



LEIGH M. CHAPMAN, IN HER OFFICIAL :  
CAPACITY AS THE ACTING SECRETARY :  
OF THE COMMONWEALTH OF :  
PENNSYLVANIA; JESSICA MATHIS, IN :  
HER OFFICIAL CAPACITY AS DIRECTOR :  
FOR THE PENNSYLVANIA BUREAU OF :  
ELECTION SERVICES AND NOTARIES, :  
:  
Respondents :

**DISSENTING OPINION**

**JUSTICE MUNDY**

**OPINION FILED: March 9, 2022**  
**DECIDED: February 23, 2022**

When the political branches approve a redistricting plan, the map will ordinarily have gone through a public-comment stage, been sent to committee for amendment, garnered majority support from both Houses of the General Assembly, and been approved by the Governor. It will subsume a myriad of political choices and tradeoffs which have been weighed, debated, and voted on by the public’s elected representatives. These considerations may include how closely the districts should match those of the previous plan, which non-retiring incumbents should be paired against each other in the upcoming election cycle, which counties and other political subdivisions should or should not be divided, which adjacent counties and townships should be grouped together, and which communities of interest should be kept intact within a single district.

Items such as these are generally viewed as valid districting factors so long as they do not subordinate the traditional, neutral criteria appearing in the state and federal charters. See *League of Women Voters v. Commonwealth*, 178 A.3d 737, 817 (Pa. 2018) (“LWV-II”) (citing *Holt v. 2011 Legis. Reapportionment Comm’n*, 67 A.3d 1211, 1235 (Pa. 2012)). As long as the plan that results from the political process does not “clearly, plainly, and palpably” violate the constitution, *League of Women Voters v. Commonwealth*, 175 A.3d 282, 289 (Pa. 2018) (*per curiam*) (“LWV-I”), it will survive a court challenge.

The present controversy is different. This is an impasse case in which the political branches have failed to agree on a plan, and we have little choice but to wade into the “political thicket” of redistricting. *Evenwell v. Abbott*, 578 U.S. 54, 58 (2016) (internal quotation marks and citation omitted). Not only that, we are placed in an unfamiliar role: we must make a selection rather than issue an adjudication. Stated differently, we are not merely required to judge the legality of a plan, we are put to the task of choosing the best among a number of competing plans that have been submitted for our consideration by a variety of parties and amici. To the extent an adjudication is reached in this matter, it is minimal and undisputed: the current map cannot be used because of population shifts in the last ten years and, most notably, because Pennsylvania now has only 17 representatives in Congress.

In undertaking our selection task, it is vital that this Court act in a politically neutral manner – and maintain the appearance of neutrality – to the greatest extent possible in order that the public may have confidence our decision is reached via compliance with neutral legal principles alone. In this respect, the Supreme Court has characterized the need for objectively demonstrable standards in judging redistricting plans as being

necessary to enable the state legislatures to discern the limits of their districting discretion, to meaningfully constrain the discretion of the courts, and to win public acceptance for the courts’ intrusion into a process that is the very foundation of democratic decisionmaking.

*Rucho v. Common Cause*, \_\_\_ U.S. \_\_\_, \_\_\_, 139 S. Ct. 2484, 2499-2500 (2019) (quoting *Vieth v. Jubelirer*, 541 U.S. 267, 291 (2004) (plurality)). It is my position, then, that our mission should be carried out solely in reference to the politically neutral criteria appearing in the text of the state charter, namely: contiguity, compactness, population equality, and respect for political boundaries. See PA. CONST. art. II, §16 (requiring districts which are “composed of compact and contiguous territory as nearly equal in population as

practicable,” and specifying further that, “[u]nless absolutely necessary no county, city, incorporated town, borough, township or ward shall be divided in forming” such districts).<sup>1</sup>

