August 15, 2019

Ms. Juliana P. Blackwell
Director, National Geodetic Survey
SSMC3, Rm 8657
1315 East-West Hwy
Silver Spring, MD 20910-3282

Dear Ms. Blackwell:

We are submitting this letter in response to the NGS's recent plans and policies regarding SPCS2022,[1] the planned modernization of the country's state plane coordinate systems associated with the introduction of a new terrestrial reference frame in 2022. This letter is a follow-up to and is consistent with our August 17, 2018, response to the NGS request for public comment on Federal Register Notice 83 FR 17149 regarding SPCS2022.[2]

The purpose of this letter is to:

1. Express to NGS our intents and desires concerning SPCS2022 and to ask NGS to partner with us in helping Wisconsin move forward, not only with SPCS2022 but also with NATRF2022 and NAPGD2022.
2. Request exceptions to SPCS2022 policies and procedures, and make the case that these exceptions are in the mutual interests of both NGS and the State of Wisconsin.

Specifically, we seek exceptions to:

1. SPCS2022 Policy 2.a. stating that only one multi-zone layer can provide complete coverage of an entire state.
2. Any NGS specification that conflicts with our plans for WISCRS, our state's long-standing low-distortion projection (LDP) system.
3. The requirement for completion of the fully-detailed online design submittal form.

We seek these exceptions in accordance with the understanding that the NGS Director may exercise discretion to approve special requests regarding departures from published NGS procedures and policies for SPCS2022.[3]

---

[1] State Plane Coordinate System of 2022 Policy (NGS 2019-1214-01) and Procedures for Design and Modification of the State Plane Coordinate System of 2022 (NGS 2019-1214-01-A1), 4/23/2019.
https://www.ngs.noaa.gov/SPCS/policy.shtml

[2] https://www.federalregister.gov/documents/2018/04/18/2018-08141/policy-and-procedures-documents-for-the-state-plane-coordinate-system-of-2022

[3] Procedures for Design and Modification of the State Plane Coordinate System of 2022, p. 3.
https://geodesy.noaa.gov/INFO/Policy/files/SPCS2022_Procedures_NGS_2019-1214-01-A1.pdf

Who We Are

The Wisconsin Spatial Reference System 2022 Task Force (WSRS2022) was formed in January 2019 under the auspices of the Wisconsin Society of Land Surveyors (WSLS).[4] The mission of WSRS2022 is to help ensure successful adoption of NATRF2022 and NAPGD2022 across Wisconsin. WSRS2022 evolved out of the NATRF2022 Discovery Team established in 2018 to draft a response to NGS's Federal Register Notice.

WSRS2022 represents a broad coalition of geospatial[5] and surveying professionals in Wisconsin, including federal, state, regional, county and local governments, as well as agencies, corporations and associations involved in the production and use of geospatial data. WSRS2022 has five focus groups, each designed to address a specific issue of concern. The technical content of this letter was drafted primarily by the members of the Technical Focus Group, with discussion and consensus arrived at by the entire Task Force at a series of quarterly meetings.

The leads for WSRS2022's focus groups and the members of the Technical Focus Group are provided at the end of this letter.[6] WSRS2022 meets the NGS's definition and criteria for a stakeholder group, and contains representatives of the state DOT, the State Cartographer's Office, professional surveying societies, state geospatial organizations, post-secondary institutions, and state and local offices that produce and use geospatial data.[7]

Statewide Single-Zone and Three-Zone Layers

Before discussing our low-distortion projection system, we would like to provide our perspective on the state's needs for statewide single-zone and three-zone layers as referenced in NGS policy.[8]

In the mid-1980s, the Wisconsin Department of Natural Resources (DNR) was an early adopter of GIS technology. DNR's administrative responsibilities are statewide and much of their analysis, planning and regulation is done at that extent and at its associated scale. Wisconsin straddles the boundary between UTM zones 15 and 16, such that the largest linear distortions of each zone run north-south through the middle of the state. Thus, DNR designed a single-zone statewide layer, sometimes dubbed "UTM Zone 15½" but more formally named "Wisconsin Transverse Mercator" (WTM). At the time, NAD 27 was still in

[4] Organized in 1952, Wisconsin Society of Land Surveyors (WSLS) is Wisconsin's largest professional surveying association. https://www.wsls.org/

[5] Within this letter, the term "geospatial" should be considered in its broadest sense to include GIS, geodesy, cartography, land surveying, mapping, navigation, photogrammetry, LiDAR-sensing and other forms of remote sensing, and other location-based activities and disciplines.

