



The *FastMap* Redistricting Algorithm: Promoting Fair Elections with Optimized Political Districts

Dr. Matthew Petering
 Owner, District Solutions LLC
 Associate Professor
 University of Wisconsin-Milwaukee
 Matt.Petering@DistrictSolutions.net

The Wisconsin Supreme Court

On January 12, 2024 seven proposals for Wisconsin's legislative districts were submitted to the WI Supreme Court in the case *Clarke v. Wisconsin Elections Commission*. One was generated by a computer algorithm, and six were created by expert human mapmakers.

In this study, we examine a major development from the case: the map proposal generated by the *FastMap* algorithm significantly outperformed the other proposals. The case likely marks the moment when computer algorithms overtook humans in overall mapmaking ability.

Legislative Redistricting in Wisconsin

Five aspects make Wisconsin a particularly challenging state for legislative redistricting.

1. Wisconsin is one of only three states with a 3-in-1 nesting requirement for assembly (i.e., house) districts within senate districts.
2. Wisconsin requires district populations to be within +/-1% of the average district population, whereas most states allow +/-5%.
3. The shapes of Wisconsin's voting wards, the building blocks of the districts, are among the most irregular in the nation.
4. Wisconsin's entire land area consists of local municipalities, adding to the difficulty of keeping municipalities intact within districts.
5. The rights of Wisconsin's Black and Hispanic voters must be protected in accordance with the federal Voting Rights Act (VRA).

Wisconsin Statistics

Total Population: 5,893,718
 18+ Population: 4,612,300
 Hispanic% of 18+ Pop: 6.16%
 Black % of 18+ Pop: 6.03%
 Asian % of 18+ Pop: 3.06%
 Native % of 18+ Pop: 1.69%
 No. census blocks: 202,510

No. voting wards: 7136
 No. assembly districts: 99
 No. senate districts: 33
 No. counties: 72
 No. municipalities: 1850
 Dem% of 2-party vote: 51.2%
 Rep% of 2-party vote: 48.8%

Timeline

October 6, 2023: Wisconsin Supreme Court agrees to hear the case <i>Clarke v. Wisconsin Elections Commission</i> .	December 22, 2023: Court strikes down Wisconsin's legislative maps because districts are not contiguous.	January 17, 2024: Court disqualifies the <i>FastMap</i> proposal because it was not submitted by a party to the case.	February 1, 2024: Court-appointed consultants submit report: "The six remaining proposals all favor Republicans."	February 19, 2024: Case becomes obsolete when the governor signs maps into law that are identical to those he submitted to the Court.
November 8, 2023: Petering submits amicus brief: " <i>FastMap</i> algm. is the best solution for WI legislative redistricting."	January 12, 2024: Court receives 7 map proposals: six proposals from parties to the case + Petering's <i>FastMap</i> proposal.	January 22, 2024: Petering submits amicus brief: "None of the other six proposals is politically neutral."	February 8, 2024: Petering submits amicus brief: "Petering and the consultants are the only groups to acknowledge that better maps exist. Therefore, the Court should instruct the consultants to create another map proposal."	

FastMap Algorithm

FastMap is a heuristic algorithm that assigns geographic units (e.g., voting wards) to districts. It generates legally acceptable district maps according to criteria specified by user-inputted weights. The algorithm is randomized, so it creates a unique map every time.

Algorithm Criteria

1. District numbering & nesting (if required)
2. Population equality
3. The Voting Rights Act (VRA)
4. District contiguity
5. Political neutrality
6. District competitiveness
7. District compactness
8. Keeping counties intact
9. Keeping municipalities intact
10. Keeping communities of interest intact
11. Population equality (beyond legal requirements)
12. Similarity to previous map (i.e., core retention)
13. Staggered-senate-term disenfranchisement
14. Minimizing incumbent pairings
15. Protecting incumbents

Criteria in black reflect strict legal requirements.
 Criteria in brown are optimized based on user preferences.

Algorithm Advantages

1. Unbiased work
2. Speedy mapmaking
3. Flexible mapping goals
4. Rigorous analysis of trade-offs
5. Optimized maps

Court Opinion Issued Dec. 2023

The WI Supreme Court's Dec. 22, 2023 decision to strike down the state's legislative maps specified 11 criteria to be considered in replacement maps of the state's 99 assembly and 33 senate districts: criteria 1-5 and 7-11 above and one more criterion: keeping voting wards intact.

