

IN THE CIRCUIT COURT OF JACKSON COUNTY
STATE OF MISSOURI, AT KANSAS CITY

TERRENCE WISE, et al.,

Plaintiffs,

v.

STATE OF MISSOURI, et al.,

Defendants.

Case No. 2516-CV29597

Division 11

ELIZABETH HEALEY, et al.,

Plaintiffs,

v.

STATE OF MISSOURI, et al.,

Defendants.

Case No. 2516-CV31273

Division 11

Rebuttal Report of Dr. Jonathan Rodden

Dr. Jonathan Rodden

January 14, 2026

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I. INTRODUCTION AND SUMMARY OF FINDINGS

I have been asked to reply to the expert reports of Dr. Sean Trende and Dr. M.V. Hood III, both of which were provided to me on January 8, 2026. Both reports focus primarily on a notion of compactness that draws on standard measures from the academic literature that consider the physical shape and size or visual appearance of electoral districts. But my understanding based on *Pearson v. Koster*, 367 S.W.3d 36 (Mo. banc 2012), is that Missouri courts reject “the proposition that ‘compact’ refers solely to physical shape or size,” instead characterizing these factors as “relevant” but “not the decisive factor in determining whether a district departs from the principle of compactness.” Dr. Trende and Dr. Hood have little to say about Missouri’s definition of compactness as “closely united territory,” which encompasses broader considerations of the arrangement of people in geographic space and an analysis of the social and economic ties between them.

The first section of this report examines the data associated with the “physical shape” approach to compactness favored by Dr. Trende and Dr. Hood. When placed in full context, I demonstrate that under this approach, District 5 in the 2025 Plan is one of the most non-compact Missouri congressional districts in the last 50 years.

The second section of my report suggests, as an alternative to metrics focused on “physical shape,” a quantitative approach to “closely united territory” that pays attention to population distribution and density. Using this metric, which I term “district sprawl,” we see that the 2025 Plan’s District 5 is by far the least compact Kansas City-based district in Missouri history.

Next, I reply to Dr. Trende’s and Dr. Hood’s discussion of county and municipality splits. I demonstrate that while the raw number of county and municipal splits is smaller in the 2025 Plan than in the 2022 Plan, the splits affect more people and are therefore more consequential in the 2025 Plan.

Finally, I evaluate Dr. Trende’s claim that non-compact features of the 2025 Plan can be understood, at least in the Kansas City area, as arising from an attempt to keep state senate districts together. I demonstrate that state senate district boundaries may have little correspondence with the notion of closely united territory, and in any case, the 2025 Plan undermines any possible aspiration to adhere to state senate district boundaries in the greater Kansas City area.

II. STATISTICAL MEASURES OF “PHYSICAL SHAPE” AS INDICATORS OF COMPACTNESS

Both Dr. Trende and Dr. Hood dedicate the lion’s share of their reports to consideration of traditional measures of compactness from the academic literature. The Reock score captures the extent to which a district approximates a minimal bounding circle, penalizing districts that are distended. The Polsby-Popper score considers a circle that has the same perimeter as the district and calculates the percentage of such a circle that the district would fill, thus penalizing a district with many arms and inlets that add to its perimeter. The Schwarzberg score (discussed by Dr. Hood but not Dr. Trende) is closely related to the Polsby-Popper score: it is the ratio of the perimeter of the district to the circumference of a circle whose area is equal to the area of the district. This is the only indicator considered here where higher numbers are associated with *lower* levels of compactness. Instead of a circle, the Convex Hull score (discussed by Dr. Trende) examines the percentage of the district that would fit within a minimal bounding polygon, rewarding a distended district resembling a very elongated rectangle, but penalizing, for instance, a horseshoe-shaped district. Finally, Dr. Trende also discusses a metric called “you know it when you see it” (KIWYSI), which is based on subjective judgments about the types of districts viewed as acceptable.

To begin, Dr. Trende’s report presents an incomplete summary of how districts in Missouri’s congressional plans from 1972 to 2025 perform on these metrics. Dr. Trende calculates the Reock, Polsby-Popper, Convex Hull, and KIWYSI statistics for each district in each enacted Missouri congressional plan from 1972 to 2022 as well as the 2025 Plan, which should result in scores for a total of 61 districts (because the number of districts in Missouri’s congressional map has changed over time: ten in 1972; nine in 1982, 1992, and 2002; and eight in 2012, 2022, and 2025). But Dr. Trende does not present the traditional compactness metrics for each of these 61 congressional districts. Instead, he presents a table of statewide averages for each metric over time. See Expert Report of Sean P. Trende at 19 (Table 2). Statewide averages are of limited value in assessing the compactness of the districts in the Kansas City area. Indeed, statewide averages can mask the existence of a highly non-compact district in one part of the state with more compact districts elsewhere.