[6] Additional details on WSRS2022 activities can be found online at https://www.sco.wisc.edu/community/wsrs2022/

[7] Procedures for Design and Modification of the State Plane Coordinate System of 2022, p. 4. https://geodesy.noaa.gov/INFO/Policy/files/SPCS2022_Procedures_NGS_2019-1214-01-A1.pdf

[8] State Plane Coordinate System of 2022 Policy (NGS 2019-1214-01), pp. 6-7. https://geodesy.noaa.gov/INFO/Policy/files/SPCS2022_Policy_NGS_2019-1214-01.pdf

use for some applications, so both WTM 27 and WTM 83 were designed. WTM is modeled after UTM with the central meridian at 270° east longitude. WTM 27 has a false easting of 500,000 m and WTM 83 has a false easting of 520,000 m. Parameters for both WTM 27 and WTM 83 are included in the International Association of Oil and Gas Producers (IOGP) EPSG Geodetic Parameters Dataset.

WTM 83 is currently in use by at least 15 state agencies, regional planning commissions, and Native American Tribes in Wisconsin. There are almost certainly additional users. Given the widespread use of WTM, **we will request, through the online request and proposal form, that NGS design a statewide single-zone layer which is a Transverse Mercator projection with its central meridian at 270° east longitude and has a false easting significantly different from those of WTM 27 and WTM 83.**

Wisconsin's three-zone layer, the traditional State Plane Coordinate System (SPCS 27, then SPCS 83), has been in use in Wisconsin since its inception in the 1930s. Current users include utilities, regional planning commissions, state and county agencies, and others with geographically extensive projects, infrastructure, or administrative jurisdictions. Given continued utilization of SPCS, **we will request, through the online request and proposal form, that NGS design a default three-zone layer for Wisconsin.** We understand that this layer will consist of three Lambert Conformal Conic zones with boundaries identical to those of SPCS 83.

We understand that the NGS design for both the single-zone and three-zone layers will be at the topographic surface. **Thus we will request that, if the NGS design must have a central meridian at a longitude other than 270° east to better fit the topographic surface, then the longitude difference be taken into account when selecting the false easting to be significantly different from those of WTM 27 and WTM 83 (for the single-zone layer) and those of SPCS 27 and SPCS 83 (for the three-zone layer).**

Wisconsin's Multi-Zone LDP Systems

In the early 1990s, the Wisconsin Department of Transportation (WisDOT) sought development of a set of LDPs with statewide coverage. For many years, WisDOT had been using SPCS 27, then SPCS 83. There were frequent misunderstandings over whether or not grid-to-ground factors had been applied in the chain of data handling from initial survey to construction. Over the years, WisDOT used several methods to deal with grid-to-ground factors, none of which completely avoided confusion and associated cost overruns.

Therefore, WisDOT was seeking a method by which grid-to-ground factors were near unity and could be ignored. The result was the Wisconsin County Coordinate System (WCCS), with design linear distortions no greater than 33 ppm (1:30,000) in rural areas and 20 ppm (1:50,000) in urban areas. WCCS zones were designed near the topographic surface. Where possible, without violating linear distortion criteria, multiple counties were consolidated under a single zone. WCCS had 59 zones for 72 counties with all zone boundaries following

county boundaries. Twenty-four of the zones were based upon Lambert Conformal Conic projections and 35 zones were based upon Transverse Mercator projections.

See pages 16-18 of the enclosed publication, "Wisconsin Coordinate Systems" (1995), for a map of WCCS zones and descriptions of its design methodology and testing. Pages 19-90 contain parameters and design details for each county.[9,10]

Once published, WCCS became popular not only for state-level infrastructure design and construction but also for many applications at local levels of government and in the private sector. In particular, the WCCS design criteria were deemed appropriate such that grid distances could be used as ground distances in applications such as cadastral surveying and mapping, platting, real property conveyancing and facilities management. At the same time, the Wisconsin Land Information Program[11] began funding development of GIS spatial databases at the county level, many of which involved conversion of hardcopy cadastral maps and plats to digital form. WCCS seemed ideal for this.

WCCS was designed with reference ellipsoids modified from the GRS 80 ellipsoid to bring their surfaces near the subject topography and then applying secant projections. This, effectively, caused each zone to have its own datum, bringing about some confusion and, just as importantly, difficulties with off-the-shelf software. In 2005, the Wisconsin Land Information Association[12] formed a committee to address this problem. The committee decided that a new LDP layer should be developed, using only the GRS 80 ellipsoid and non-intersecting projection surfaces. The WCCS linear distortion tolerances of 33 ppm (1:30,000) in rural areas and 20 ppm (1:50,000) in urban areas were deemed to still be appropriate such that grid-to-ground factors could be ignored. The new layer was to have the same zones as WCCS and was to best fit WCCS such that the difference between any WCCS coordinate and its corresponding coordinate in the new layer be no more than 5 mm, so that legacy WCCS data and new data could be used interchangeably.