Limiting our consideration to these express constitutional criteria has multiple benefits. In addition to maintaining the appearance of neutrality, it helps avoid any subtle, unconscious influence that political considerations might otherwise bring to bear upon our decision-making. Relatedly, the map we select will be known by all involved to be that which is most compliant with the Constitution’s commands as judged by an objective, neutral standard open to public view.<sup>2</sup> Such an approach also appears likely to reduce any incentive the political branches might otherwise have to view an impasse as desirable in its own right – in the sense that they would rather “take their chances” with this Court than seek political compromise – and thereby, to reduce the incentive for those branches to act strategically. And while I do not discount the theoretical possibility that gerrymandering might occur within the confines of an effort to comply scrupulously with

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<sup>1</sup> Article II, Section 16 only facially applies to state legislative districts. In the *LWV-II*, however, a majority of this Court held that it applies, as well, to Pennsylvania’s congressional districts through Article I, Section 5, the Free and Equal Elections Clause. See *LWV-II*, 178 A.3d at 816.

<sup>2</sup> In this regard, I agree with many of the sentiments expressed by Justice Brobson to the effect that it is the Article II, Section 16 criteria, and not some concept of partisan fairness, that should control any redistricting exercise; whereas, the experts’ fairness metrics may be used in proving that a challenged map embodies illegal gerrymandering. See Dissenting Op. at 8-9 (Brobson, J.). In my view, the neutral criteria appearing in the Constitution’s text are insufficiently ambiguous to support the consideration of policy goals that are claimed to have motivated their adoption. As Judge McCullough suggested, moreover, the use of such policy goals as quality metrics in a map-selection endeavor can lead to reverse gerrymandering aimed at altering the partisan performance which arises naturally from the political geography of this state, which in turn stems from the decisions of many individual voters concerning where they wish to live. See Special Master Report at 197. Most importantly, the partisan-fairness metrics are not well suited to an objective scoring methodology because political judgments must be made about how to rank the maps in relation to such metrics.

the state charter's neutral directives, it seems evident that the closer a map adheres to those directives, the less likely it will be that district boundaries have been manipulated to give any political or partisan group an artificial advantage. As this Court recently explained in *LWV-II*:

Because the character of these [constitutional] factors is fundamentally impartial in nature, their utilization reduces the likelihood of the creation of congressional districts which confer on any voter an unequal advantage by giving his or her vote greater weight in the selection of a congressional representative as prohibited by Article I, Section 5. Thus, use of these objective factors substantially reduces the risk that a voter in a particular congressional district will unfairly suffer the dilution of the power of his or her vote.

*LWV-II*, 178 A.3d at 816; see also *id.* (noting these standards also comport with the United States Constitution's requirements for congressional districts).

All of this leads to the question of how to determine which of the proffered maps best complies with the Constitution's neutral factors after eliminating any maps that fail to meet the constitutional floor. See generally *LWV-II*, 178 A.3d at 817 ("These neutral criteria provide a 'floor' of protection for an individual against the dilution of his or her vote in the creation of such districts.").<sup>3</sup> To answer this question, two observations may be made. First, the maps can be analogized to candidates in an election where each criterion by which they are judged is the equivalent of an individual voter taking part in a ranked-choice voting exercise:

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<sup>3</sup> A map might fail to meet the floor by, for example, containing districts which are not contiguous, or by having an unjustified population variance between districts. Such maps should be eliminated from consideration.

A given map must also comply with federal statutory law such as the Voting Rights Act or it, too, will not be considered. Here, however, there has been no suggestion that any of the proposed maps violates federal statutory law.

When a court or agency purports to select one of many possible outcomes by ranking the outcomes under a set of criteria, the situation parallels the democratic process. In place of the preferences of individual citizens, rankings under criteria determine judicial or administrative choices.

