FACTORS FOR ESTIMATING PRODUCTIVITY AND YIELD INDICES OF ILLINOIS SOILS; AGGREGATION TO THE MAP UNIT; AND ADJUSTMENTS TO REFLECT PHASE DIFFERENCES

Productivity and Yield Indices were derived by Adjusting University of Illinois Bulletin 810 and Bulletin 811 base data with the application of established factors to address differences in soil series phases.

Factors, Definitions, Estimated Yield and PI tables for Agriculture and the Illinois Land Evaluation and Site Assessment (LESA).

Calculating Productivity and Yield Indices in Illinois for Crop Productivity Estimates

Summary

The Illinois USDA Natural Resources Conservation Service uses the base Productivity index and the base indices for Corn, Soybeans, Winter Wheat, Oats, Grain Sorghum, Grass-Legume Hay and Grass-Legume Pasture derived from Bulletins 811 and 810 from the University of Illinois (UI). Illinois NRCS uses these indices for Conservation planning and policy.

Until now, yields and indices have been populated manually in the National Soil Information System (NASIS) database and delivered to the public through Web Soil Survey, the digital soil survey geographic database (SSURGO), and through published soil survey reports for individual counties. Productivity and base index updates from UI require laborious manual edits to the NASIS database. Individual edits for the seven indexed crops on the more than 10,000 soil map units in the state generates a significant workload.

Illinois NRCS has developed database update techniques that substantially improve consistency and delivery time, and increase database update efficiency. The new processes use formulas to uniformly calculate indices from factors provided by UI bulletin updates, and allow them to be applied spatially with the soil survey geographic database (SSURGO and gSSURGO). Factors considered in the calculations include flooding (frequency and duration), ponding (duration), drainage status, surface texture and substratum textures or materials.

Soil Database Composition

A Soil Series represents the central characteristic concepts of a soil. Soil map units are identified as phases of soil series, based on variations of slope, erosion, flooding, surface texture, substratum (layers below the developed soil profile), drainage, or other specifically identified properties. Consociations are soil map units containing one major component soil series that should comprise at least 85 percent of that map unit. Complexes and undifferentiated groups are map units that contain more than one major component soil series. Additional map units are composed of miscellaneous soil areas or materials that are not represented by standard soil series concepts. Examples of miscellaneous areas include urban land, dams, beaches, dumps, oil-waste land, pits, riverwash, rock outcrop, water, and miscellaneous water. (http://soils.usda.gov/technical/manual/contents/chapter2.html#3b) Orthents of several kinds, Alfic udarents, and Aquents are examples of soil materials identified on the map that do not typically have interpretations because of the variability of these materials. (http://soils.usda.gov/technical/manual/contents/chapter2.html)

Indices for consociations are calculated by representing the major component as 100 percent of the whole map unit. Complexes and undifferentiated groups are developed by ignoring minor component percentages, and re-calculating the major components to equal 100 percent of the map unit. This allows the major components in complexes and undifferentiated groups to proportionately dominate productivity and yield indices. If a miscellaneous area is included in a map unit as a component, it carries a value of zero in subsequent calculations.

Yield Indices and Productivity Indices for row crops are not calculated for agricultural purposes when land capability classification (LCC) of the map unit is 6s, 6e, 7e, 8 or 8s; or when the map unit component is identified as “Taxon above family” or “Miscellaneous area”. Grass-Legume Hay indices are not calculated when LCC is 7s, 7e, or 8. Grass-Legume Pasture indices are not calculated when LCC is 8 or 8s.

These calculated yield indices are developed to be relative to one another from the base yields of U of I publications, bulletins 810 and 811. They are intended for use in the ranking, comparison, and estimation of yields and productivity of crops typically grown where the named soil series are found.

Productivity indices derived with this method will be incorporated with the statewide Land Evaluation and Site Assessment (LESA) system for the protection of farmland relative to The Illinois Farmland Preservation Act, 1982 (505 ILCS 75/1 et seq.); in which the Illinois Department of Agriculture (IDA) was legislatively directed to review all state agency projects and activities that may have a direct or indirect effect upon the potential conversion of farmland in Illinois.
(http://www.agr.state.il.us/Environment/LandWater/LESA.pdf)
(http://www.ccrpc.org/planning/pdfs/Brief%20History%20of%20LESA%20Development.pdf)

Productivity indices derived with this method will be incorporated with the federal Farmland Protection Policy Act (FPPA), 1981, which directs all federal agencies to evaluate their programs and projects and to modify their actions so as to produce the least impact on farmland. The FPPA also seeks to assure that federal programs are administered in a manner that, to the extent practicable, will be compatible with state and local government, as well as private programs and policies to protect farmland.
(http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/fppa/)

These indices **are not** those values used for land assessment for real estate or valuation for real estate tax base.

Yield indices have been adjusted for several years by Illinois NRCS for slope, erosion and flooding. Additional factors may be needed to address specific site or series phase differences.

The yields and productivity indices given in the table are relatively good values, but local variability and slight differences in soil characteristics still exist across the landscape.
(http://soils.usda.gov/technical/manual/contents/chapter2.html#3b) It is important to keep in mind that some soils are more variable than others and some soils respond differently to management. Different landforms and landform positions also affect soil moisture and nutrient availability and consequently, yield.

Yield indices are for Non-irrigated land under normal management that includes soils typically drained for agricultural purposes. Yield indices for soils under Irrigation management will be higher than values given in these tables and soils that are typically drained under normal management, that have not been drained, will have lower yields than given in the tables for commonly grown crops.

Index Calculations

The following tables present factors used in calculating yields and indices for soil map units in Illinois.

Revised Table 2 in UI Bulletin 810 (Productivity of Illinois Soils Under Average Management, Slightly Eroded, 0 to 2 Percent Slopes) provides base yield index factors for calculating representative values (RV) for soil map units. The resulting Average Productivity Index and Average Pasture Yield Index values reflect each soil map unit's overall productivity and productivity for pasture under what is considered to be average management.

Revised Table S2 in UI Bulletin 811 (Productivity of Illinois Soils Under Optimum Management, Slightly Eroded, 0 to 2 Percent Slopes) provides index factors for determining RV Optimum Productivity index and Optimum row crops and hay yield indices. The calculated indices reflect soil productivity for crops and hay considered to be dominantly under optimum management.

Hay and Pasture yields are delivered as Grass-Legume mixed hay and Grass-Legume mixed pasture. Well drained soils typically use alfalfa yields, whereas wetter soils are more mixed, assuming that if alfalfa can be grown, it will; but dominantly both hay and pasture will have mixed grass and legume species.

Factors used for slope and erosion are applied as defined by bulletin 810 and 811. Illinois NRCS uses Relative Value slope, assigned erosion class, and a simple table to determine the value to use from table S3 identified in bulletin 811 for row crops and hay. Table 7 in bulletin 810 is used with the Rv slope and assigned erosion to determine animal unit days which are then divided by 30 to get animal unit months.

