National Geodetic Survey

Positioning America for the Future

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Existing SPCS 83 (or 27) Design



Preliminary SPCS2022 Default Design



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Cen	parallel scale: 0.999 392 636	$M_{2} = +1/$	Mean = -588					-400		$t_0 + 300$	
DORA TA AND AND AND AND AND AND AND AND AND AN	Areas within ±400 ppm distortion	Cities and	towns:		to -70	00	1	to -200		to +500	
	(±2.11 ft per mile):	Min = -891	Range = 859		to -60	00	:	±100		to +600	
NOAA's	20% of entire zone	Max = -32	Median = -616		to -50	00	1	to +200		> +600	
National Geodetic	19% of all cities and towns	Mean = -613	3	0	50	100		50 200	25	_ 0 300	
Survey	6% of population	(weighted by	population)	E						km	

Existing SPCS 83 design: North Carolina Zone 83°W 79°W 77°W 76°W 84°W KENTUCKY ~~A Suffolk IENNESSEE Johnson North standard paralle Knoxville A Carlow and a car a Central parallel (computed) 35° 15' 06.33096..." N Charlotte Fayetteville South standard parallel_____ 34° 20' N SOUTH CARONE NA oswell ਨੇ Sandy Springs Columbia Atlanta G E O R G V 81°W 78°W 77°W 76°W 83°W 82°W 80°W 79°W Lambert Conformal Conic projection Linear distortion at topographic **Distortion values (ppm)** North American Datum of 1983 surface (parts per million) Entire zone: Central parallel: 35° 15' 06.3..." N Min = -418 Range = 597 to -200 to +150 < -400 Cen parallel scale: 0.999 872 592... Max = +179 Mean = -91 to -150 to +200 to -400 Areas within ±100 ppm distortion to -100 Cities and towns: to -350 to +250 (±0.53 ft per mile): to +300 Min = -300 Range = 469 ±50 to -300 44% of entire zone Max = +169 Median = -109 to -250 to +100 > +300 NOAA's 42% of all cities and towns National Mean = -103 44% of population Geodetic (weighted by population) Survey

160°W	159°W	158°W	157°W	156°W	155°W
		•			

Cen	parallel scale: 0.999 9 (exact)	Max = +467 Mean = -79		< -800 to -800	to -400		$t_{0} + 300$
DOAR TOAR	Areas within ±400 ppm distortion	Cities and towns:		to -700	to -200		to +500
	(±2.11 ft per mile):	Min = -380 Range = 822		to -600	±100		to +600
NOAA's	97% of entire zone	Max = +441 Median = -112		to -500	to +200		> +600
National Geodetic Survev	99% of all cities and towns 100% of population	Mean = -113 (weighted by population)	0	50 100	150 200	250) 300 km

Preliminary SPCS2022 default design: North Carolina Zone 84°W KENTUCKY R N Virginia Beach Suffolk <u>iennessee</u> Knoxville <u>Central parallel</u> 35°-15'-N SOUT HLCA ROLLINA oswell Sandy Springs Columbia Atlanta 81°W 78°W 77°W 76°W 83°W 82°W 80°W 79°W Lambert Conformal Conic projection Linear distortion at topographic **Distortion values (ppm)** North American Terrestrial Reference Frame of 2022 surface (parts per million) Entire zone: Central parallel: 35° 15' N Min = -341 Range = 597 to -200 to +150 < -400 Cen parallel scale: 0.999 95 (exact) Max = +256 Mean = -14 to +200 to -400 to -150 Areas within ±100 ppm distortion to -350 to +250 Cities and towns: to -100 (±0.53 ft per mile): to +300 to -300 ±50 Min = -222 Range = 469 76% of entire zone to -250 Max = +246 Median = -32 > +300 to +100 NOAA's 78% of all cities and towns National Mean = -25 Geodetic 90% of population (weighted by population) Survey