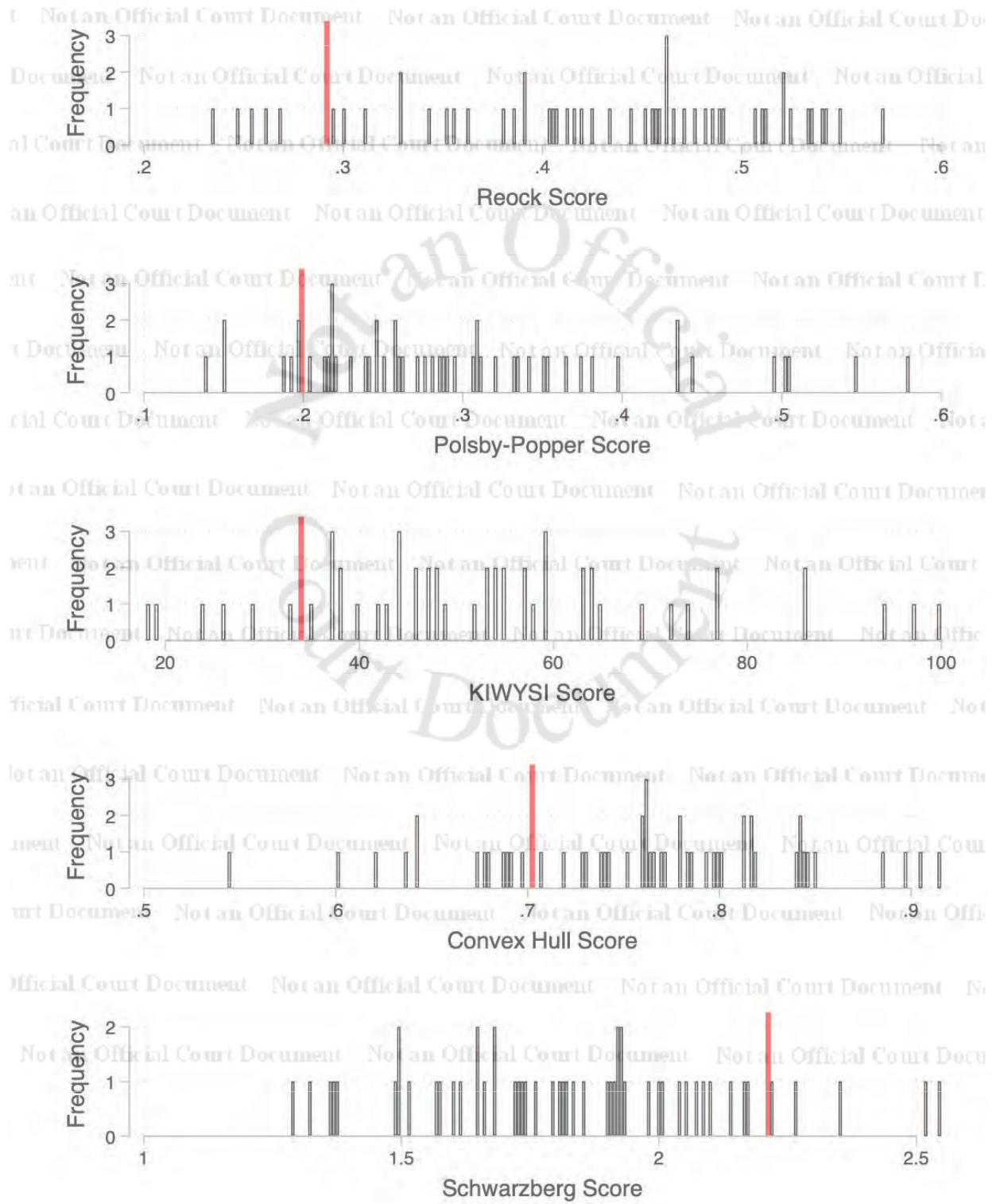
Without explaining why, Dr. Trende also presents the average statewide traditional metrics of compactness for the current operative state legislative districts. Drawing state legislative

districts in Missouri is an entirely different undertaking than drawing congressional districts. The Missouri Constitution imposes partisan fairness and competitiveness requirements for state legislative maps. It also requires that state legislative maps minimize splits of counties and cities and provides that more populous political subdivisions should generally be divided rather than less populous subdivisions. This means that a map-drawer crafting state legislative districts may string together a handful of entire counties within a relatively small region while applying different substantive requirements than for congressional districts. Direct comparisons of compactness metrics across these very different scales for redistricting for different types of districts makes little sense.

Dr. Trende provides information specific to individual congressional districts only in the text of his report, but even there, he only provides information for a small handful of districts. For each compactness metric, Dr. Trende provides a short list of districts with lower compactness scores than District 5 in the 2025 Plan. The purpose of this exercise is evidently to demonstrate that the low compactness score of District 5 in the 2025 Plan is not singular in recent Missouri history. This exercise is of limited usefulness, however, since it contrasts the compactness score of District 5—historically one of the most compact in the state—with districts that are perennially relatively near the bottom of compactness score ranking due to their geography (such as District 6 in northern Missouri). As demonstrated in my initial report, Missouri map-drawers have traditionally been able to draw a relatively compact District 5 based in Kansas City.

Even if one accepts it is worthwhile to contrast District 5's performance on traditional metrics of compactness with other districts in Missouri's congressional map, a review of the full set of Missouri's congressional districts since 1972 demonstrates that the 2025 Plan's District 5 is an outlier. **Figure 1** below provides a histogram of the traditional compactness metrics for all 61 congressional districts drawn since 1972, where the compactness measure for District 5 in the 2025 Plan is indicated with a bold red vertical line. This figure indicates that even when throwing all Missouri congressional districts together without regard for specific constraints of local geography, jurisdictional structure, or population density, District 5 in the 2025 Plan is relatively non-compact by most measures.

Figure 1: Histograms of Traditional “Physical Shape” Compactness Metrics for All Missouri Congressional Districts since 1972, with District 5 of the 2025 Plan Indicated in Red



The Reock and KIWYSI scores of District 5 in the 2025 Plan are ranked 55th out of the 61 districts, which places it in the 10th percentile.¹ District 5 in the 2025 Plan ranked 54th on the Polsby-Popper metric, which places it in the 11.5th percentile. Note that higher values of the Schwarzberg score indicate lower levels of compactness, so that District 5 in the 2025 Plan is ranked 56th out of 61 districts, placing it in the 8th percentile. Only on the Convex Hull score is District 5 in the 2025 Plan closer to the middle of the distribution, ranking 46th, placing it in the 25th percentile. This is not surprising, since District 5 in the 2025 Plan does not have the distinctive feature of low compactness according to the Convex Hull score: a large “carved out” section in a horseshoe-like arrangement, such as District 3, which wraps around St. Louis County in the 2022 Plan.