Bulletin 811 table for slope and erosion factor used for Optimum PI, Row crops, and Hay (modified to include slopes to tenths and half percent):

	fav	fav	fav	unfav	unfav	unfav	Substratum Favorable\Unfavorable
% Slope	1	2	3	1	2	3	Degree of Erosion 1,2,3
0	1.00	0.96	0.89	1.00	0.94	0.79	
0.1	1.00	0.96	0.89	1.00	0.94	0.79	
0.2	1.00	0.96	0.89	1.00	0.94	0.79	
0.3	1.00	0.96	0.89	1.00	0.94	0.79	
0.4	1.00	0.96	0.89	1.00	0.94	0.79	
0.5	1.00	0.96	0.89	1.00	0.94	0.79	
0.6	1.00	0.96	0.89	1.00	0.94	0.79	
0.7	1.00	0.96	0.89	1.00	0.94	0.79	
0.8	1.00	0.96	0.89	1.00	0.94	0.79	
0.9	1.00	0.96	0.89	1.00	0.94	0.79	
1	1.00	0.96	0.89	1.00	0.94	0.79	
1.5	1.00	0.96	0.89	1.00	0.94	0.79	
2	0.99	0.95	0.88	0.99	0.93	0.78	
2.5	0.99	0.95	0.88	0.99	0.93	0.78	
3	0.99	0.95	0.88	0.99	0.93	0.78	
3.5	0.99	0.95	0.88	0.99	0.93	0.78	

4	0.98	0.94	0.87	0.98	0.92	0.77	
4.5	0.98	0.94	0.87	0.98	0.92	0.76	
5	0.98	0.94	0.87	0.98	0.92	0.76	
5.5	0.98	0.94	0.87	0.97	0.91	0.76	
6	0.98	0.94	0.87	0.97	0.91	0.75	
6.5	0.97	0.93	0.86	0.97	0.91	0.75	
7	0.97	0.93	0.86	0.96	0.90	0.74	
7.5	0.97	0.93	0.86	0.96	0.90	0.74	
8	0.97	0.93	0.86	0.96	0.89	0.74	
8.5	0.96	0.92	0.85	0.95	0.89	0.73	
9	0.96	0.92	0.85	0.95	0.88	0.73	
9.5	0.95	0.91	0.84	0.94	0.88	0.72	
10	0.95	0.91	0.84	0.94	0.87	0.72	
10.5	0.95	0.91	0.83	0.93	0.86	0.71	
11	0.94	0.90	0.83	0.93	0.86	0.71	
11.5	0.94	0.90	0.82	0.92	0.85	0.70	
12	0.93	0.89	0.82	0.92	0.85	0.70	
12.5	0.93	0.89	0.81	0.91	0.84	0.69	
13	0.92	0.88	0.80	0.90	0.83	0.68	
13.5	0.92	0.88	0.80	0.90	0.83	0.68	
14	0.91	0.87	0.79	0.89	0.82	0.67	
14.5	0.91	0.86	0.79	0.89	0.82	0.67	
15	0.90	0.86	0.78	0.88	0.81	0.66	
15.5	0.89	0.85	0.77	0.87	0.80	0.65	
16	0.89	0.84	0.77	0.87	0.80	0.65	
16.5	0.88	0.83	0.76	0.86	0.79	0.64	
17	0.88	0.83	0.76	0.86	0.79	0.64	
17.5	0.87	0.82	0.75	0.85	0.78	0.63	
18	0.86	0.81	0.74	0.84	0.77	0.62	
18.5	0.86	0.81	0.74	0.83	0.77	0.62	
19	0.85	0.80	0.73	0.83	0.76	0.61	
19.5	0.84	0.79	0.72	0.82	0.75	0.60	
20	0.84	0.79	0.72	0.81	0.75	0.60	
20.5	0.83	0.78	0.71	0.80	0.74	0.59	
21	0.82	0.77	0.70	0.79	0.73	0.58	
21.5	0.81	0.76	0.69	0.79	0.72	0.57	
22	0.81	0.76	0.69	0.78	0.72	0.57	
22.5	0.80	0.75	0.68	0.77	0.71	0.56	
23	0.79	0.74	0.67	0.76	0.70	0.55	
23.5	0.78	0.73	0.66	0.75	0.69	0.54	
24	0.77	0.72	0.65	0.74	0.68	0.53	
24.5	0.76	0.71	0.64	0.73	0.67	0.52	
25	0.76	0.71	0.64	0.73	0.67	0.52	
25.5	0.75	0.70	0.63	0.72	0.66	0.51	
26	0.74	0.69	0.62	0.71	0.65	0.50	
26.5	0.73	0.68	0.61	0.70	0.64	0.49	
27	0.72	0.67	0.60	0.69	0.63	0.48	
27.5	0.71	0.66	0.59	0.68	0.62	0.47	

28	0.70	0.65	0.58	0.67	0.61	0.46	
28.5	0.69	0.64	0.57	0.66	0.60	0.45	
29	0.68	0.63	0.56	0.65	0.59	0.44	
29.5	0.67	0.62	0.55	0.64	0.58	0.43	
30	0.66	0.61	0.54	0.63	0.57	0.42	
30.5	0.64	0.59	0.52	0.61	0.55	0.40	
31	0.63	0.58	0.51	0.60	0.54	0.39	
31.5	0.62	0.57	0.50	0.59	0.53	0.38	
32	0.61	0.56	0.49	0.58	0.52	0.37	
32.5	0.60	0.55	0.48	0.57	0.51	0.36	
33	0.59	0.54	0.47	0.56	0.50	0.35	
33.5	0.58	0.54	0.46	0.55	0.49	0.34	
34	0.58	0.53	0.46	0.55	0.49	0.34	
34.5	0.57	0.52	0.45	0.54	0.48	0.33	
35	0.56	0.52	0.44	0.53	0.47	0.32	
35.5	0.55	0.51	0.43	0.52	0.46	0.31	
36	0.54	0.50	0.42	0.51	0.45	0.30	
36.5	0.54	0.49	0.42	0.51	0.45	0.30	
37	0.53	0.49	0.41	0.50	0.44	0.29	
37.5	0.52	0.48	0.40	0.49	0.43	0.28	
38	0.52	0.48	0.40	0.49	0.43	0.28	
38.5	0.51	0.47	0.39	0.48	0.42	0.27	
39	0.51	0.47	0.39	0.48	0.42	0.27	
39.5	0.50	0.47	0.39	0.48	0.42	0.27	
40	0.50	0.46	0.38	0.47	0.41	0.26	
40.5	0.50	0.46	0.38	0.47	0.41	0.26	
41	0.49	0.46	0.37	0.47	0.40	0.25	
41.5	0.49	0.45	0.37	0.46	0.40	0.25	
42	0.49	0.45	0.37	0.46	0.40	0.25	
42.5	0.48	0.44	0.36	0.45	0.39	0.24	
43	0.48	0.44	0.36	0.45	0.39	0.24	
43.5 to 65	0.47	0.42	0.34	0.44	0.37	0.22	

Bulletin 810 table for slope and erosion factor used for Average PI, and Pasture (modified to include slopes to tenths and half percent):

	fav	fav	fav	unfav	unfav	unfav	Substratum Favorable\Unfavorable
% Slope	**1**	**2**	**3**	**1**	**2**	**3**	Degree of Erosion 1,2,3
0	1.00	0.96	0.88	1.00	0.93	0.78	
0.1	1.00	0.96	0.88	1.00	0.93	0.78	
0.2	1.00	0.96	0.88	1.00	0.93	0.78	
0.3	1.00	0.96	0.88	1.00	0.93	0.78	
0.4	1.00	0.96	0.88	1.00	0.93	0.78	
0.5	1.00	0.96	0.88	1.00	0.93	0.78	
0.6	1.00	0.96	0.88	1.00	0.93	0.78	
0.7	1.00	0.96	0.88	1.00	0.93	0.78	