Matthew L. Spitzer, *Multicriteria Choice Processes: An Application of Public Choice Theory to Bakke, the FCC, and the Courts*, 88 YALE L.J. 717, 717-18 (1979). This type of decisional process – having multiple voters rank the contenders in an effort to select the best one – has been applied in such diverse contexts as selecting the most valuable player in sports, see Saul Levmore, *More than Mere Majorities*, 2000 UTAH L. REV. 759, 763, choosing an Academy Award winning film, see National Conference of State Legislatures, *Ranked-Choice Voting*, Vol. 25, No. 24 (2017), available at <https://www.ncsl.org/research/elections-and-campaigns/ranked-choice-voting.aspx> (last viewed Feb. 23, 2022), nominating political candidates, see *Maine Senate v. Sec’y of State*, 183 A.3d 749, 751-52 (Me. 2018), and electing political leaders, see *id.*

The second observation is that ranked-choice voting can be accomplished through pairwise comparisons of the candidates, in this case, the candidate maps. As long as this Court has adequate data concerning how well the maps score for a given quality metric at the most granular level (for example, the Polsby-Popper compactness metric), any two maps can be compared to see which one is better, or if they are tied. These pairwise comparisons can then be used to rank and score the maps for each quality metric using the “Borda count” system.<sup>4</sup> Under this system, for each quality metric, each map receives one point for every other map it is superior to, plus one-half point for every other

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<sup>4</sup> The Borda count method is named after Jean-Charles de Borda, an eighteenth-century French mathematician. See Edward B. Foley, *Tournament Elections with Round-Robin Primaries: A Sports Analogy for Electoral Reform*, 2021 WIS. L. REV. 1187, 1200 n.39 (indicating Borda count is viewed as the best method to rank three or more candidates).

map it ties with.<sup>5</sup> In this way, the pairwise comparisons yield a “raw” Borda count score for each map, for each quality metric at the most detailed level.

The method is simple and transparent. It is also flexible enough to accommodate virtually any type of quality metric, including continuous metrics such as a map’s score on a particular measure of compactness; integer-based metrics such as the number of county splits or county pieces reflected in a given map; binary metrics such as whether a map splits Pittsburgh (if this were indeed to be considered a valid quality metric); or criteria with a few discrete points, such as how many non-retiring incumbents are paired and whether they are from the same or opposite parties.<sup>6</sup> These examples are given by way

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<sup>5</sup> See Bernard Grofman, *Public Choice, Civil Republicanism, and American Politics: Perspectives of a “Reasonable Choice” Modeler*, 71 TEX. L. REV. 1541, 1565 n.110 (1993); Jean-Pierre Benoit & Lewis A. Kornhauser, *Assembly-Based Preferences, Candidate-Based Procedures, and the Voting Rights Act*, 68 S. CAL. L. REV. 1503, 1522 & n.44 (1995).

With human voters, Borda count can be subject to distortion based on insincere (strategic) voting, see Cheryl D. Block, *Truth and Probability – Ironies in the Evolution of Social Choice Theory*, 76 WASH. U.L.Q. 975, 987-88 (1998) (providing an example of insincere ranked-choice voting and its underlying motivation), and it has been shown to sometimes miss a majority winner, see Saul Levmore, *Voting Paradoxes and Interest Groups*, 28 J. LEGAL STUD. 259, 266 n.9 (1999). These problems are absent here, as objective pairwise comparisons cannot be insincere, and our goal is not to pick the map that comes in first in most of the quality metrics, but to pick the best map overall.

<sup>6</sup> For example, the maps before the Court reflect the following non-retiring incumbent pairings: one (R-D), one (R-R), two (R-D and R-D), two (R-R and R-D), two (D-D and R-D), and none.

These can be ranked in order from best to worst as follows. Best: none; second-best: one (R-D); third-best: two (R-D and R-D); fourth-best: one (R-R); worst: two (R-R and R-D) or two (D-D and R-D).

