likely that some locations will be missing. The following procedure recommends one possible solution to creating a current set of spatial data for a StateMod data set:

1. Copy a GeoView Project file (*.gvp*) from an existing StateMod data set. Such files should be available from State of Colorado staff and are being phased in on baseline data sets. If one is not available, copy from this documentation or create using a text editor. Point data configuration properties in particular often have similar properties. Place the resulting file in a *gis* directory under the StateMod data directory or a directory to be shared with other tools. It is recommended that the file be named *XXXXX_StateMod.gvp*, where *XXXXX* is the data set name.
2. Copy shapefiles from available sources, such as old StateMod data sets, State of Colorado spatial data sources, or digitized layers, and place in the *gis* directory mentioned in the previous step. The GeoView tools have limited ability to project on the fly so using data with a consistent coordinate system is recommended.
3. Edit the *gvp* and order the use of the shapefiles as appropriate. In general the map layers should be ordered back to front as: background color/image, then polygons, then lines, then points. Use examples from GeoView Project documentation or guidelines from the State to define symbols. Use placeholder layers and the `SkipLayerView` property where needed until all data can be found.
4. Make sure that point data have appropriate `AppLayerType` and `AppJoinField` properties. The `AppJoinField` should be a field in the shapefile that corresponds exactly to the identifiers used for the StateMod data type. For example for diversions that use WDID in StateMod, the identifiers may be padded to six or seven characters. Spatial data files generated from HydroBase spatial data typically include character fields similar to `id_label_6` and `id_label_7` to allow matching with multiple uses. This information must be specified correctly in order for the StateMod GUI to properly join spatial data with the StateMod data set.
5. Reference the *gvp* file in the StateMod data set response file for the `GeographicInformation` property. Use a relative path like *gis\XXXXX_StateMod.gvp* to increase options to move the data set from one computer to another.

6. Run the StateMod GUI and select the response file that references the *gvp* file. The spatial data will be loaded and a map will display. Note that when the StateMod GUI loads spatial data, it processes the data so that identifiers that are not matched in spatial data will not display. Consequently, although extra data in shapefiles may require resources, the shapes are not actually displayed. Note also that the first match that is found for an identifier is used. If a structure is in a diversions layer and a transbasin layer, the first layer to be processed will be used. It is therefore important that if a location is re-defined in a user-generated layer that the layer is specified first in the gvp file. The GUI will also create files in the same folder as the response file with names like *x-gui-MissingSpatial-dds.csv*. These files can be edited and configured as a layer in the **.gvp* file to specify additional location information.
7. Use the StateMod GUI ***View…Data Set Summary*** menu to list features that do not have location data.
8. In many cases, missing locations can be added by adding another layer (e.g., add another Division's layer or the trans-basin layer for the data type). It may be useful to review spatial data using GIS software. Repeat above steps as needed to completely define spatial data.
9. If locations are still missing (e.g., for aggregate diversions), then it may be necessary to digitize locations. For this case, it is recommended that the official shapefile from HydroBase not be edited but instead an additional layer be added. This more easily allows for updates of the official data. No naming convention is currently suggested for "user defined" layers and official CDSS tools do not exist to define missing location.

4. Old Spatial Data Conventions

In StateMod GUI versions prior to version 05.10.xx, the map interface was a holdover from previous versions of the software. Although this interface worked relatively well within the StateMod GUI, it had some limitations. In more recent versions, the map interface is consistent with other software in Colorado's Decision Support Systems, and is more consistent with general GIS tools.
A GIS Control File referenced in the StateMod response file controlled the old map interface. An example of the file is as follows:

```
#
# rg.gis - graphics files for the Rio Grande data set
# ------------------------------------------------------------------
basin:         gis\counties.shp  displayReferenceMap=true
rivers:        C:\cdss\statemod\rg\gis\riversd3.shp
streamflow:    gis\div3_flowstations_1999-02-02.shp id=station_id
diversions:    gis\div3_diversions_1999-02-02.shp id=ID_LABEL_6
reservoirs:    gis\div3_reservoirs_1999-02-02.shp id=ID_LABEL_6
precipitation: gis\div3_climatestations_1999-02-02.shp id=station_id
```

Comments in the file are lines that start with a # character. Data lines consist of a keyword and a shapefile path. File names can contain explicit or relative paths. Multiple keywords of the same type can be specified to plot more than one file. The keywords are used to set the data type, which the GUI then uses to internally set colors, symbols, etc., for plotting. Recognized keywords are:

baseflow	Baseflow nodes (if not in other site files)
basin	Overall basin boundary
diversions	Location of diversion headgates
instream	Location of instream (minimum) flow nodes
precipitation	Location of precipitation gages
reservoirs	Location of reservoirs
rivers	River reaches
streamflow	Location of stream gages

usersites Location of user-specified sites
wells Location of wells
dw Location of diversion/well nodes

The layers are displayed in the order listed, with the last layer displayed on top. Any layers to be displayed in the reference map (typically only the basin layers) must have the keywords `displayReferenceMap=true` after the filename. Also, for the GIS to know which column from the shapefile to use as the identifier, specify the column title using the id keyword (e.g., `id=ID_LABEL_6`). This information allows the shapefile data to be joined to StateMod data.

Although the above convention can be easily implemented, it is not very flexible, in particular with respect to assigning symbol colors and other properties. Therefore, old GIS control files should be migrated to the new conventions.

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