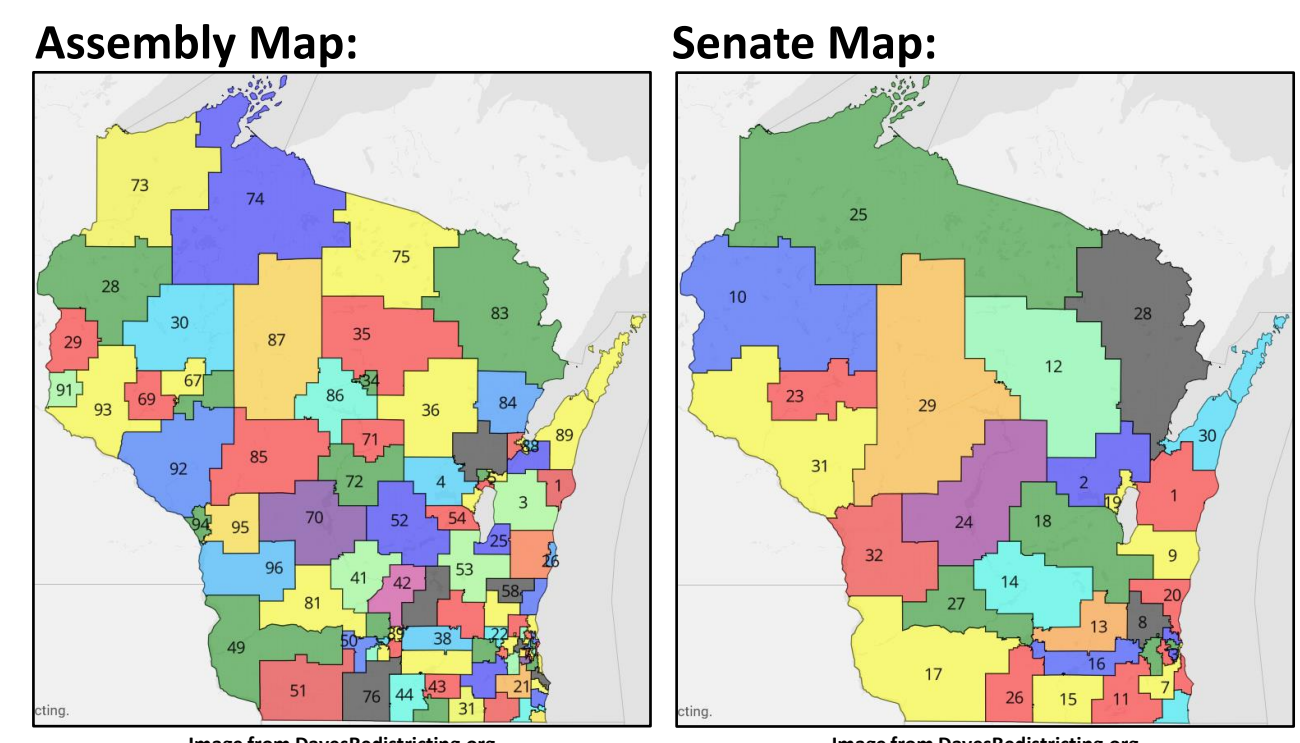
The criterion of *political neutrality* featured prominently in the Court's opinion: "We do not have free license to enact maps that privilege one political party over another."

The Seven Map Proposals

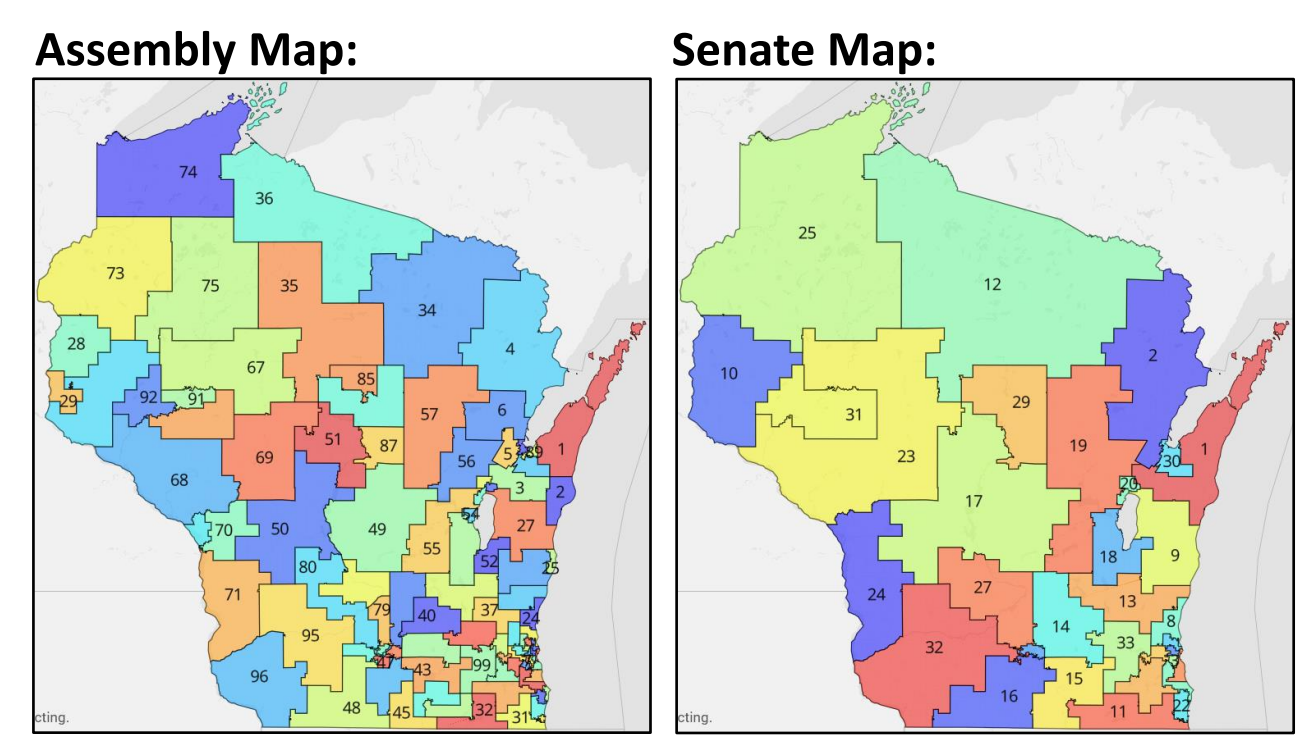
Of seven proposals submitted to the Court, **two—Johnson and WI Legislature—were made by conservative law firms or elected officials. Three proposals—Governor Evers, Democratic Senators, and Clarke—were submitted by progressive law firms or elected officials. Two proposals—FastMap and Wright—were submitted by groups claiming to use state-of-the-art computational tools.**

The proposals can be viewed at https://www.therecombobulationarea.news/p/discussion-thread-new-wisconsin-state/comments?utm_source=profile&utm_medium=reader2.