All design criteria for the new layer were met with many zones having no more than a 2-mm difference in any coordinate. The new layer came to be dubbed "Wisconsin Coordinate

[9] The Wisconsin Coordinate Systems document can also be found online at https://www.sco.wisc.edu/wp-content/uploads/2019/07/WCCS-Handbook-1995-smaller.pdf

[10] Further detail on design and testing of WCCS can be found in "Wisconsin County Coordinate Systems, Report to the Wisconsin Department of Transportation, Technical Services, Phase I" (1993), online at https://www.sco.wisc.edu/wp-content/uploads/2019/07/WCCS-WISDOT-Report-1993.pdf

[11] The Wisconsin Land Information Program (WLIP), administered by the Department of Administration, provides over $13 million annually in public funding to Wisconsin counties for the modernization of local land records. All 72 Wisconsin counties participate in the WLIP. The program is governed by state statute and administrative rule. https://doa.wi.gov/Pages/LocalGovtsGrants/WLIP.aspx

[12] Founded in 1987, WLIA is a non-profit association representing professionals united by an interest in land records modernization, GIS and related technologies, and by the need for government policies and programs that support their efficient and effective application. https://www.wlia.org/

Reference Systems" (WISCRS). See pages 19-95 of the enclosed publication, "Wisconsin Coordinate Reference Systems" (2009) for WISCRS design details and parameters.[13,14]

WISCRS and NATRF2022

Currently, WISCRS is used by *virtually every* Wisconsin county government which, over the past three decades, have been the focus of heavy investment through the Wisconsin Land Information Program. WISCRS is also used by many municipalities and regional planning commissions in their land information systems and in their surveying and mapping activities. Many Wisconsin land surveyors use WISCRS as a matter of routine business practice. WisDOT *requires* WISCRS for use in development and publication of highway construction plans and Transportation Project Plats and is investing hundreds of millions of dollars in projects that utilize WISCRS. WISCRS is also built into the major software tools utilized by the geospatial community. WISCRS parameters are included in the IOGP EPSG Geodetic Parameters Dataset.

Given this level of adoption, familiarity, and financial and intellectual investment in WISCRS, it is our belief that the geospatial community in Wisconsin will be best served by the continuation and perpetuation of WISCRS into the NATRF2022 era. Keeping WISCRS intact as one of Wisconsin's layers will support Wisconsin's active land information communities at the local level who have made large investments in low-distortion spatial networks. *Eliminating WISCRS, or significantly altering it to accommodate new design criteria, would have serious financial impacts on county and state land information budgets and negatively impact how spatial data are used and supported across the state.*

As we stated in our letter of August 17, 2018, we see mutual benefits in having WISCRS recognized by NGS, having WISCRS coordinates included in NGS databases and NGS's new data delivery system, and including WISCRS as an option in NGS coordinate transformation software.

We believe that WISCRS can serve as a mechanism to facilitate adoption of NATRF2022 and to further NGS's national spatial reference system modernization goals. If users in Wisconsin are able to easily access WISCRS coordinates via NGS data and services, adoption of NATRF2022 will be greatly facilitated at the state, county and municipal levels, and in land surveying practice. Without this capability, users will need to find alternative ways to convert coordinates or may opt to simply maintain data in the existing NAD 83 framework. For this reason, we think it makes sense to have NGS partner with us in moving NATRF2022 forward in the State of Wisconsin.

[13] A second edition of this document can be found online at https://www.sco.wisc.edu/pubs/wisconsin-coordinate-reference-systems-second-edition/

[14] For deeper detail on design and results of testing, see "WISCRS (Wisconsin Coordinate Reference Systems): Redesign of the WCCS (Wisconsin County Coordinate System), Final Report" (2006), online at https://www.sco.wisc.edu/wp-content/uploads/2019/07/WISCRS-Final-Report-2006.pdf

We understand that many states have not yet developed LDPs and might be looking to do so, given the opportunity provided by NGS through SPCS2022. For those states, NGS policy and procedures provide very good specifications for use in design. However, for states like Wisconsin, which already have proven and long-used LDP layers created under their own designs, it is nearly certain that their design criteria will have at least some conflicts with those of NGS. Such is the case with WISCRS. For example, some WISCRS zones are under the NGS-specified minimum size, none of the Transverse Mercator zones have the NGS-specified false northing value of exactly zero, and scale factors on central parallels of Lambert Conformal Conic zones and central meridians of Transverse Mercator zones are typically defined to more than the NGS-specified maximum of six decimal places. There are additional conflicts.