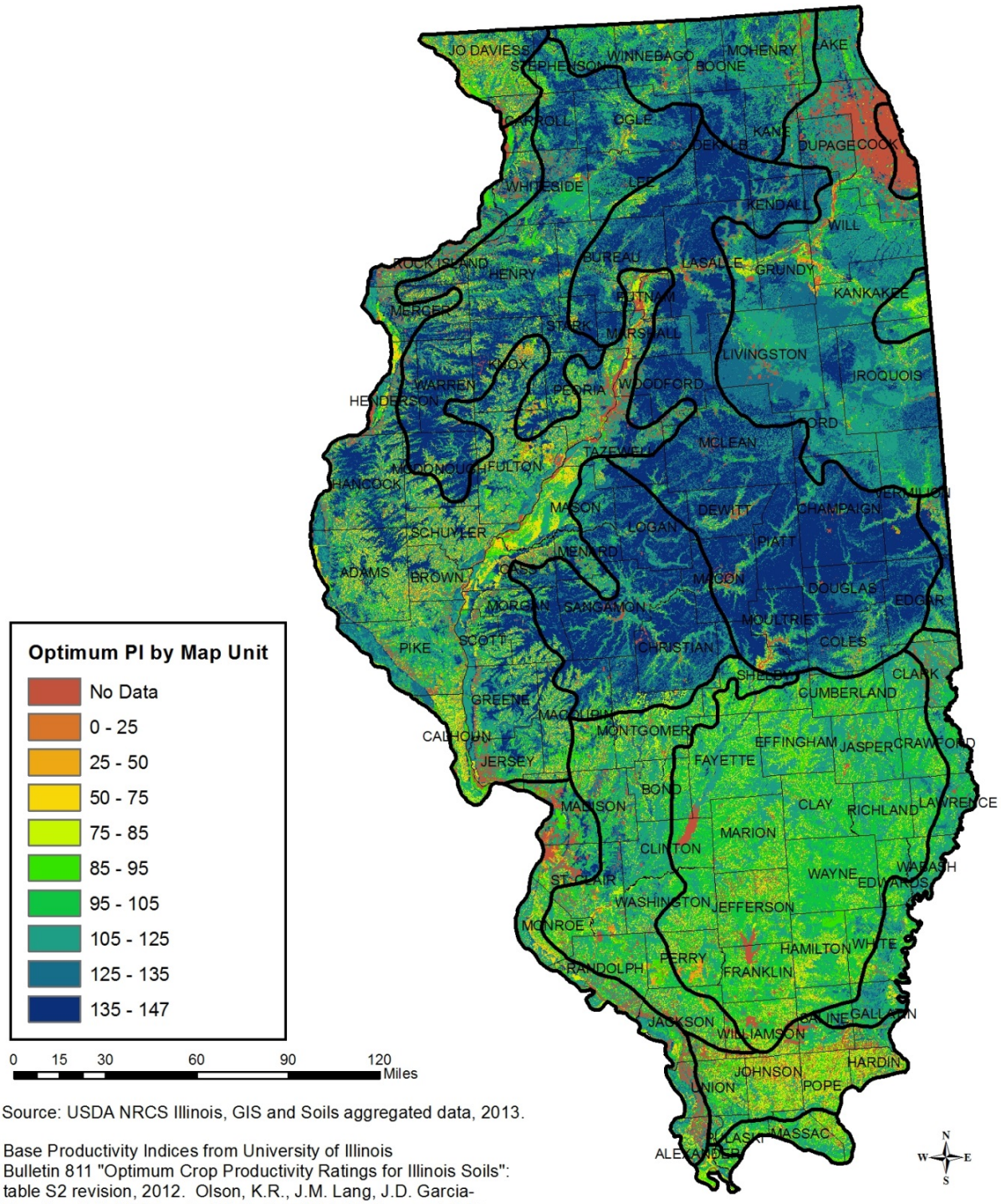
0.8	1.00	0.96	0.88	1.00	0.93	0.78	
0.9	1.00	0.96	0.88	1.00	0.93	0.78	
1	1.00	0.96	0.88	1.00	0.93	0.78	
1.5	1.00	0.96	0.88	1.00	0.93	0.78	
2	1.00	0.96	0.87	0.99	0.92	0.77	
2.5	0.99	0.95	0.87	0.99	0.92	0.77	
3	0.99	0.95	0.86	0.98	0.91	0.76	
3.5	0.99	0.95	0.86	0.98	0.91	0.76	
4	0.99	0.95	0.86	0.98	0.91	0.76	
4.5	0.98	0.94	0.86	0.97	0.90	0.75	
5	0.98	0.94	0.85	0.97	0.90	0.75	
5.5	0.98	0.94	0.85	0.97	0.90	0.74	
6	0.97	0.93	0.85	0.96	0.89	0.74	
6.5	0.97	0.93	0.85	0.96	0.89	0.73	
7	0.96	0.92	0.84	0.95	0.88	0.73	
7.5	0.96	0.92	0.84	0.95	0.88	0.72	
8	0.96	0.92	0.83	0.95	0.87	0.72	
8.5	0.95	0.91	0.83	0.94	0.87	0.71	
9	0.95	0.91	0.82	0.94	0.86	0.71	
9.5	0.94	0.90	0.82	0.93	0.86	0.70	
10	0.94	0.90	0.81	0.93	0.85	0.70	
10.5	0.94	0.89	0.80	0.92	0.84	0.69	
11	0.93	0.89	0.80	0.92	0.84	0.69	
11.5	0.93	0.88	0.79	0.91	0.83	0.68	
12	0.92	0.88	0.79	0.91	0.83	0.68	
12.5	0.92	0.87	0.78	0.90	0.82	0.67	
13	0.91	0.86	0.78	0.89	0.81	0.66	
13.5	0.91	0.86	0.77	0.89	0.81	0.66	
14	0.90	0.85	0.77	0.88	0.80	0.65	
14.5	0.90	0.84	0.76	0.88	0.80	0.65	
15	0.89	0.84	0.76	0.87	0.79	0.64	
15.5	0.88	0.83	0.75	0.86	0.78	0.63	
16	0.88	0.82	0.75	0.86	0.78	0.63	
16.5	0.87	0.81	0.74	0.85	0.77	0.62	
17	0.87	0.81	0.74	0.85	0.77	0.62	
17.5	0.86	0.80	0.73	0.84	0.76	0.61	
18	0.85	0.79	0.72	0.83	0.75	0.60	
18.5	0.85	0.78	0.71	0.82	0.75	0.60	
19	0.84	0.78	0.71	0.82	0.74	0.59	
19.5	0.83	0.77	0.70	0.81	0.73	0.58	
20	0.83	0.76	0.69	0.80	0.73	0.58	
20.5	0.82	0.75	0.68	0.79	0.72	0.57	
21	0.81	0.74	0.67	0.78	0.71	0.56	
21.5	0.80	0.74	0.67	0.78	0.70	0.55	
22	0.80	0.73	0.66	0.77	0.70	0.55	
22.5	0.79	0.72	0.65	0.76	0.69	0.54	
23	0.78	0.71	0.64	0.75	0.68	0.53	
23.5	0.77	0.70	0.63	0.74	0.67	0.52	