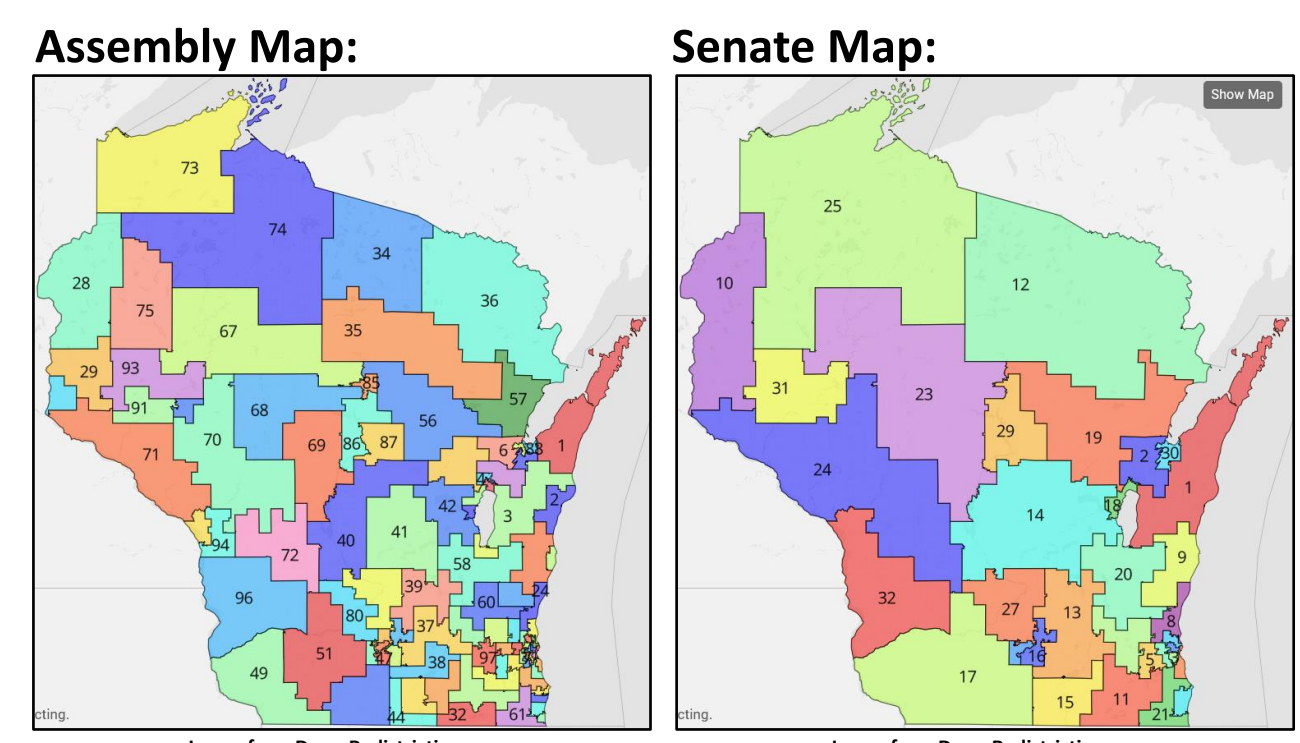
FastMap Proposal



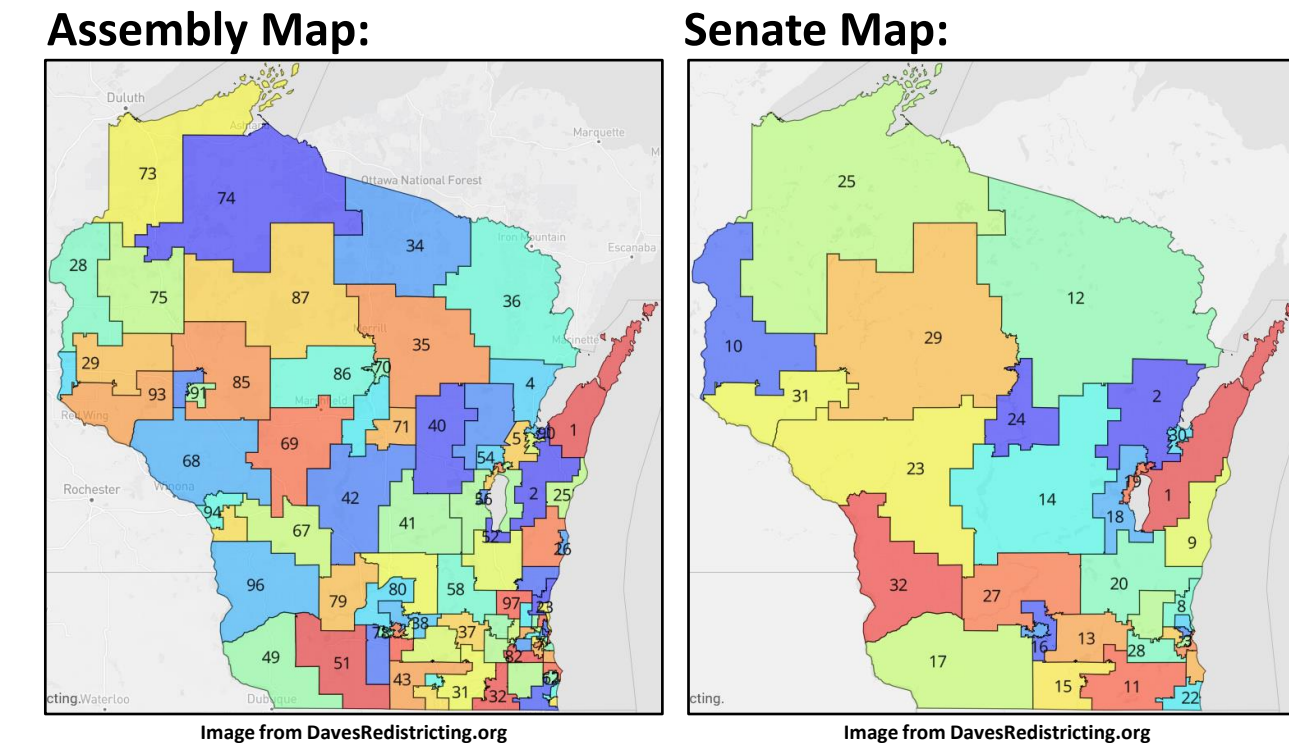