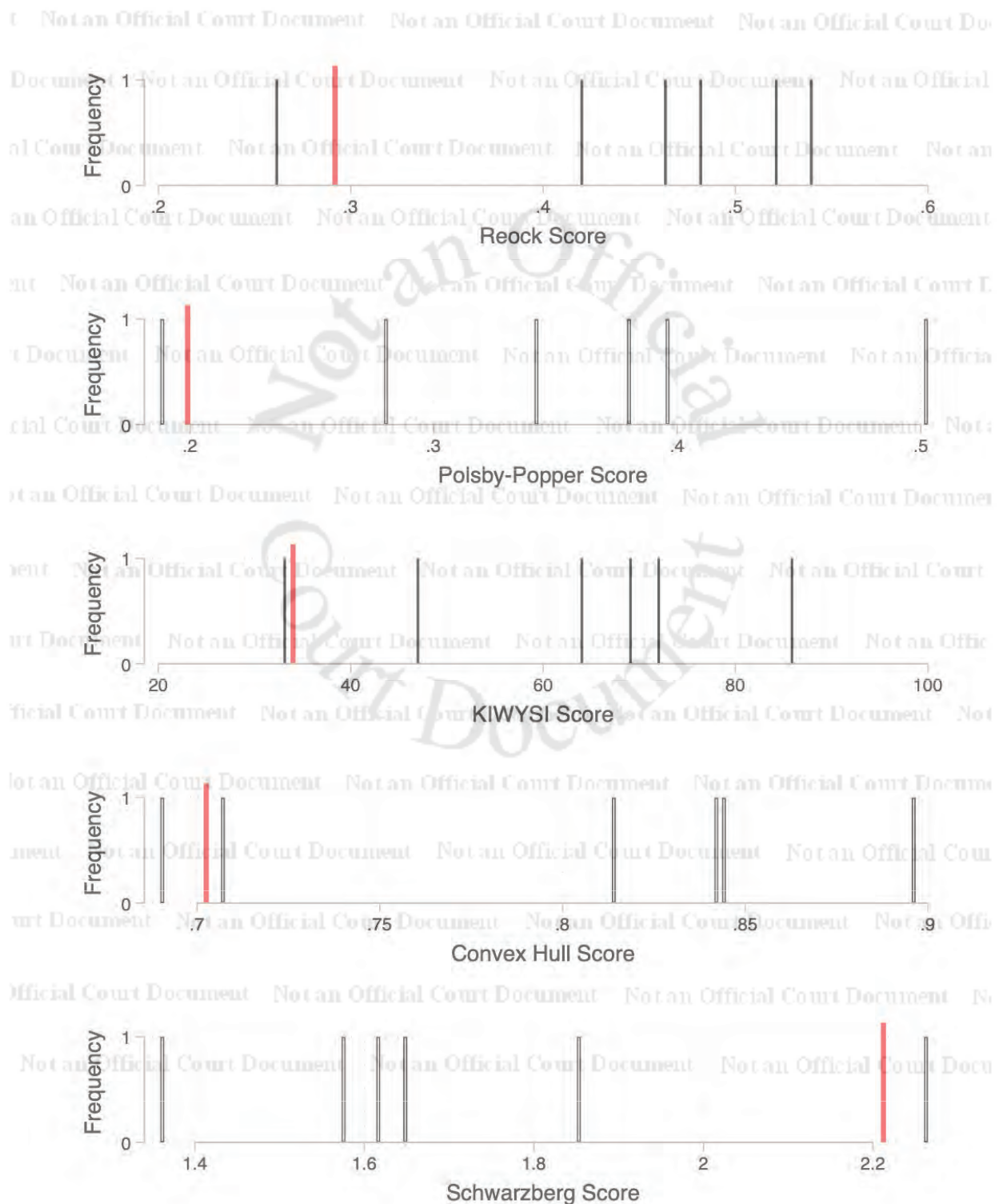
One might argue that a better comparison is with only the 2012 and 2022 Plans, since each of these plans had eight districts, while previous plans had nine (or ten in 1972). Looking at only the 2012, 2022, and 2025 Plans, the compactness of District 5 in the 2025 Plan was ranked 22nd of 24 districts for Polsby-Popper and KIWYSI (falling in the 8th percentile), 21st for Schwarzberg and Convex Hull (falling in the 12.5th percentile), and 20th for Reock (falling in the 17th percentile).

As mentioned above, this approach to ranking compactness is potentially misleading, since the geographic constraints associated with districts in different parts of the state are so different, and District 5 has historically been one of the most compact districts in Missouri according to traditional compactness metrics. Perhaps a more illuminating approach is to examine the typical rank of District 5 relative to other districts within each of the previous congressional plans that Dr. Trende analyzes and compare this with the rank of District 5 in the 2025 Plan. For congressional plans prior to the 2025 Plan, the median compactness rank of District 5 was 3rd for Reock and Convex Hull, and 2.5 for Polsby-Popper, Schwarzberg, and KIWYSI. In contrast, in the 2025 Plan, District 5’s Reock score is ranked 7th of eight districts (only slightly edging out District 6), and for the other four indicators, District 5 is ranked dead last. In other words, Dr. Trende’s data indicate that no matter which metric is used, District 5 had previously ranked highly in terms of traditional “physical shape” measures of compactness relative to other districts in the same plan, but it is at or near the bottom in the 2025 Plan. Dr. Trende’s data show that the 2025 Plan is indeed quite unusual relative to prior plans.

¹ Note that one of the lower-ranked districts according to the Reock measure was also in the 2025 Plan (District 6).

Thus far I have examined traditional compactness metrics of District 5 in the 2025 Plan relative to (1) a ranking of all congressional districts in the last 50 years, and (2) rankings within each individual plan over the last 50 years. We can also contrast District 5 in the 2025 Plan with other versions of District 5 over the last 50 years. **Figure 2** below displays compactness scores for other versions of District 5 since 1972 with vertical black lines, with the 2025 version of District 5 indicated in red. In each case, the black line slightly to the left of the red line for the 2025 Plan (or to the right for Schwarzberg) is the compactness score for the 2012 Plan, which was challenged but ultimately upheld in *Pearson v. Koster*. In terms of the traditional “physical shape” notions of compactness, the 2012 and 2025 Plans are outliers relative to the typical compactness of a Kansas City district. One can also appreciate this by simply visualizing the images of the districts in my initial report.