24	0.76	0.69	0.63	0.73	0.66	0.51	
24.5	0.75	0.68	0.62	0.72	0.65	0.50	
25	0.75	0.68	0.61	0.72	0.65	0.50	
25.5	0.74	0.67	0.60	0.71	0.64	0.49	
26	0.73	0.66	0.59	0.70	0.63	0.48	
26.5	0.72	0.65	0.59	0.69	0.62	0.47	
27	0.71	0.64	0.58	0.68	0.61	0.46	
27.5	0.70	0.63	0.57	0.67	0.60	0.45	
28	0.69	0.62	0.56	0.66	0.59	0.44	
28.5	0.68	0.61	0.55	0.65	0.58	0.43	
29	0.67	0.60	0.54	0.64	0.57	0.42	
29.5	0.66	0.59	0.53	0.63	0.56	0.41	
30	0.65	0.58	0.52	0.62	0.55	0.40	
30.5	0.64	0.57	0.51	0.61	0.54	0.39	
31	0.63	0.56	0.50	0.60	0.53	0.38	
31.5	0.62	0.55	0.49	0.59	0.52	0.37	
32	0.61	0.54	0.48	0.58	0.51	0.36	
32.5	0.59	0.53	0.46	0.56	0.49	0.34	
33	0.58	0.52	0.45	0.55	0.48	0.33	
33.5	0.57	0.52	0.44	0.54	0.47	0.32	
34	0.57	0.51	0.44	0.54	0.47	0.32	
34.5	0.56	0.50	0.43	0.53	0.46	0.31	
35	0.55	0.50	0.42	0.52	0.45	0.30	
35.5	0.54	0.49	0.41	0.51	0.44	0.29	
36	0.53	0.48	0.40	0.50	0.43	0.28	
36.5	0.53	0.47	0.40	0.50	0.43	0.28	
37	0.52	0.47	0.39	0.49	0.42	0.27	
37.5	0.51	0.46	0.38	0.48	0.41	0.26	
38	0.51	0.46	0.38	0.48	0.41	0.26	
38.5	0.50	0.45	0.37	0.47	0.40	0.25	
39	0.50	0.45	0.37	0.47	0.40	0.25	
39.5	0.49	0.44	0.36	0.46	0.39	0.24	
40	0.49	0.44	0.36	0.46	0.39	0.24	
40.5	0.49	0.44	0.36	0.46	0.39	0.24	
41	0.48	0.43	0.35	0.45	0.38	0.23	
41.5	0.48	0.43	0.35	0.45	0.38	0.23	
42	0.47	0.42	0.34	0.45	0.37	0.22	
42.5 to 65	0.47	0.42	0.34	0.44	0.37	0.22	

Flooding and drainage factors:
Frequently flooded brief duration: 0.9
Occasionally flooded, brief duration: 1.0
Rarely flooded, brief duration: 1.0
Frequently flooded, long duration: 0.7
Occasionally flooded, long duration: 0.85
Undrained, Wet phases: 0.7

Factors were applied to the base University of Illinois Data and Productivity and Yield Indices were adjusted. The base tables and calculated estimated tables are separate form this document. The calculated estimated tables were used to produce statewide Productivity and Yield Maps.

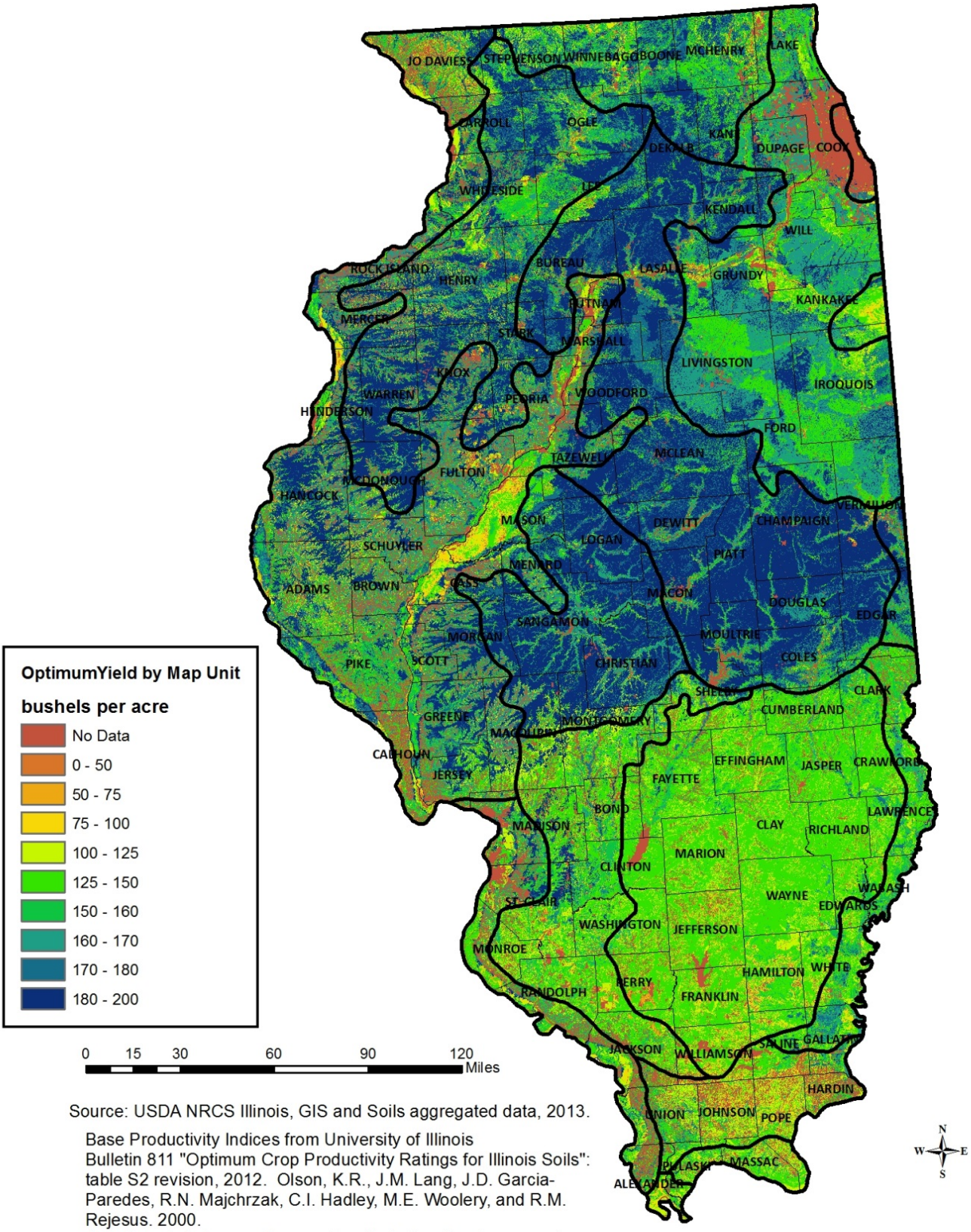
Illinois Productivity Index 2013



Source: USDA NRCS Illinois, GIS and Soils aggregated data, 2013.

Base Productivity Indices from University of Illinois Bulletin 811 "Optimum Crop Productivity Ratings for Illinois Soils": table S2 revision, 2012. Olson, K.R., J.M. Lang, J.D. Garcia-Paredes, R.N. Majchrzak, C.I. Hadley, M.E. Woolery, and R.M. Rejesus. 2000.
Adjustments to base values made with factors for slope, erosion, flooding, surface texture, and substratum phases by Illinois NRCS.