Wright Proposal



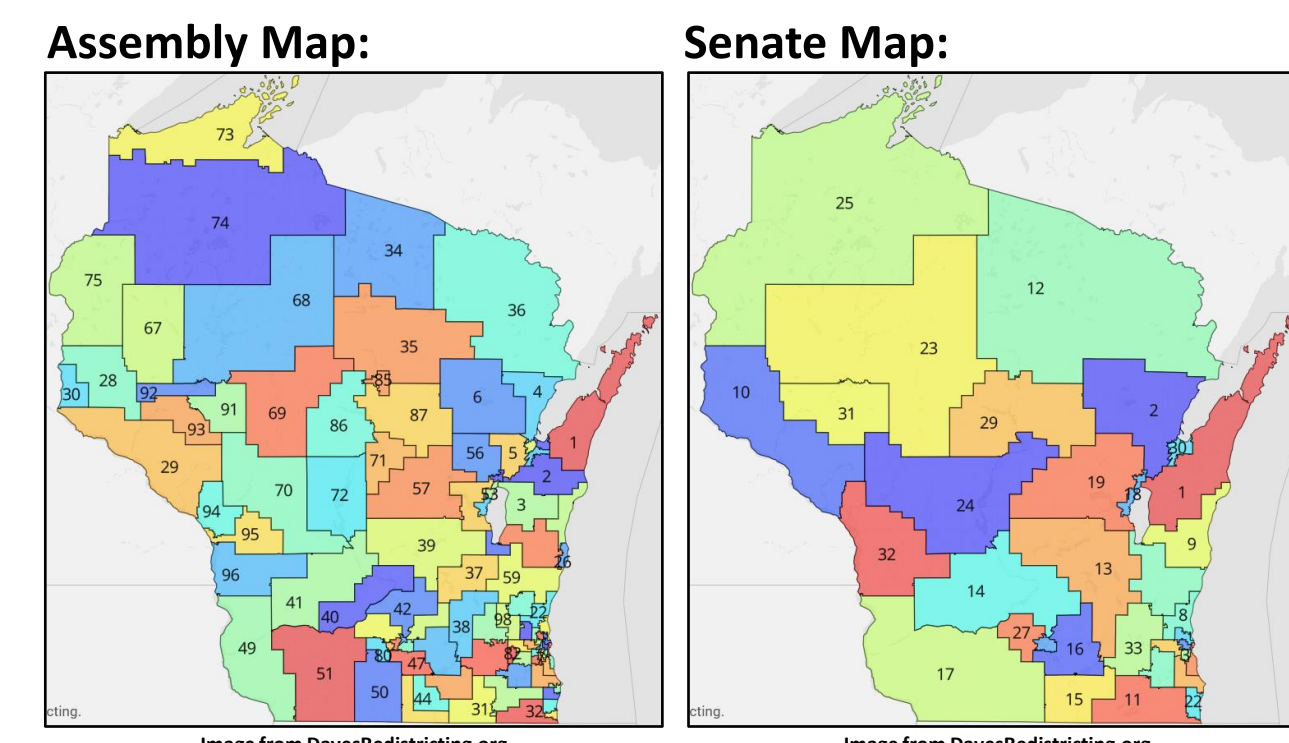
Clarke Proposal



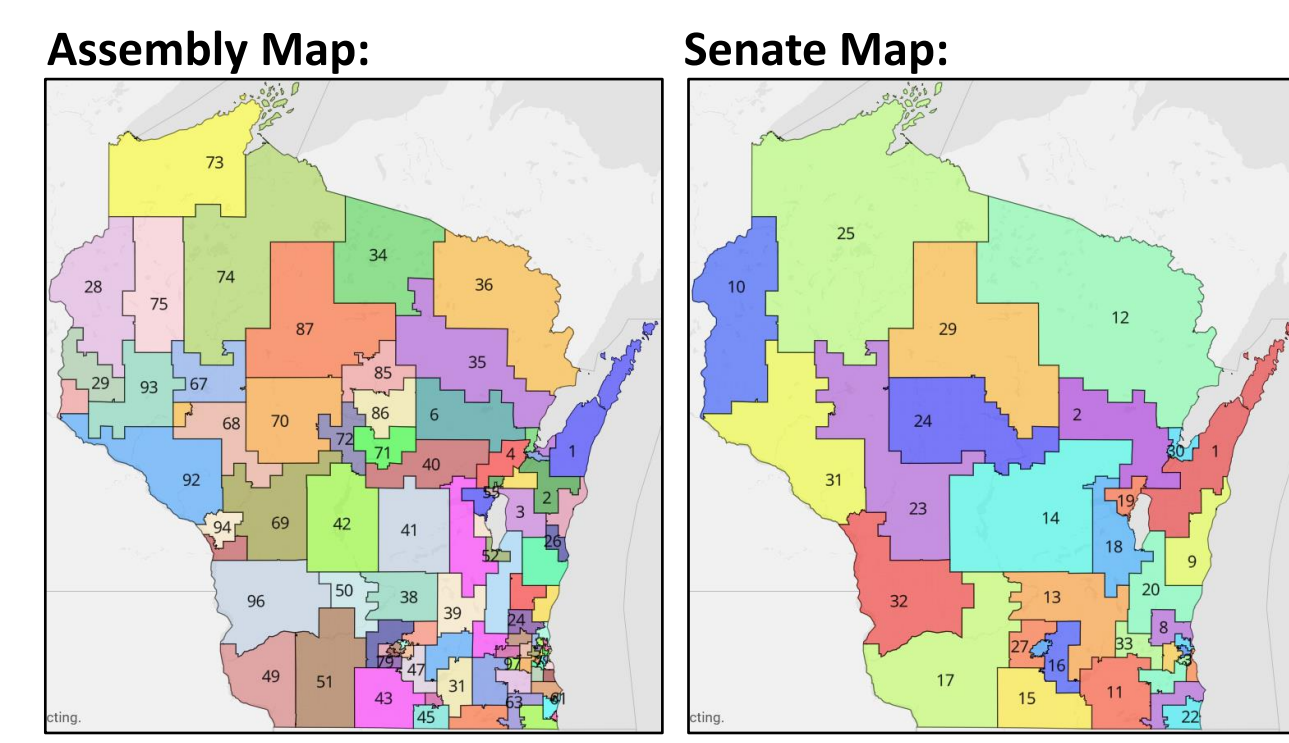