Figure 2: Histograms of Traditional “Physical Shape” Compactness Metrics for All Kansas City-Based District 5 Iterations since 1972, with District 5 of the 2025 Plan Indicated in Red

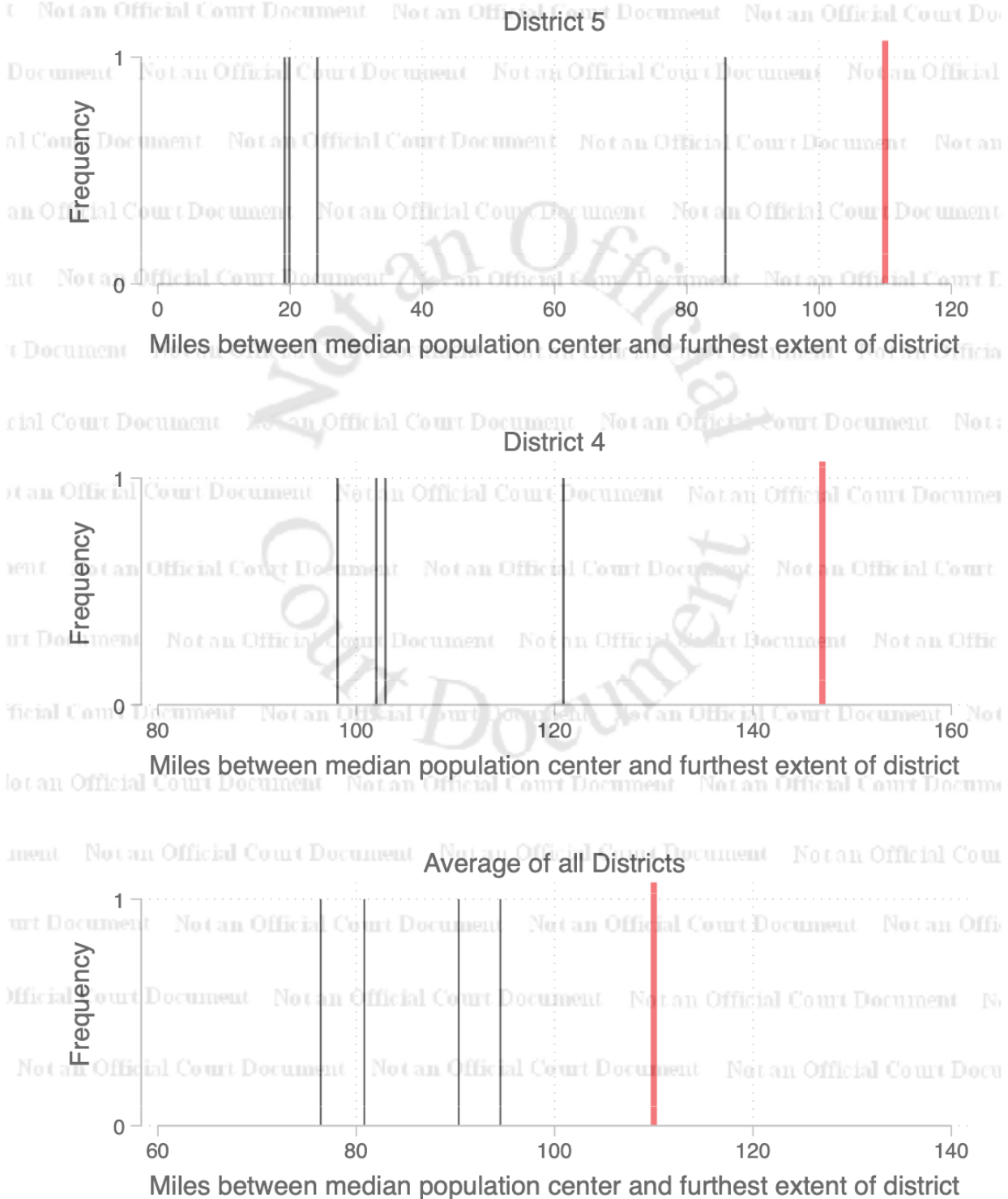


However, the Missouri Supreme Court has made clear that the resemblance of a district to a circle or bounding polygon is not at the heart of its notion of “closely united territory.” Like all its predecessors, District 5 in the 2012 Plan held the densely populated Jackson County portion of Kansas City together, then reached its population target not by moving further north, but by adding three whole counties to the east. The inclusion of these sparsely populated counties made the district more elongated and added significantly to its perimeter, thus decreasing its performance on “physical shape” compactness metrics. However, these changes did little to undermine the integrity of the closely united territory of Kansas City. Above all, a focus on closely united territory calls for an awareness not only of district shapes in the abstract, but of the arrangement and density of the population that inhabits them. I discuss those additional factors in the following section.

III. DISTRICT SPRAWL: A POPULATION-BASED INDICATOR OF COMPACTNESS

In my initial report, I presented a measure of compactness that considers the arrangement of people within districts and thus comes closer to the notion of closely united territory than the abstract focus on shapes and appearances favored by Dr. Trende and Dr. Hood. Using fine-grained population data from census tracts, I locate the median population center of each district and calculate the distance from that point to the furthest extent of the district. This measure of “district sprawl” captures the extent to which clusters of population in a region—or in a districting plan as a whole—are carved out from their geographic context and combined with faraway voters. **Figure 3** below summarizes the district sprawl for District 4 and District 5 in each redistricting plan since 1992, as well as the average district sprawl in each redistricting plan since 1992. I begin with 1992 because I do not have access to full tract-level population data in prior censuses that is necessary to locate the median population center of each district.

Figure 3: District Sprawl in Redistricting Plans Since 1992, with the 2025 Plan Indicated in Red



On this indicator, the 2025 Plan is clearly an outlier. The 2025 Plan combines the median population center of District 5 with much more distant populations than ever before. While I only have the requisite census data to calculate district sprawl since 1992, there has always been a small Kansas City-oriented District 5 since the 1930s, and from 1900 to 1930, Jackson County was its own district. Thus, by this metric, District 5 in the 2025 Plan is by far the least compact Kansas City-oriented district since at least 1900, and likely in all of Missouri history, with one exception: District 4 in the 2025 Plan. Relative to other congressional plans since 1992, by becoming a second Kansas City-oriented district, the 2025 Plan's District 4 has also become far less compact.

It is worth noting that on the other side of the state, in every redistricting plan since 1992, the distance between the median population center of District 1 in St. Louis and its furthest geographic extent has been in a narrow band between 12 and 15 miles, and although the requisite data are not available to obtain a precise measure, the distance was also very small in all previous St. Louis-based districts. Thus, the district sprawls of 143 and 147 miles for Districts 5 and 4 in the Kansas City area in the 2025 Plan are truly extraordinary for an urban Missouri congressional district, far surpassing even District 5 in the 2012 Plan.