155°W 158°W 157°W 156°W 159°W 160°W











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170°50)'W 170°40'W	170°30'W	170°20'W	170°10'W	170°0'W	169°50'W	169°40'W	169°30'W	
170°50'W	/ 170°45'W	170°40'W	170°35'W	/	169°40'W	169°35'W	169°30'W	169°25'\	w
C	entral parallel 14° 16' S Pa	goRago Tu	tuila		Ofu-Olos	sega Manu Grou	1 (5) 1 (5)	a'u	°15'S 14°10'S
170°50'V	V 170°45'W	170°40'W	0 170°35'V	5 v	10 15 km 169°40'W	Central paral 14° 16' S 169°35'W	169°30'W	169°25'\	×
Lamb C Cen	ert Conformal American Samoa D entral parallel: ´ parallel scale: ´	Conic proje ^{atum of 1962} 14° 16' S 1.000 000 (ex	ction A N (act)	Distortior <i>II island I</i> lin = -153 lax = -1	n values (ppm) and areas: Range = 152 Mean = -34	Linear d surface <-120 to -12	istortion at to (parts per milli) to -60 20 to -40	on) to +6 to +8	0 0
OAA's ational eodetic	Areas within ±5 (±0.26 ft per mile 77% of all island 87% of Tutuila 82% of Ofu-Olos	0 ppm distort e): land areas ega	tion T N N O N	<i>utuila:</i> lin = -98 lax = -3 fu-Olose lin = -81	Range = 95 Mean = -26 ga: Range = 80	to -10 to -80 <i>Ta'u:</i> Min = -15	53 Range =	149	00 0

									km
	170°50'V	N 170°40'W	170°30'W	170°20'W	170°10'W	170°0'W	169°50'W	169°40'W	169°30'W
	170°50'W	170°45'W	170°40'W	170	°35'W	169°40'W	169°35'W	169°30'W	169°25'W
14°20'S 14°15'S	Ce	entral parallel 14º 15'S Pa Tafun	go Pago T u	tuila	5	Ofu-Olc	Manu Grou <u>Central parall</u>	'a Ta p e/	່ ແ
	170°50'\\\/	170°45'\\\\/	170°40'\\\/	170	225114/		160°25'\\\/	160°20'\\/	160°25'\\\/
	Lambe Pa Ce Cen <u>p</u>	ert Conformal cific Terrestrial Referent entral parallel: 1 parallel scale: 1	Conic projence Frame of 2022 14° 15' S I.000 02 (exa	ection	Distortio All island Min = -134 Max = +18	n values (ppm) <i>land areas:</i> Range = 152 Mean = -14	Linear di surface (2 5 5 W Surface (2 5 5 W Surface (2 5 5 W Surface (2 5 0 - 120 to -120	stortion at top parts per millio to -60 0 to -40	to +60 to +80
ANOTAL .	TIDAR TOART OF COMMAN	Areas within ±50 (±0.26 ft per mile 90% of all island	0 ppm distor e): land areas	tion	<i>Tutuila:</i> Min = -78 Max = +17	Range = 95 Mean = -6	to -10 to -80	0 ±20 to +40	to +100 >+100
 (NOAA's National Geodetic Survey	99% of Tutuila 97% of Ofu-Olos 63% of Ta'u	ega		<i>Ofu-Olose</i> Min = -62 Max = +18	ega: Range = 80 Mean = -8	<i>Ta'u:</i> Min = -13 Max = +1	4 Range = 1 6 Mean = -4	50 0

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Future State Plane Coordinate System for the United States

Michael L. Dennis, Dana J. Caccamise II, and William A. Stone

Lambert Conformal Conic (LCC)

Transverse

Mercator

(TM)

The United States *State Plane Coordinate System* (SPCS) will soon change!

A new version (SPCS2022) will replace the existing North American Datum of 1983 (NAD83) version (SPCS 83) as part of the transition to the Terrestrial Reference Frames of 2022 of the ongoing modernization of the U.S. National Spatial Reference System. Because this change will significantly impact U.S. mapping, surveying, engineering, and myriad georeferenced activities, NOAA's National Geodetic Survey (NGS) is seeking user-community input on the development of SPCS2022 (see below for deadlines). In support of this process, NGS is creating preliminary designs (subject to change, based in part on state input) of SPCS2022 zones (including statewide zones) to help state stakeholders make informed decisions on what design best meets each state's needs. These SPCS2022 designs are illustrated on the side panels with maps showing linear distortion (map scale error) at the topographic surface, along with maps of existing SPCS 83 (or 27) distortion. The map comparisons provide a means to visually assess the performance of proposed SPCS2022 zones and to compare them to SPCS 83. The intent is that SPCS2022 will be a technically sound and practical component of the nation's spatial data infrastructure of tomorrow, fully satisfying the broad needs and applications of the geospatial community for years to come.





All interested parties are invited to partner with NGS in this collaborative effort to formulate and optimize the **State Plane Coordinate System of 2022**!