Democratic Senators Proposal



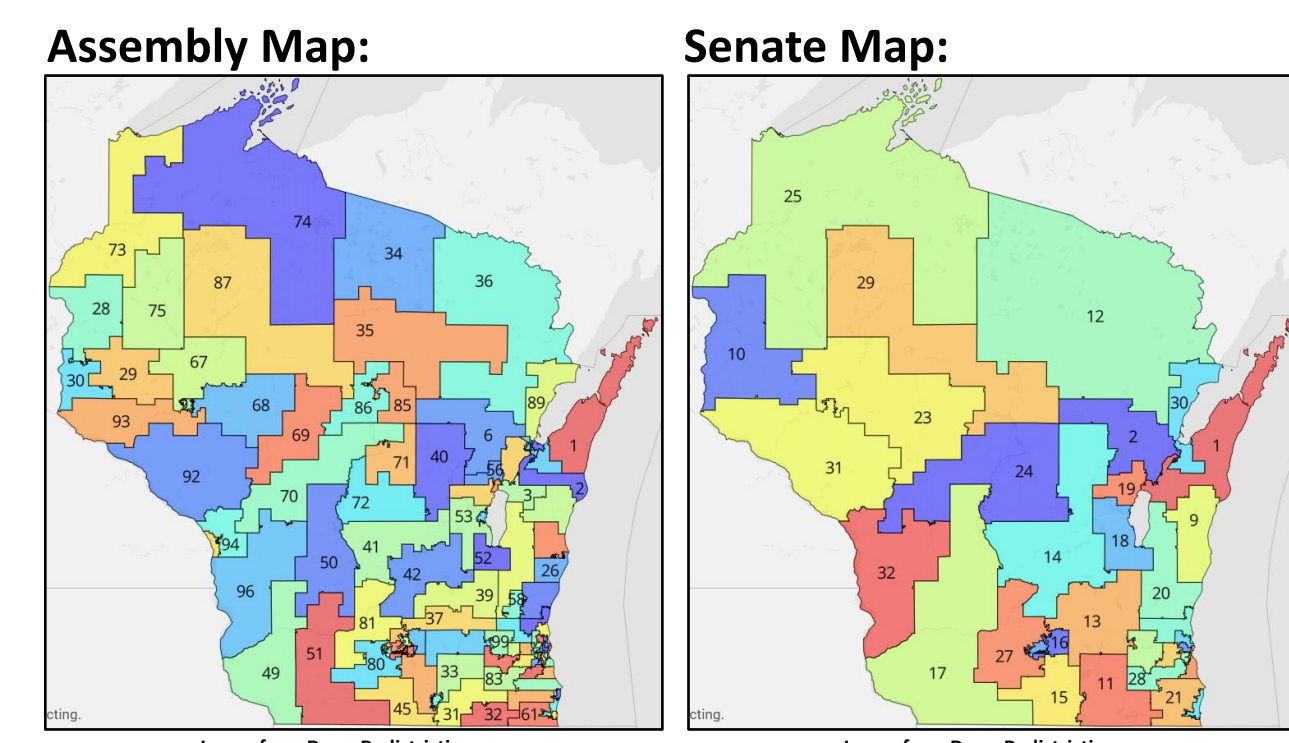
Governor's Proposal (enacted)