The final panel in **Figure 3** above demonstrates that the 2025 Plan's large increases in within-district distances between voters in Districts 5 and 4 had a substantial effect on the average compactness of all districts in the 2025 Plan. In sum, a quantitative metric of compactness that considers population and territory rather than abstract physical shapes demonstrates that the 2025 Plan is the least compact plan since appropriate data became available with the publication of the 1990 census, and likely much earlier.

IV. COUNTY AND MUNICIPALITY SPLITS

Dr. Trende and Dr. Hood both seem to recognize that keeping voters from the same county or municipality together in the same congressional district might be relevant to the notion that districts should be drawn based on the principle of closely united territory. Both reports draw attention to the fact that the raw number of county splits is lower in the 2025 Plan than in the 2022 Plan. However, the raw number of county splits in an entire redistricting plan can be a poor proxy for the extent to which the plan undermines the types of closely connected communities that sometime correspond to county boundaries. One type of county split might remove a rural, sparsely populated corner of a county from one predominantly non-metropolitan district and place it in

another similarly non-metropolitan district in order to achieve population equality, thereby having no substantive impact on closely united territory. Another type of county split might remove a substantial number of people in a densely populated urban area from their neighborhood and place them in a rural-oriented district that extends to the other side of the state, as does District 6 in the 2025 Plan with the Kansas City neighborhoods of Pendleton Hights, Scarritt Point, and North Indian Mound. These different types of splits have very different impacts on the notion of closely united territory.

Dr. Trende points out that a three-way split of Jackson County is not unprecedented in a congressional map. However, the splits of Jackson County in previous plans were far less disruptive to the closely united territory of Kansas City. **Figure 1** of my initial report demonstrates that in every redistricting plan since 1982 (with the exception of the 2012 Plan, when Jackson County was split into only two districts), the most rural parts of southeastern Jackson County have been joined with a rural-oriented District 4, and the most rural parts of northeastern Jackson County have been joined with a rural-oriented District 6, with the largest chunk of the county reserved for an urban-oriented District 5. In other words, past splits of Jackson County have *enhanced* rather than undermined the principle of closely united territory. As explained in my initial report, the 2025 Plan diverges from this past practice and instead creates two hybrid urban-rural districts (Districts 4 and 5) and extracts an additional urban chunk of Kansas City and places it into a rural District 6 that reaches all the way to the Mississippi River.

One way to examine the number of people affected by a county split is to identify the largest fragment of the split county and ask how many residents were carved off into a different district or districts. In the 2012 Plan, 87,412 Jackson County residents were excluded from the dominant district in the county (District 5). In the 2022 Plan, 90,966 Jackson County residents were excluded from District 5. In the 2025 Plan, the number almost quadrupled, to 346,336. Even by this simple metric that ignores population density or economic and social ties, the impact of the 2025 Plan's split of Jackson County is clearly far greater than prior splits.

Dr. Trende and Dr. Hood also discuss municipality splits. As with county splits, the raw number of splits is a very poor indicator of the extent to which these splits violate the principle of closely united territory. One type of split might remove a mostly unpopulated tentacle of a small municipality that was annexed at some point to add a park or airport, while another type of split might extract a large urban neighborhood from the core of a city and place it in a sprawling rural

district. Again, to assess the impact of a split municipality, it is useful to identify the largest fragment of the split municipality and count the number of residents who have been placed into another district or districts. While Dr. Hood notes that the number of split municipalities declined statewide in the 2025 Plan relative to the 2022 Plan when aggregating across the entire state, the number of “extracted” residents in split municipalities was 267,248 in the 2022 Plan, and 312,910 in the 2025 Plan.

Dr. Trende focuses on split municipalities in Jackson County, pointing out that relative to the 2022 Plan, the 2025 Plan “fixed” the splits of some relatively small municipalities like Lake Lotawana while introducing its novel splits to Kansas City. Within Jackson County, however, only 23,788 people lived in the smaller fragment of a split municipality in the 2022 Plan. In the 2025 Plan, this number expanded to 300,419. From the perspective of closely united territory, the Jackson County municipality splits in the 2025 Plan are radically more disruptive to closely united territory than those in previous plans.

V. STATE SENATE DISTRICTS

In *Pearson v. Koster*, the Missouri Supreme Court indicated that deviations from compactness in a congressional map might be acceptable if they result from efforts to consider “the boundaries of political subdivisions, including counties, municipalities, and precincts.” 367 S.W. 3d at 50. The Court did not mention state legislative districts, which are quite different from county and municipal boundaries in that they may be redrawn every decade and are bound by different constitutional criteria. As Dr. Trende points out in his discussion of the 2022 Plan, *see* Expert Report of Sean P. Trende at 31, it does not appear that Missouri congressional districts, or District 5 in particular, have typically been drawn with a special effort to keep state senate districts whole within congressional districts.

Figure 4 displays the boundaries of Missouri’s state senate districts from 1992 to 2022, superimposing them on congressional districts with a focus on District 5.² **Figure 5** provides a similar visual for the 2025 Plan. **Figure 6** zooms in on Jackson County in the 2025 Plan. All three figures are below.

² I obtained state legislative boundaries from Jonathan Schroeder, David Van Riper, Steven Manson, Katherine Knowles, Tracy Kugler, Finn Roberts, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 20.0 [dataset]. Minneapolis, MN: IPUMS. 2025. <http://doi.org/10.18128/D050.V20.0>.

Figure 4: Boundaries of State Senate Districts and Congressional Districts for Redistricting Plans from 1992 to 2012