SPCS2022 projection types (above):

- all conformal projections
- based on Geodetic Reference System of 1980 (GRS80) ellipsoid
- SPCS2022 LCC projection will use the 1-parallel form (whether secant, tangent, or non-intersecting)
- same projections used for SPCS 27 and 83

Schematics contrasting the zone design approach and characterization of linear distortion (map scale error) for:

- SPCS 27 and 83 (top): minimizes distortion with respect to the ellipsoid
- SPCS2022 (bottom): minimizes distortion with respect to the topography Positioning the developable surface (the plane) along the topography (vs. the ellipsoid) reduces distortion in many regions, particularly at higher elevation.



Explore the *left poster panel* to compare linear distortion maps for 4 states / territories based on: existing SPCS 83 (or 27) design and preliminary SPCS2022 default design. Compare zone statistics and note the typical improvement (decreased distortion) in default zone performance due primarily to positioning the developable surface (the plane) at the topographic surface and weighting by population. Explore the *right poster panel* to compare linear distortion maps for 4 states based on: existing SPCS 83 design, preliminary SPCS2022 default design, and preliminary SPCS2022 statewide design. Compare zone statistics and note the typical improvement (decreased distortion) in default zone performance. Statewide zones are designed to support geospatial activities that benefit from a single, consistent state coordinate system, such as a statewide GIS.

Learn More

NGS website: https://geodesy.noaa.gov SPCS website: https://geodesy.noaa.gov/SPCS/ SPCS2022 Proposed Policy/Procedures: https://geodesy.noaa.gov/SPCS/draft-policy

https://geodesy.noaa.gov/SPCS/draft-policy.shtml



Deadlines for Stakeholder Involvement

August 2018: proposed policy/procedures feedback (Federal Register notice) December 2019: state zone requests/proposals to NGS December 2020: state zone designs to NGS

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Preliminary SPCS2022 Default Design

Preliminary SPCS2022 Statewide Design



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117°W

116°W

statewide zone design: **Oblique Mercator projection** North American Terrestrial Reference Frame of 2022 Origin latitude: 37° 00' N Origin longitude: 119° 30' W Skew axis scale: 0.999 85 (exact) Areas within ±400 ppm distortion Distortion values (ppm) Cities and towns. Min. Max = -474, +559 Range = 1032Median = -116Mean = -46(weighted by population

121°	°W 120°W	119°W	118°W	117°W		116°W	115°W	
Lamb	North American Datum of	c projection	Distortion Entire zone:	values (ppm)	Linea surfa	ar distor ace (part	tion at topo s per million	ographic)
Cen	parallel scale: 0.999	922 127	Min = -552 Max = +92	Range = 644 Mean = -145	to	-400	to -200 to -150	to +150
	Areas within ±100 pp (±0.53 ft per mile): 31% of entire zone	m distortion	<i>Cities and to</i> Min = -365	wns: Range = 438 Modian = 62	to to	-350 -300	to -100 ±50	to +250 to +300
NOAA's National Geodetic Survey	70% of all cities and to 91% of population	wns	Mean = -31 (weighted by p	population)	0	50 50	100	150 200 km

121°\	W 120°W	119°W	118°W	117°W		116°W		115°V	V		
Lambert Conformal Conic projection North American Terrestrial Reference Frame of 2022			Distortion values (ppm) Entire zone:			Linear distortion at topographic surface (parts per million)					
Cen	parallel scale: 0.999	95 (exact)	Min = -524 Max = +121	Range = 645 Mean = -117		< -400 to -400		to -200 to -150		to +150 to +200	
NOAA's	Areas within ±100 ppr (±0.53 ft per mile): 41% of entire zone	n distortion	<i>Cities and to</i> Min = -338 Max = +100	wns: Range = 438 Median = -34		to -350 to -300 to -250		to -100 ±50 to +100		to +250 to +300 > +300	
National Geodetic Survey	76% of all cities and tov 90% of population	wns	Mean = -3 (weighted by p	opulation)	0	50		100	150	200 km	

	Lir su	near disto rface (part	rtic is p	on at topog per million)	gra	phic
N°t		< -700		to -300		to +400
ň		to -700		to -200		to +500
		to -600		±100		to +600
z		to -500		to +200		to +700
33°		to -400		to +300		> +700
	0	100	2	200 300		400 km



Preliminary SPCS2022 NOAA's National Geodetic Survey Transverse Mercator projection North American Terrestrial Reference Frame of 2022 Cen merid scale: 0.999 87 (exact) 0) **Distortion values (ppm)** Min = -724 Min, Max = -531, +659 (weighted by population) to -300 to +400 to -200 to +500 to +600 to +200 to +700 to -400 to +300 > +700

135°W









160°W







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