Johnson Proposal



WI Legislature Proposal

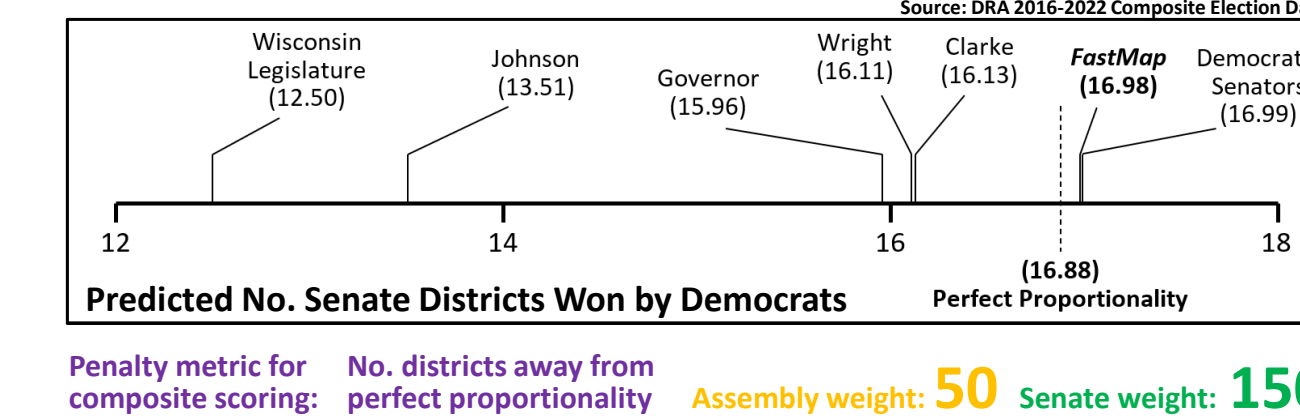
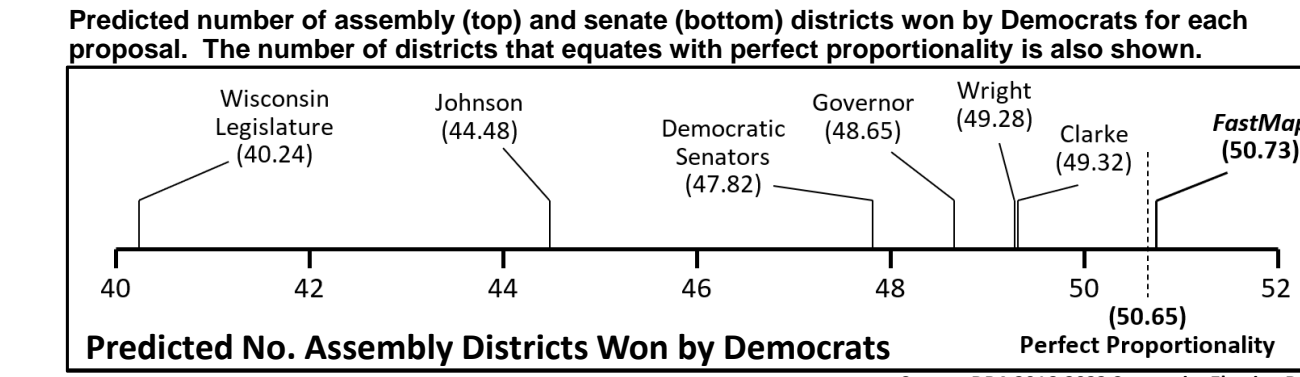


Comparing the Proposals

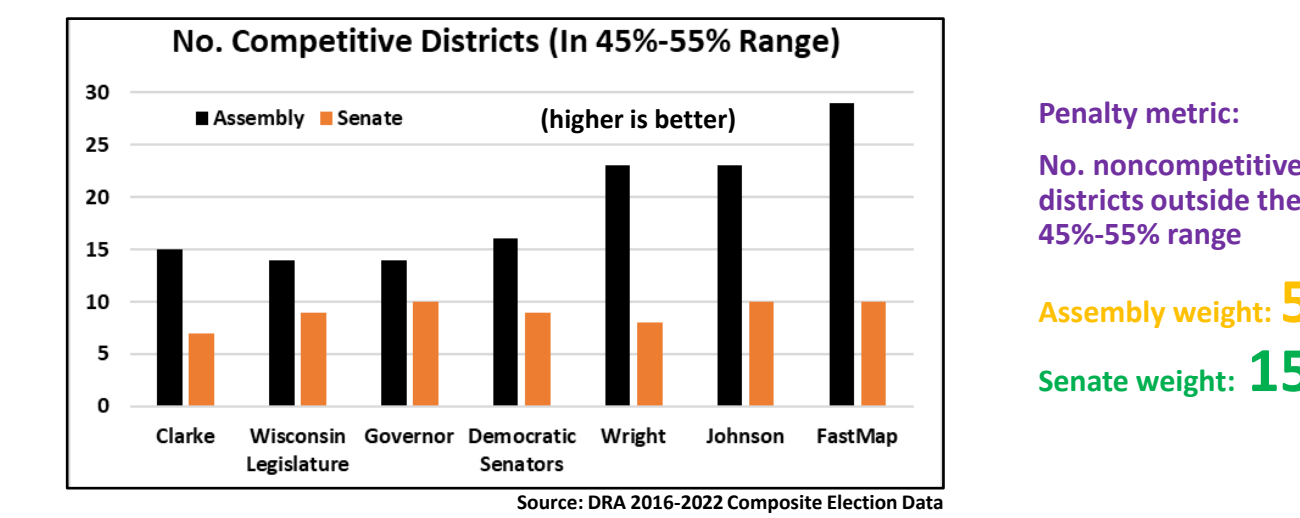
Proposal	Criteria 1-4 Satisfied?				Ranking for Criteria 5-11 (1=best, 7=worst)							Sum
	1	2	3	4	5	6	7	8	9	10	11	
Wisconsin Legislature	Y	Y	Y	Y	7	6	7	7	5	2	4	41
Democratic Senators	Y	Y	Y	NO	2	4	5	5	6	3	5	30
Clarke	Y	Y	Y	Y	3	7	6	4	2	7	1	30
Governor	Y	Y	Y	Y	5	5	2	3	4	2	7	28
Wright	Y	Y	Y	Y	4	2	4	6	3	4	4	28
Johnson	Y	Y	Y	Y	6	2	3	1	1	6	3	22
<i>FastMap</i>	Y	Y	Y	Y	1	1	1	2	5	1	6	17