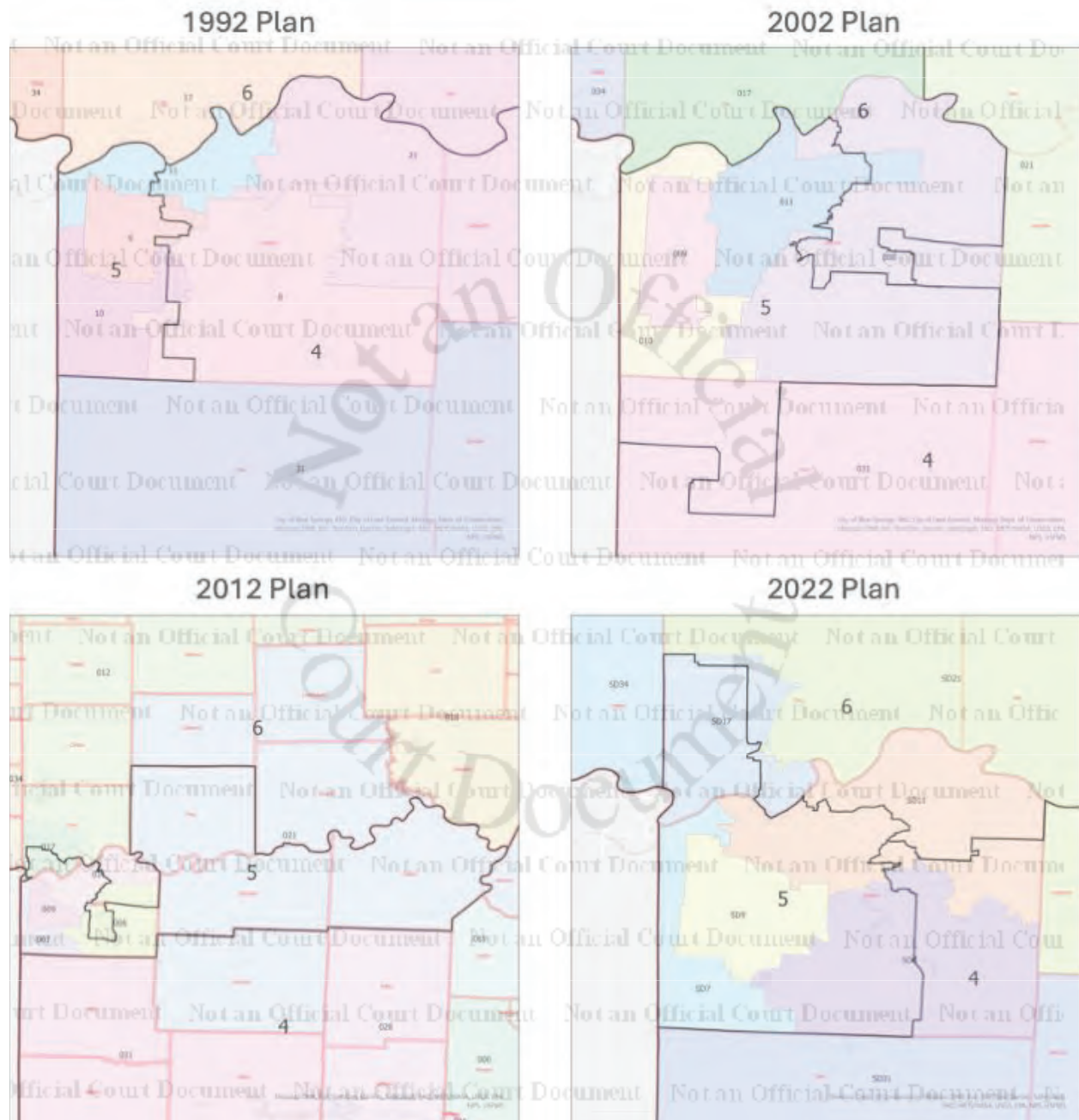


Figure 5: Boundaries of State Senate Districts and Congressional Districts for 2025 Plan