Given the considerations in this section, and the above-mentioned conflicts between WISCRS and NGS specifications for LDPs, **we seek an exception to any NGS specification that conflicts with WISCRS.**

If our sought exceptions are approved, Wisconsin will provide to NGS a digital compilation of all WISCRS parameters. This submittal will comply with NGS zone name specifications.[15] We can also provide a shapefile of the boundary for each WISCRS zone, if necessary. However, **we seek an exception to the requirement for completion of the fully-detailed online design submittal form.** The detailed design and testing information required in the online NGS design submittal form is already available in the documents we have provided herein and online.

Three Statewide Layers

As the above discussion shows, for decades the Wisconsin geospatial community has enjoyed productive use of plane coordinates from three layers of conformal map projections covering the entire state:

1. A multi-zone LDP layer.
2. A single-zone layer.
3. A three-zone SPCS 83 layer.

These layers support a host of applications at the state, regional, county and municipal levels of government as well as for utilities and the private sector. The three layers, with some modifications, will be used into the foreseeable future, during and well beyond adoption of NATRF2022. **We therefore seek exception to SPCS2022 Policy 2.a. that only one multi-zone layer can provide complete coverage of an entire state.** *Our goal is see all three layers of Wisconsin plane coordinates recognized by NGS and accessible to users via NGS data and services.* We believe that the geospatial community in Wisconsin will be best

[15] Procedures for Design and Modification of the State Plane Coordinate System of 2022, section 5.b., p. 8. https://geodesy.noaa.gov/INFO/Policy/files/SPCS2022_Procedures_NGS_2019-1214-01-A1.pdf

served in this manner, and that this approach will facilitate more rapid and widespread adoption of the modernized national spatial reference system.

On behalf of the Wisconsin Spatial Reference System 2022 Task Force,

Howard Veregin, PhD, GISP
Wisconsin State Cartographer
University of Wisconsin-Madison
550 N. Park St., Madison, WI 53706
veregin@wisc.edu
608-262-6852

Richard Kleinmann, PLS
Ayres Associates
N17 W24222 Riverwood Drive, Suite 310
Waukesha, WI 53188
KleinmannR@AyresAssociates.com
262-522-4920

cc: John Ellingson, Great Lakes Regional Advisor

Enclosures:
Wisconsin Coordinate Systems (1995)
Wisconsin Coordinate Reference Systems (2009)

WSRS2022 Task Force Composition

Chair & Co-Chair
Howard Veregin, Wisconsin State Cartographer
Richard Kleinmann, Wisconsin Society of Land Surveyors, Geospatial Committee Chair

Technical Focus Group Chair and Vice Chair
Al Vonderohe, University of Wisconsin-Madison (emeritus)
Glen Schaefer, Wisconsin Department of Transportation (retired)

Technical Focus Group Members
Kirk Contrucci, Quantum Spatial
John Ellingson, National Geodetic Survey
Mick Heberlein, Wisconsin Department of Transportation
Mike Koutnik, Esri
Jerry Mahun, University of Wisconsin-Platteville
Cindy McCallum, Wisconsin Department of Transportation
Rob Merry, Southeastern Wisconsin Regional Planning Commission
Ethan Remus, County Land Information Officers Network
Zach Robinson, Legislative Technology Services Bureau
Dan Rodman, City of Madison
Sam Wenz, Wisconsin County Surveyors Association

Leads, Legislative Focus Group
Eric Damkot, Wisconsin Land Information Association
Emily Pierce, Wisconsin Society of Land Surveyors/National Society of Professional Surveyors

Leads, Education/Outreach Focus Group
Brenda Hemstead, State Cartographer's Office
Corey Hughes, Wisconsin County Surveyors Association

Lead, Software/Hardware Focus Group
Jim Lacy, State Cartographer's Office

Leads, Implementation/Adoption Focus Group
Jeremiah Erickson, County Land Information Officers Network
Nina Rihn, Wisconsin Department of Natural Resources

Wisconsin Society of Land Surveyors – Task Force sponsor representatives
Terry Van Hout, President
Frank Thousand, Executive Director

Wisconsin Land Information Association – Representative
Peter Strand, President