5. Political Neutrality

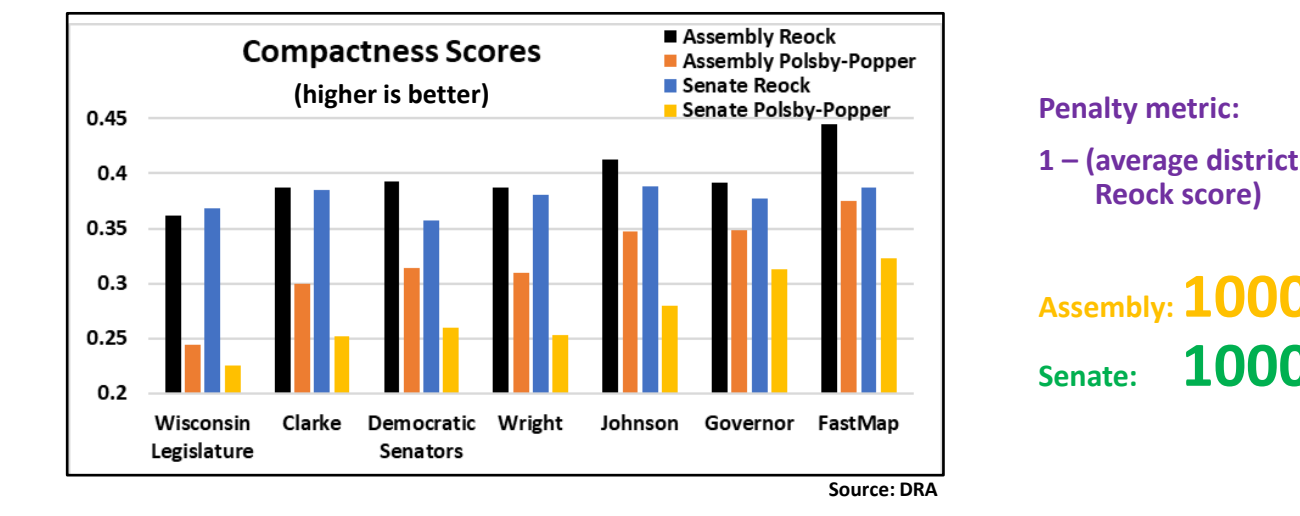
The *FastMap* proposal ranked #1 for 9 of 10 metrics of political neutrality computed by DavesRedistricting.org (i.e., DRA), including *proportionality* (see below).