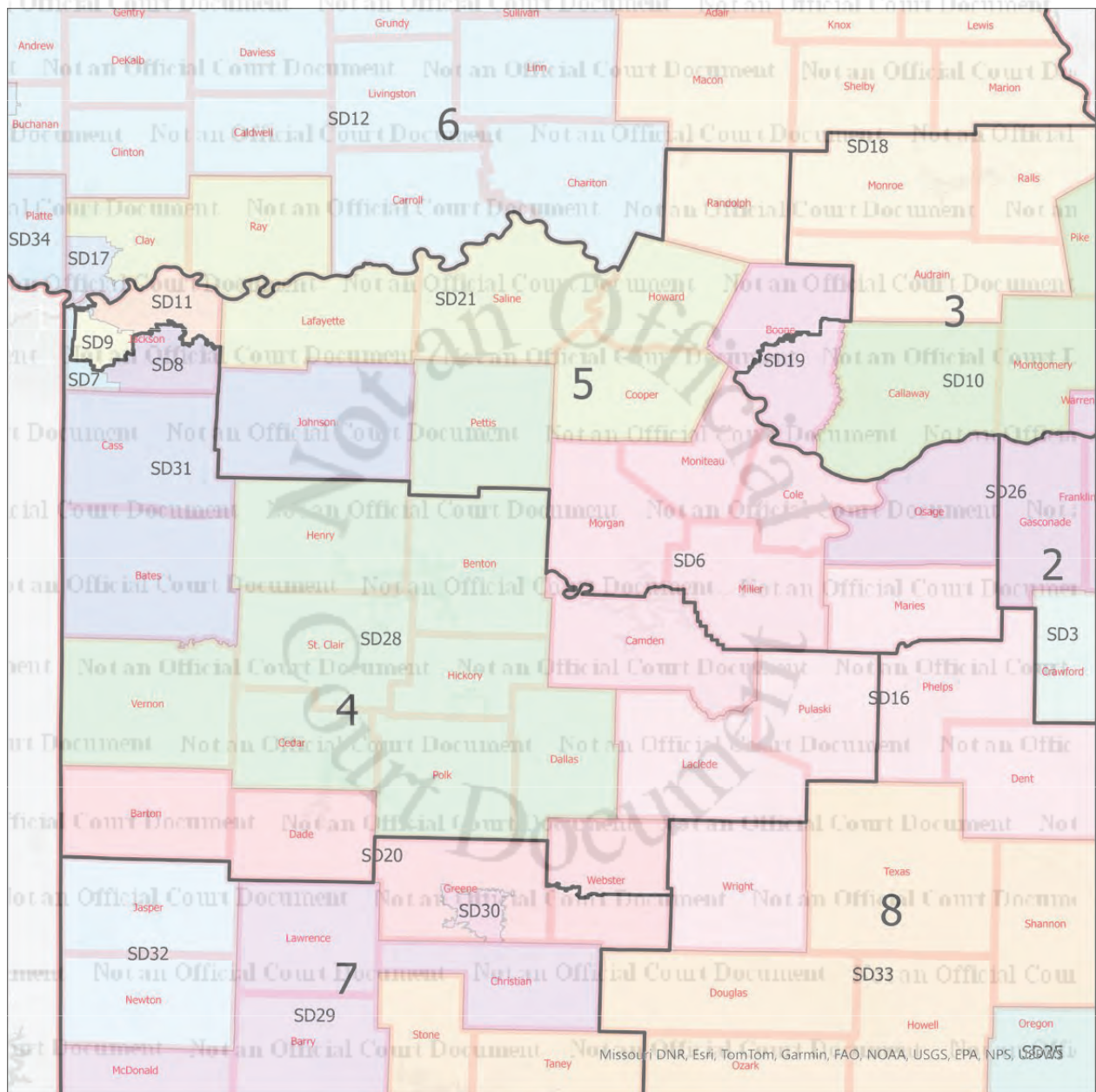
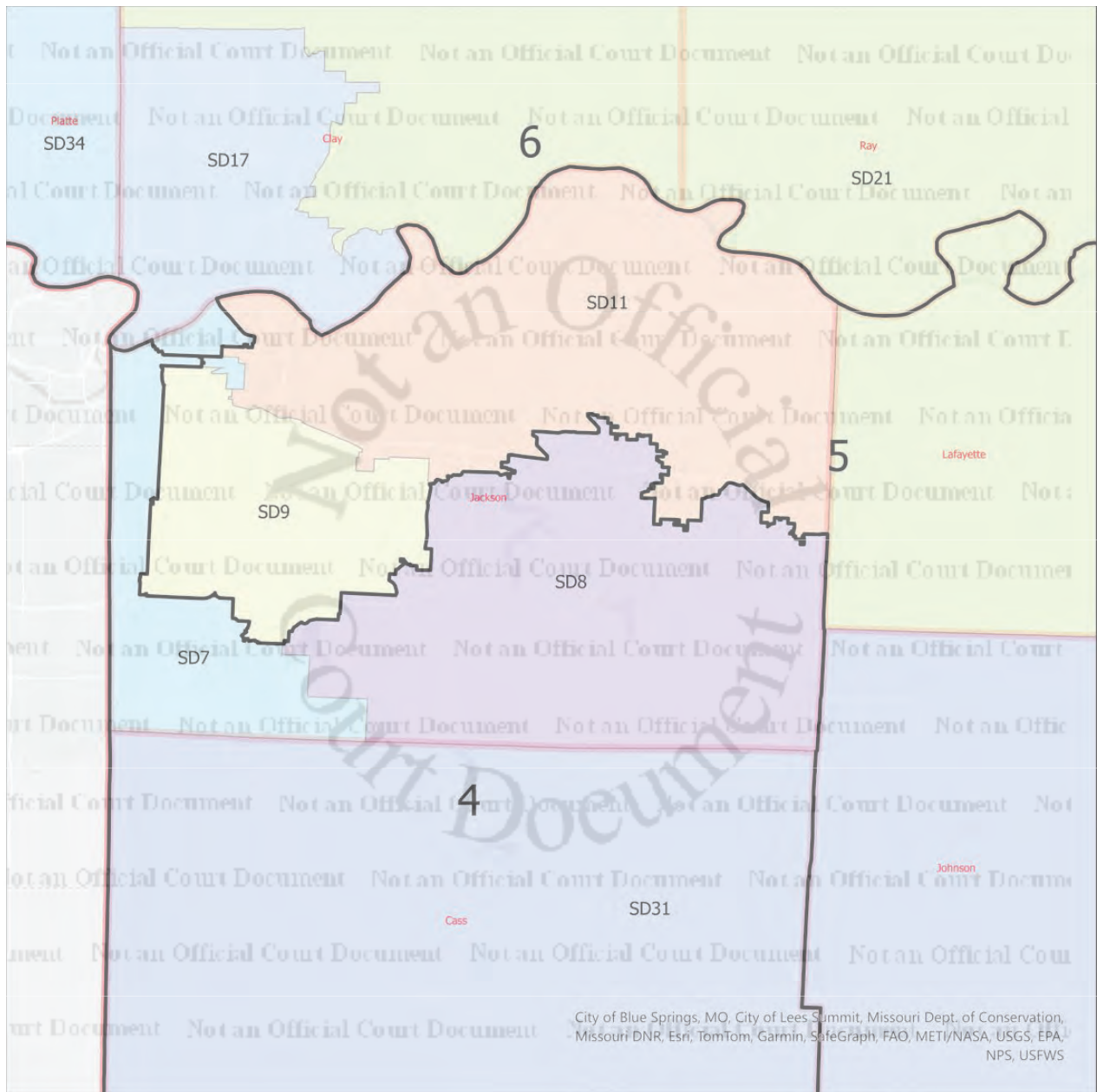


Figure 6: Boundaries of State Senate Districts and Congressional Districts in Jackson County for 2025 Plan