Illinois Corn Yield Index 2013

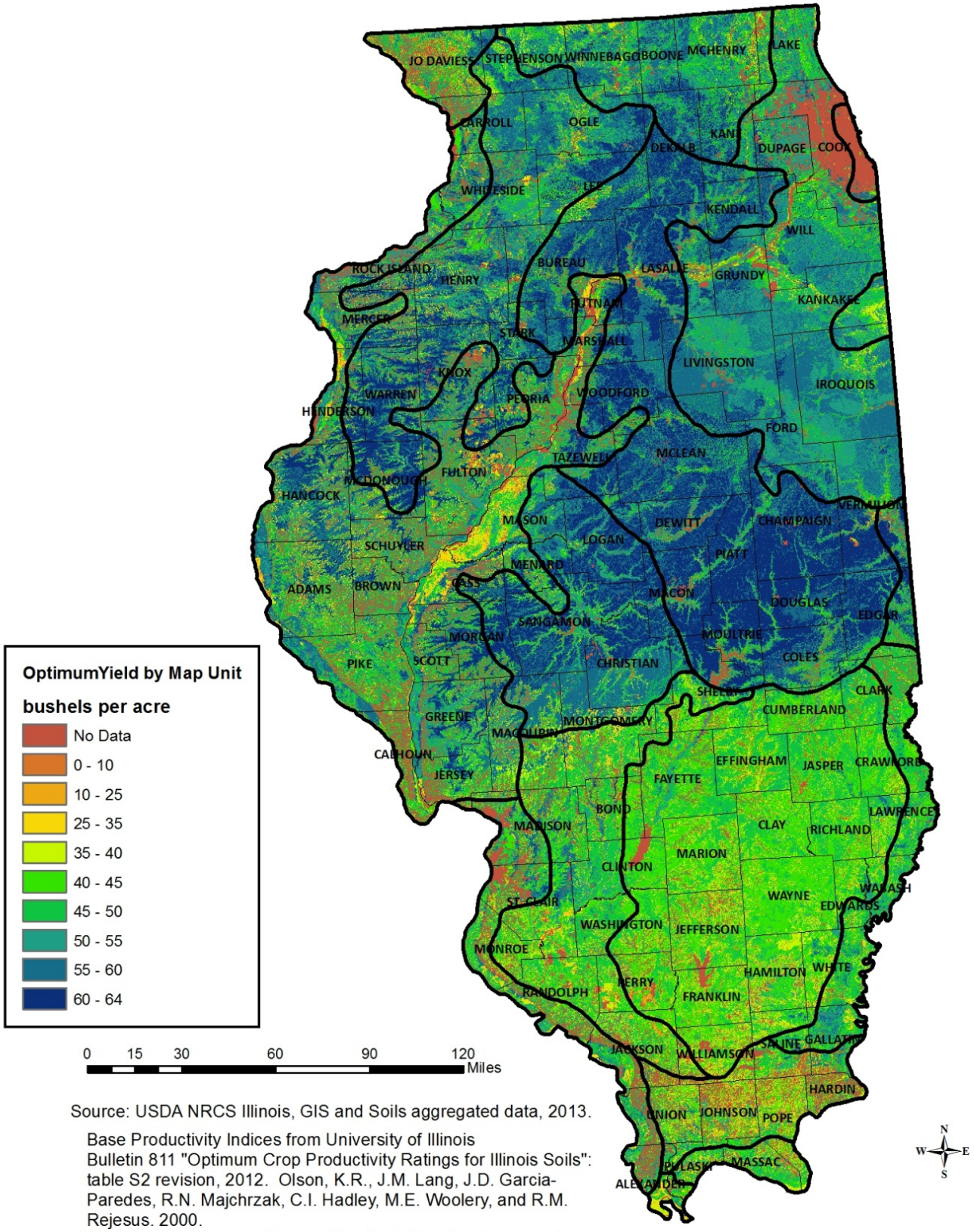


Source: USDA NRCS Illinois, GIS and Soils aggregated data, 2013.

Base Productivity Indices from University of Illinois Bulletin 811 "Optimum Crop Productivity Ratings for Illinois Soils": table S2 revision, 2012. Olson, K.R., J.M. Lang, J.D. Garcia-Paredes, R.N. Majchrzak, C.I. Hadley, M.E. Woolery, and R.M. Rejesus. 2000.

Adjustments to base values made with factors for slope, erosion, flooding, surface texture, and substratum phases by Illinois NRCS.

Illinois Soybean Yield Index 2013

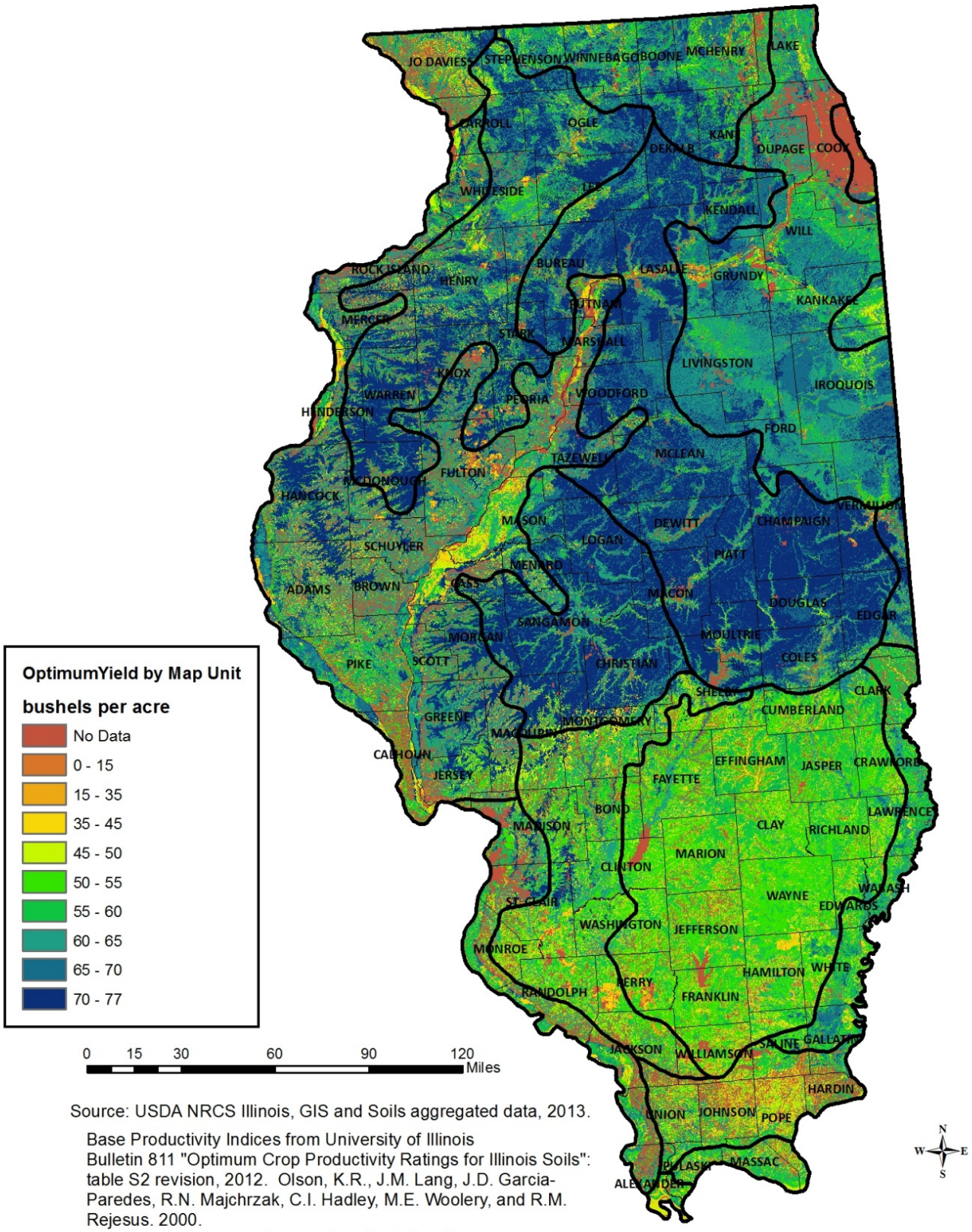


Source: USDA NRCS Illinois, GIS and Soils aggregated data, 2013.