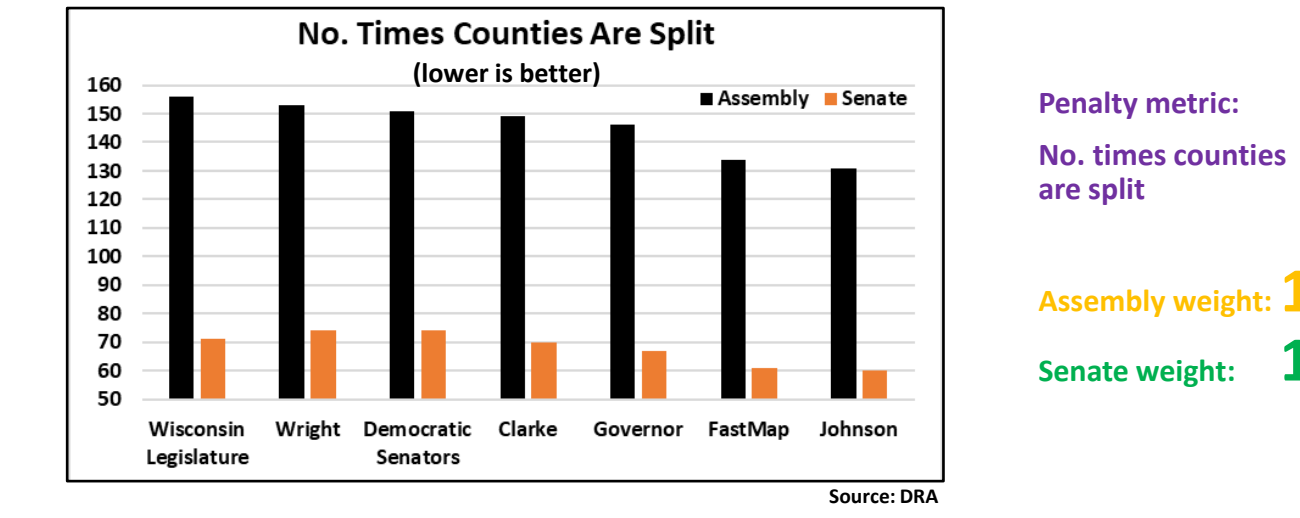
6. District Competitiveness



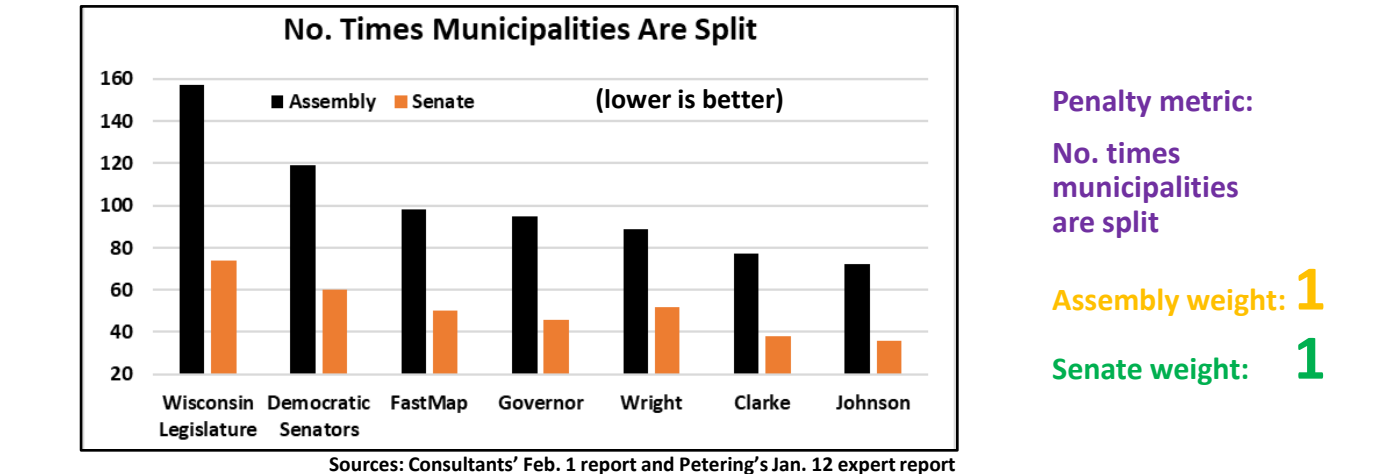
7. District Compactness



8. Keeping Counties Intact



9. Keeping Municipalities Intact



10. Keeping Native American Communities Intact

Proposal	Two Asm. Dist. With Highest Native American VAP %		Two Sen. Dist. With Highest Native American VAP %		Sum of 4 Native American VAP %s
	Native American VAP %	Native American VAP %	Native American VAP %	Native American VAP %	
Clarke	74.6	9.66%, 7.35%	25.12	6.09%, 5.13%	28.23%
Johnson	74.6	9.53%, 7.52%	25.2	6.07%, 5.54%	28.66%
Wisconsin Legislature	38.74	10.45%, 7.75%	2.12	5.84%, 5.72%	29.70%
Wright	57.5	9.67%, 9.64%	25.2	5.41%, 5.40%	30.12%
Democratic Senators	74.35	12.77%, 9.21%	25.12	7.38%, 4.92%	34.28%
Governor	6.73	12.55%, 9.18%	2.25	7.52%, 6.42%	35.67%
<i>FastMap</i>	74.38	14.88%, 12.01%	25.12	7.08%, 5.23%	39.29%

11. Population Equality

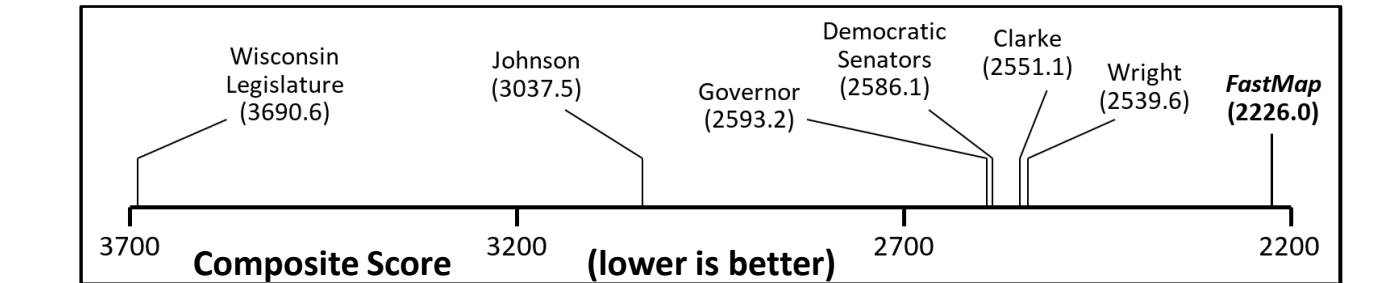
Chamber	Governor		Democratic Senators		Wright		Johnson		Wisconsin Legislature		Clarke	
	Population Deviation	Population Deviation	Population Deviation	Population Deviation	Population Deviation	Population Deviation	Population Deviation	Population Deviation	Population Deviation	Population Deviation	Population Deviation	Population Deviation
Assembly	1.96%	1.98%	1.86%	1.83%	1.83%	1.83%	1.11%	0.92%	0.92%	0.92%	0.92%	0.92%
Senate	1.48%	1.35%	1.36%	1.19%	0.65%	0.49%	0.49%	0.65%	0.65%	0.65%	0.65%	0.65%
Sum	3.42%	3.33%	3.22%	3.02%	1.63%	1.60%	1.60%	1.57%	1.57%	1.57%	1.57%	1.57%

Keeping Wards Intact

In a Jan. 2, 2024 stipulation, the parties to the case agreed to use out-of-date August 2021 wards to make their maps. All WI municipalities did once-a-decade local redistricting (changing the shapes of their wards) after August 2021, so all proposals split scores, if not hundreds, of 2024 wards.

Composite Scores

A composite penalty score was computed for each proposal based on criteria 5-9. (Metrics are in purple, assembly map weights in orange, and senate map weights in green.) The *FastMap* proposal had the best composite score by far: 2226.



Conclusion

Clarke v. Wisconsin Elections Commission marks the start of a new era of algorithmic mapmaking in which congressional, state legislative, and local election districts can better reflect constitutional requirements and the will of the voters.

References

Clarke v. Wisconsin Elections Commission case documents, www.wicourts.gov/courts/supreme/oriact/2023ap1399.htm.
 Dave's Redistricting App (DRA), www.DavesRedistricting.org.
 District Solutions LLC website, www.DistrictSolutions.net.