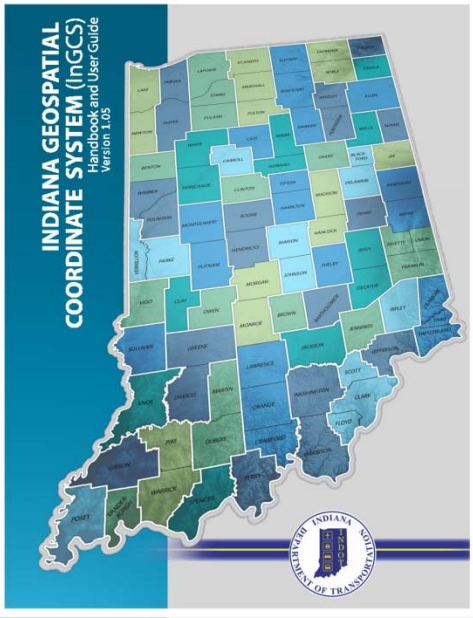
The Indiana Geospatial Coordinate System (InGCS)



Although we live on the curved surface of the Earth, we depict both small and large regions of the Earth on flat maps via map projections. There are numerous map projections worldwide and their usage ranges from military to civilian, from simply needing to know directions from one point to another to the planning, survey, design, and construction of an interstate highway. In the process of projecting the curved surface of the Earth onto flat maps, unavoidable map distortions in direction, distance, areas, and shapes are produced. Conformal map projections have been widely used in the United States to preserve the angular relationships of positions on the surface of the Earth when projected to mapping surfaces. The U.S. State Plane Coordinate System (SPCS) of 1983 utilizes the Transverse Mercator, Oblique Mercator, and Lambert Conformal Conic projections. Published coordinate reference systems such as the SPCS offer a direct tie between positions of latitude and longitude with projected grid coordinates. For the everyday geospatial practitioner not involved with scientific research studies, projected grid coordinates are far more attractive to work with rather than positions of latitude and longitude, but maintaining this direct tie is of significant importance for creating a seamless workflow across geospatial industries as well as for reprojecting coordinates from one projected grid coordinate system to another.

For decades in both the public and private sectors, Indiana geospatial practitioners have been making use of the native forms of the East and West zones of the Indiana State Plane Coordinate System of 1983, but they have also been making widespread use of what have been referred to as modified SPCS by a process known as "scaling to ground." The primary benefit of using modified SPCS is that ground-measured horizontal distances between positions within *each* project match much more closely to the distances between these same positions as projected on the accompanying map, survey plat, design plans, electronic drawing, etc. than they do in the native SPCS. The chief drawback of modified SPCS is that the direct tie between the native (published) SPCS grid coordinates and the corresponding positions of latitude and longitude is broken. Subsequent users of modified SPCS will need to know the exact modification parameters of each project in order to correctly work inside of each system, as well as how to import or export datasets from or to other projects based upon other systems. Another drawback of no less concern is that the process of developing modified SPCS for ***each project*** conceivably has no limit in the proliferation of dissimilar coordinate systems, regardless of size, shape, proximity to or overlapping of other modified SPCS. In other words, unless projects are correctly georeferenced and based directly (without modification) upon projected coordinate systems as defined in geospatial software platforms, they can be thought of as independent pieces of a geographic puzzle that future geospatial users will be burdened with by having to spend additional time determining how they correctly fit together.

Low Distortion Projections (LDP) are conformal map projections designed primarily to minimize the differences in distances between pairs of projected grid coordinates when compared to the ground-measured horizontal distances within specified geographic regions. A slightly beneficial derivative of many LDPs is that convergence angles are typically less than those found in SPCS. Of pinnacle importance to subsequent users of projects based upon LDPs is that the direct tie between project grid coordinates and the corresponding latitudes and longitudes are preserved. When included in geospatial software platforms, LDPs offer future geospatial users a quick and easy way to fit all the different pieces (projects) of the geographic puzzle together.

The **Indiana Geospatial Coordinate System (InGCS)** is a collection of LDPs developed to equip geospatial practitioners in Indiana who perform services for the Indiana Department of Transportation with a published coordinate reference system that, similar to the SPCS, maintains a direct relationship to the National Spatial Reference System (NSRS), but also provides grid distances considerably closer to ground-measured horizontal distances than the SPCS. These highly-beneficial characteristics pave the way to close the chapter of creating modified SPCS for each project. The InGCS endeavor sets the stage for a far more efficient workflow between planning, surveying, design, construction, GIS, etc.

Similar to the SPCS, the InGCS is a collection of conformal map projections based upon the NSRS and utilizes the same Geodetic Reference System of 1980 (GRS 80) ellipsoid as the SPCS. Thus, given the same datum, realization, and epoch, the latitudes, longitudes, and ellipsoidal heights of project data points are identical for the InGCS and the SPCS, regardless of projected grid coordinates.

Similar again to the SPCS, the nominal limits of each zone of the InGCS are the boundaries of Indiana counties. For intuitive use by end users, each Indiana county was designated its own InGCS zone bearing the name of the respective county. Since Indiana contains 92 counties, there are, by default, 92 zones. Many adjacent zones share identical numerical projection parameters. In comparing the numerical projection parameters of the 92 zones, it is evident that there are 57 distinct groups of zones, in which each group contains identical numerical values, i.e., grid coordinates are identical.

On of September 21, 2015, many proprietary geospatial software vendors were contacted and informed of the release of the InGCS and were provided with the InGCS' webpage address that contains the parameters of each of the InGCS' zones in both Microsoft Excel and PDF formats. Additionally, INDOT has worked closely with the European Petroleum Survey Group (EPSG) to ensure that the InGCS is compatible with their Geodetic Parameter Dataset so that the InGCS will be easily incorporated into many geospatial software platforms that upload new systems directly from EPSG's Dataset. If your specific geospatial software vendor has not included the InGCS in their latest release, update, patch, etc., you are encouraged to contact your provider and request that the InGCS be included.

Since the InGCS is a collection of published conformal map projections based upon the NSRS, direct importation of survey data into GIS, devoid of having to resort to "rubbersheeting" acts of desperation (as is the case with modified SPCS and arbitrary coordinate systems), is made possible. Now in GIS, survey data would be readily available to others in the public sector for critical services such as defense, homeland security, law enforcement, fire fighters, emergency medical, etc. The GIS community can find that working with georeferenced data natively based upon the InGCS will be as user-friendly as historically working with the same data based upon the SPCS. ***Both survey and GIS data can now work in harmony without either dataset being degraded or workflow being impeded.***

Although developed for the Indiana Department of Transportation (INDOT) to be used in INDOT projects, the InGCS is not exclusive to INDOT, INDOT projects, surveying or GIS. Other industries within the geospatial community are also welcome to utilize the InGCS in their georeferenced projects.

For more information about the Indiana Geospatial Coordinate System, such as the Handbook and User Guide, a list of participating geospatial software vendors, etc., visit the InGCS webpage on INDOT's website at www.in.gov/indot/InGCS.htm (case sensitive).