Base Productivity Indices from University of Illinois Bulletin 811 "Optimum Crop Productivity Ratings for Illinois Soils": table S2 revision, 2012. Olson, K.R., J.M. Lang, J.D. Garcia-Paredes, R.N. Majchrzak, C.I. Hadley, M.E. Woolery, and R.M. Rejesus. 2000.

Adjustments to base values made with factors for slope, erosion, flooding, surface texture, and substratum phases by Illinois NRCS.

Illinois Winter Wheat Yield Index 2013



Source: USDA NRCS Illinois, GIS and Soils aggregated data, 2013.

Base Productivity Indices from University of Illinois Bulletin 811 "Optimum Crop Productivity Ratings for Illinois Soils": table S2 revision, 2012. Olson, K.R., J.M. Lang, J.D. Garcia-Paredes, R.N. Majchrzak, C.I. Hadley, M.E. Woolery, and R.M. Rejesus. 2000.

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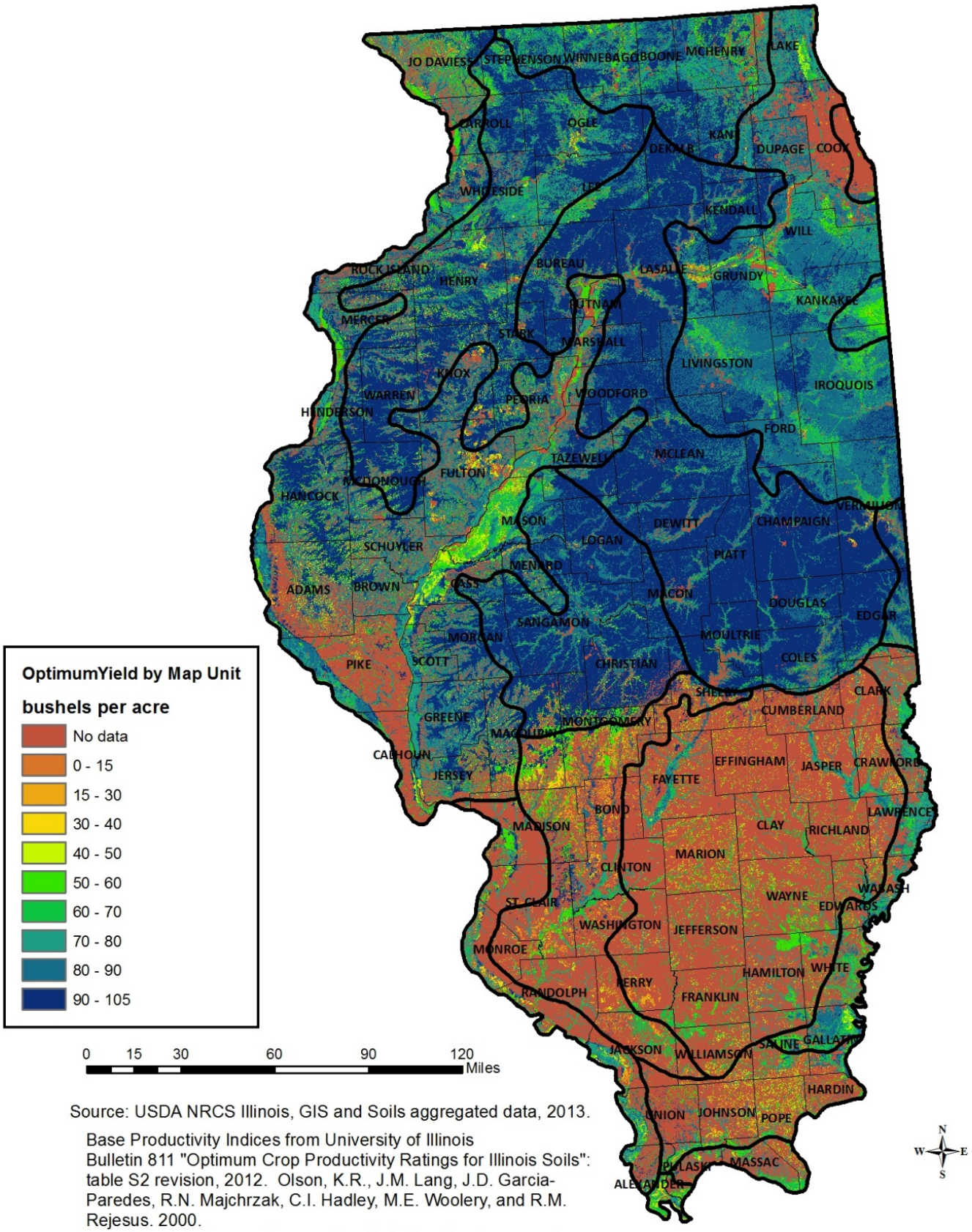
Illinois Oat Yield Index 2013

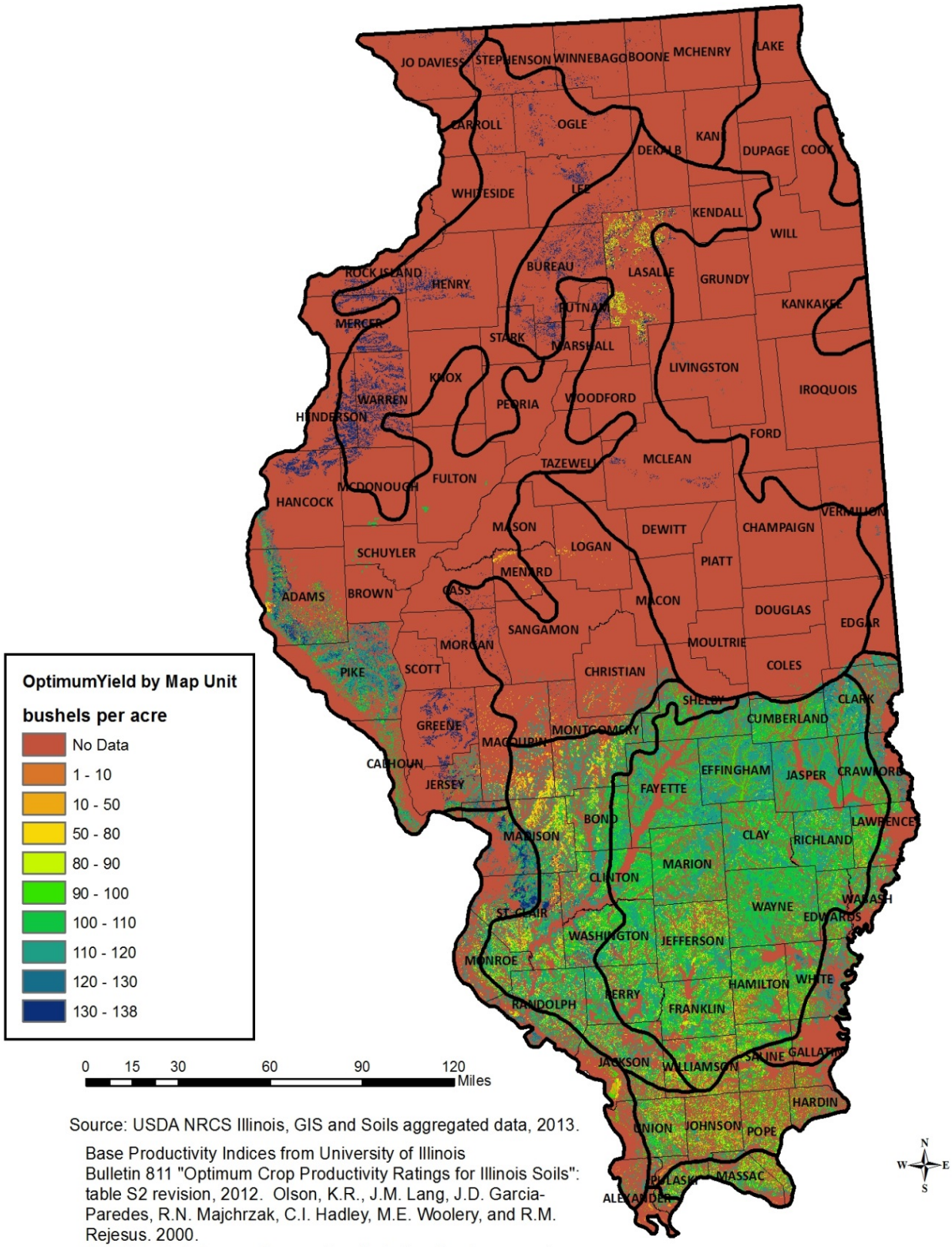


Source: USDA NRCS Illinois, GIS and Soils aggregated data, 2013.