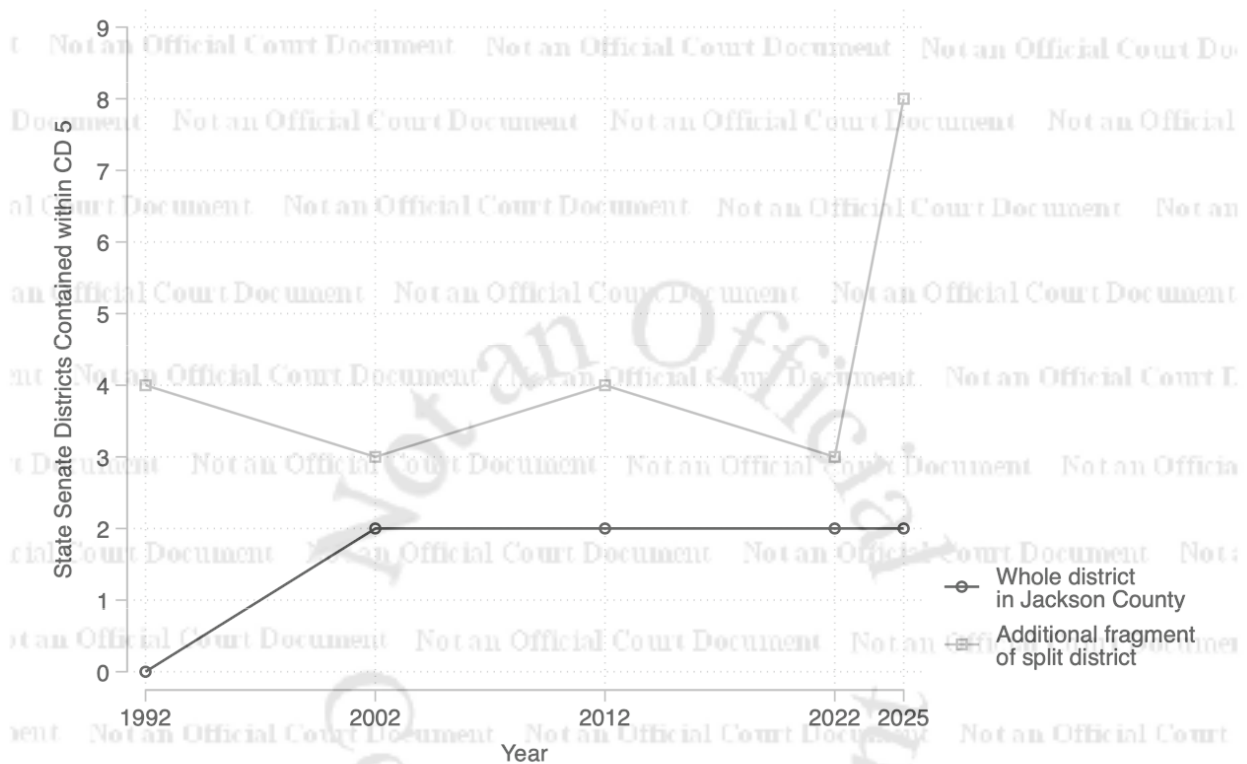
The maps in **Figure 4** do not indicate a history of efforts to keep state senate districts whole within Jackson County or in neighboring counties. In the 1992 Plan, District 5 was composed of fragments of four state senate districts. In the 2002 Plan, District 5 was composed of five state senate districts: two whole state senate districts in Jackson County and fragments of three others. In the 2012 Plan, District 5 was composed of six state senate districts: two whole Jackson County districts and fragments of four others. In the 2022 Plan, District 5 was composed of five districts: two whole Jackson County districts and fragments of three other districts. In sum, since 2002, the typical pattern has been to include two whole Jackson County state senate districts and either three or four additional fragments.

While preservation of whole state senate districts in and around Jackson County does not appear to have been a goal in the past, Dr. Trende seems to imply that the historically unprecedented deviation from the principle of closely united territory in the Kansas City metropolitan area in the 2025 Plan can be explained by an approach to district drawing that is motivated by an attempt to keep state senate districts whole within congressional districts or to reduce splits of state senate districts (but not state house districts). Dr. Trende points out that within Jackson County, the split of Kansas City and its central business district³ into three districts appears to have been achieved by extracting the entirety of State Senate Districts 9 and 11 from Jackson County and joining them with fragments of far-flung rural state senate districts to the east, while splitting State Senate District 7 across Districts 4, 5, and 6. **Figure 5** depicts this arrangement.

This map-drawing approach cannot be explained by an attempt to keep state senate districts whole within congressional districts or reduce splits of state senate districts, because it fails to do either. **Figure 7** below depicts the makeup of District 5 in terms of state senate districts split versus kept whole in each congressional plan since 1992. The number of whole state senate districts contained in District 5 is the same in each historical plan as in the 2025 Plan: two. However, while previous plans added fragments of either three or four additional state senate districts to District 5, the 2025 Plan adds fragments of eight additional senate districts. In other words, in the Kansas City area, the 2025 Plan is far less respectful of boundaries of state senate districts than previous plans.

³ In his report, Dr. Trende requests a source for my definition of the Kansas City Central Business District. I rely on the Downtown Area Plan, adopted on March 11, 2010 and available from the City Clerk of Kansas City. See Resolution Approving the Greater Downtown Area Plan, as amended, Resolution No. 100049, Kan. City Council (Mar. 11, 2010), <https://perma.cc/DSJ8-CZT6>. It is also possible to view a map here: <https://perma.cc/WT4X-8SFM>.

Figure 7: Composition of District 5 in Terms of Whole State Senate Districts and Fragments of State Senate Districts: 1992-2025



The boundary of District 5 in the 2022 Plan split three state senate districts. Using the technique discussed in the previous section, if we identify the largest fragment of each state senate district cleaved by District 5's boundary in the 2022 Plan, and sum up the people who were carved away from it into another congressional district (or districts), there were 123,842 such people. In the 2025 Plan, the District 5 boundary cleaves eight state senate districts (one of them twice), leaving 483,821 people fragmented into another congressional district or districts. If we consider all the state senate districts cleaved by either the congressional boundary of either District 4 or 5, there were 466,084 people cleaved from the larger part of their state senate district in the 2022 Plan, and 524,893 such people in the 2025 Plan.

In sum, even though State Senate Districts 9 and 11 were extracted in their entirety from Jackson County, this choice cannot be explained as an effort to align congressional and state senate boundaries in the Kansas City area, because it had the opposite effect: the boundaries of Districts 4 and 5 in the 2025 Plan split a larger number of individuals from the dominant portion of their state senate district than the 2022 Plan. Moreover, the non-compact nature of Kansas City-area

congressional districts in the 2025 Plan cannot be explained as a byproduct of the legislature's desire to keep state senate districts whole within congressional districts. Jackson County's population is just below the population of a Missouri congressional district based on the results of the most recent federal census, so a desire to minimize splits of state senate districts could have been achieved by keeping Jackson County whole in District 5—thus preserving State Senate Districts 7, 8, 9, and 11—or alternatively, making a Kansas-City-focused combination of State Senate Districts 7, 9, 11, and 17.

VI. CONCLUSION

District 5 in the 2025 Plan is quite non-compact relative to its historical predecessors according to compactness metrics that assess the physical shape of districts. However, these metrics are not determinative in Missouri. The reports of Dr. Trende and Dr. Hood do not undermine the conclusions of my initial report, which demonstrated that the 2025 Plan deviates from Missouri's tradition of drawing districts based on the principle of closely united territory. The splits of counties, municipalities, and state senate districts in the 2025 Plan undermine this principle of closely united territory to a greater extent than in the past.