Base Productivity Indices from University of Illinois Bulletin 811 "Optimum Crop Productivity Ratings for Illinois Soils": table S2 revision, 2012. Olson, K.R., J.M. Lang, J.D. Garcia-Paredes, R.N. Majchrzak, C.I. Hadley, M.E. Woolery, and R.M. Rejesus. 2000.

Adjustments to base values made with factors for slope, erosion, flooding, surface texture, and substratum phases by Illinois NRCS.

Illinois Grain Sorghum Yield Index 2013

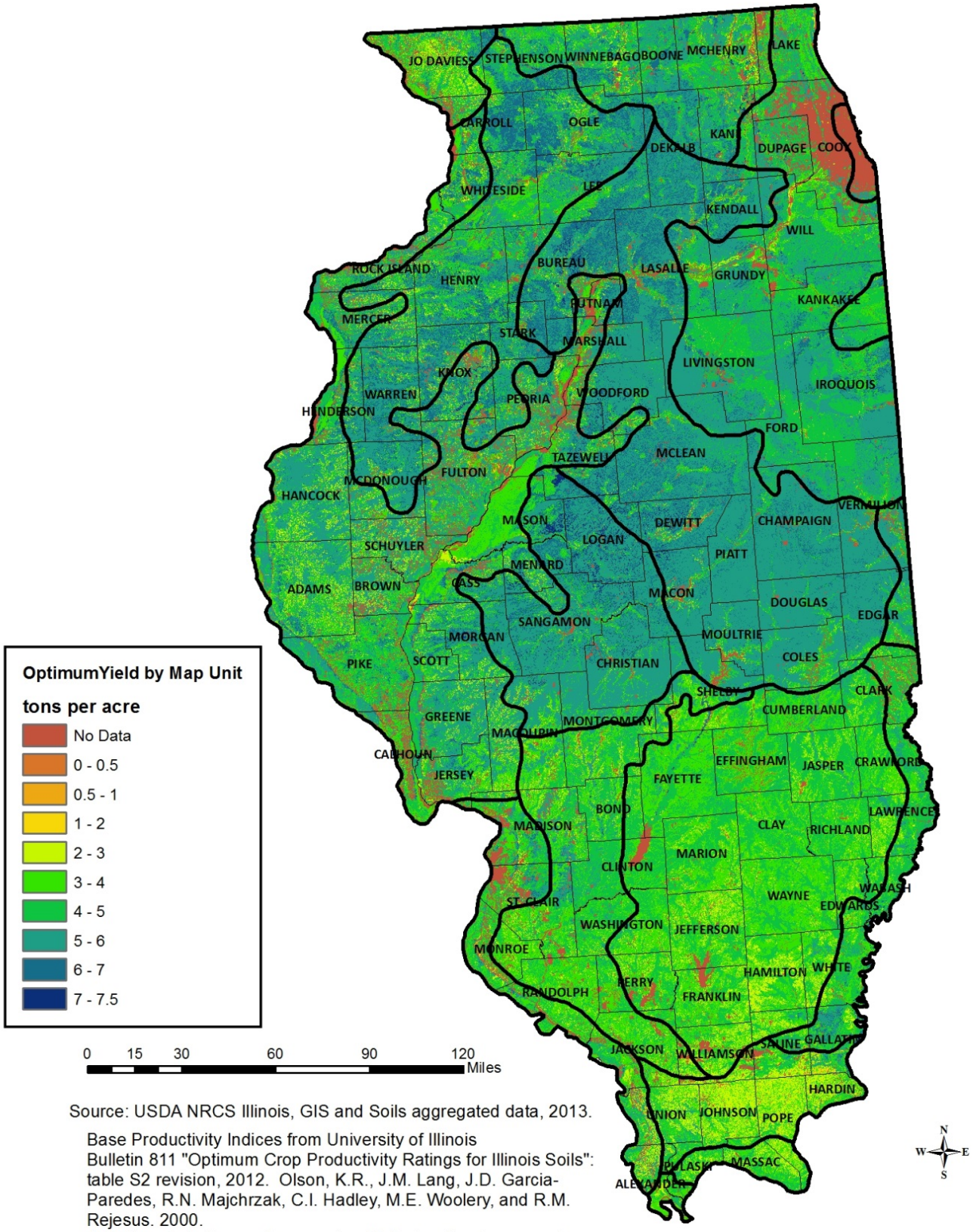


Source: USDA NRCS Illinois, GIS and Soils aggregated data, 2013.

Base Productivity Indices from University of Illinois Bulletin 811 "Optimum Crop Productivity Ratings for Illinois Soils": table S2 revision, 2012. Olson, K.R., J.M. Lang, J.D. Garcia-Paredes, R.N. Majchrzak, C.I. Hadley, M.E. Woolery, and R.M. Rejesus. 2000.

Adjustments to base values made with factors for slope, erosion, flooding, surface texture, and substratum phases by Illinois NRCS.

Illinois Grass-Legume Hay Yield Index 2013

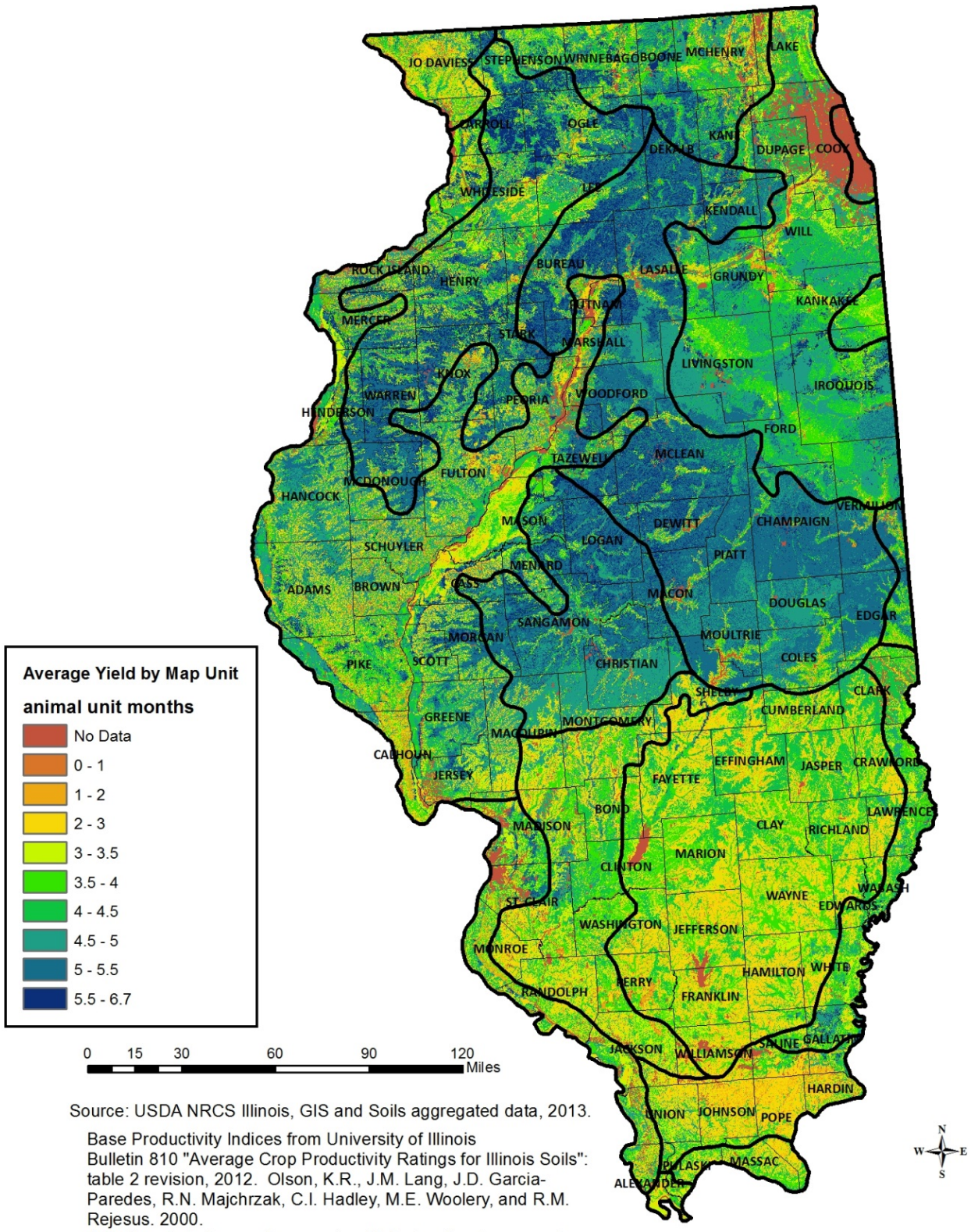


Source: USDA NRCS Illinois, GIS and Soils aggregated data, 2013.

Base Productivity Indices from University of Illinois Bulletin 811 "Optimum Crop Productivity Ratings for Illinois Soils": table S2 revision, 2012. Olson, K.R., J.M. Lang, J.D. Garcia-Paredes, R.N. Majchrzak, C.I. Hadley, M.E. Woolery, and R.M. Rejesus. 2000.

Adjustments to base values made with factors for slope, erosion, flooding, surface texture, and substratum phases by Illinois NRCS.

Illinois Grass-Legume Pasture Yield Index 2013



Source: USDA NRCS Illinois, GIS and Soils aggregated data, 2013.

Base Productivity Indices from University of Illinois Bulletin 810 "Average Crop Productivity Ratings for Illinois Soils": table 2 revision, 2012. Olson, K.R., J.M. Lang, J.D. Garcia-Paredes, R.N. Majchrzak, C.I. Hadley, M.E. Woolery, and R.M. Rejesus. 2000.

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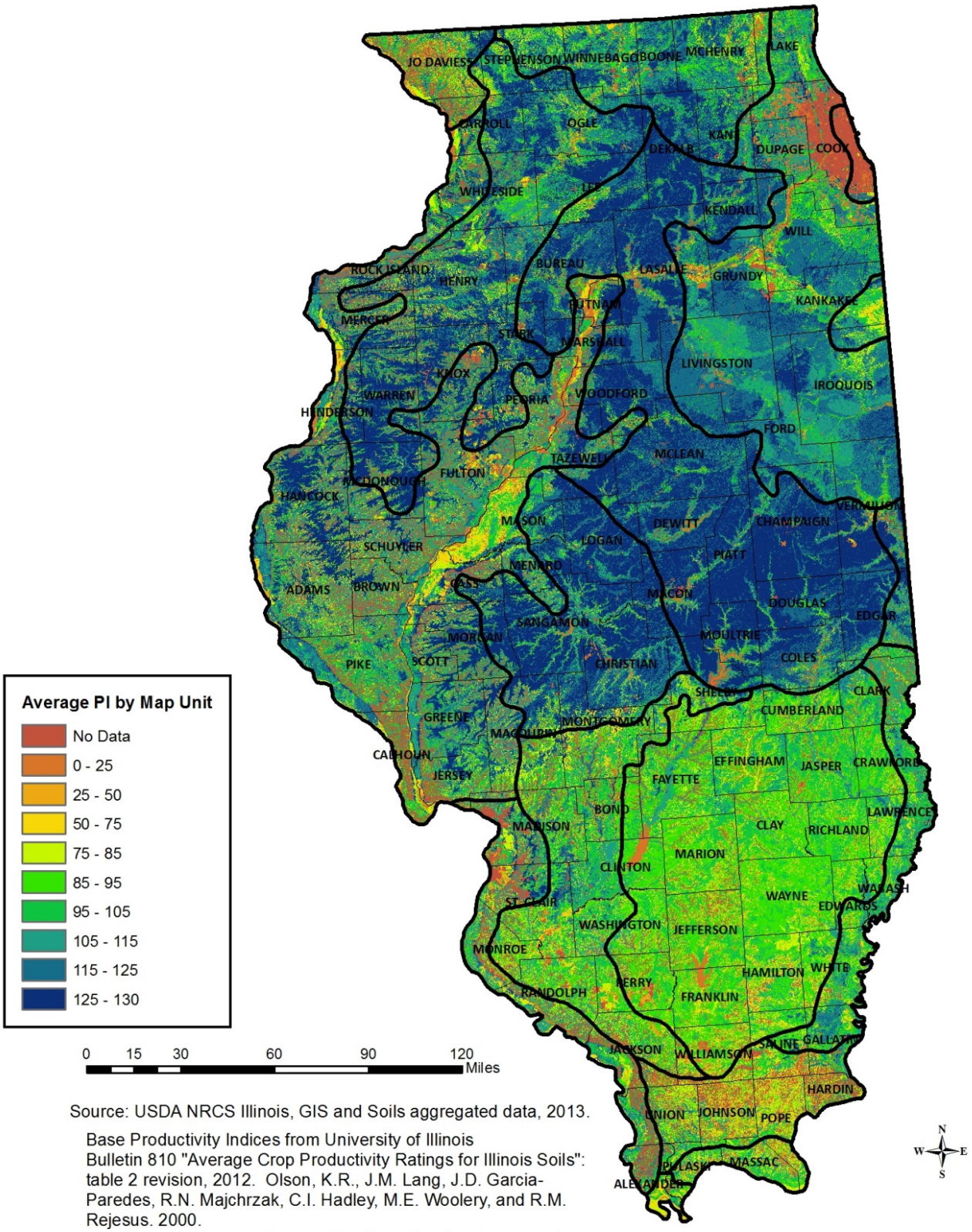
Illinois Average Productivity Index 2013



Source: USDA NRCS Illinois, GIS and Soils aggregated data, 2013.

Base Productivity Indices from University of Illinois Bulletin 810 "Average Crop Productivity Ratings for Illinois Soils": table 2 revision, 2012. Olson, K.R., J.M. Lang, J.D. Garcia-Paredes, R.N. Majchrzak, C.I. Hadley, M.E. Woolery, and R.M. Rejesus. 2000.

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