Returning to the handling of Pittsburgh: the method can accommodate a three-point quality measure where keeping Pittsburgh whole is best, keeping it whole via a “claw”

of illustration, but, as explained, I will only be using the neutral constitutional criteria for the present discussion – albeit in the Appendix, I also fold in the maps’ handling of Pittsburgh which, for reasons delineated below, is *sui generis*.

I use the term “raw scores” because the Borda count methodology must be modified slightly to be of use here. A map’s overall raw score is not ultimately what matters, but its overall weighted score, as explained *infra*.<sup>7</sup> As for terminology, I will refer to high-level measures such as compactness and respect for political subdivision boundaries as the neutral constitutional *criteria*, and the different ways of measuring those criteria as *individual quality metrics*. This distinction is needed because there are multiple ways to measure compliance with each criterion. For example, there are several individual quality metrics associated with compactness, each capturing a different aspect of mathematical compactness, and some accounting for such features as jagged state borders or peninsulas which necessarily make districts less compact. See N.T., Jan. 27, 2022, at 214 (reflecting expert testimony stressing the importance of considering multiple compactness metrics); *Holt*, 67 A.3d at 1242 (recognizing “an apparent variety” of compactness models). Likewise, there are various different quality metrics relating to subdivision splits, such as county splits, ward splits, county pieces, and so on.

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shape which grabs it, as in the House Democratic Caucus’s proposed map, is second-best, and splitting it is worst. The attached Appendix illustrates this scenario.

<sup>7</sup> The weighting of criteria has been used in a variety of multi-criteria decision making (“MCDM”) tasks involving selection. See *Thiel v. W. Mifflin Borough*, 2007 WL 1087773, at \*3 (W.D. Pa. Apr. 9, 2007) (hiring and promotion); *Transactive Corp. v. N.Y. State Dep’t of Soc. Servs.*, 665 N.Y.S.2d 701, 704 (N.Y. App. Div. 1997) (public procurement); *Pickus v. U.S. Bd. of Parole*, 507 F.2d 1107 (D.C. Cir. 1974) (parole selection); *Doe v. Alternative Med. Md., LLC*, 168 A.3d 21 (Md. 2017) (licensure selection); *Lohn v. Morgan Stanley DW, Inc.*, 652 F. Supp. 2d 812 (S. D. Tex. 2009) (assignment of client accounts to financial advisors); *Universal Grading Svc. v. eBay, Inc.*, 2009 WL 2029796 (E.D.N.Y. June 10, 2009) (assessment of rare-coin grading services).



Thus, for example, if compactness and respect for political boundaries are considered equally important and each is given a total weight of 10, there may be X ways to measure the former and Y ways to measure the latter. It follows that each compactness-related individual quality metric should have a weight of  $10/X$ , and each boundary-related individual quality metric should have a weight of  $10/Y$ . A map's score for a given individual quality metric, then, is its Borda count raw score multiplied by the weight of that quality metric.<sup>8</sup>

Consistent with my remarks at the beginning of this opinion, I would hold that this Court should rank and score all proposed maps according to each of the individual quality metrics and select the map with the highest total weighted score. The process entails five steps: (1) eliminate any map which fails to meet the constitutional "floor" or which violates federal law; then as to each of the remaining maps: (2) compute raw scores for each map for each individual quality metric using pairwise comparisons and Borda count; (3) compute weighted scores for each map for each individual quality metric by multiplying the raw scores by the weight for that individual quality metric; (4) compute the total weighted score for each map by summing all weighted scores for that map; and (5) select the map with the highest overall weighted score.

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<sup>8</sup> This type of weighting might also be useful in situations where secondary factors such as preserving communities of interest are included in the analysis. This is because not all such metrics are equally important, nor are they as important as the constitutional criteria. See Majority Op. at 15 (noting such factors are "wholly subordinate to the traditional core criteria"). Assigning different weights can reflect those realities. Similarly, weighting can be useful if this Court ultimately reads the "unless absolutely necessary" language in Article II, Section 16 as signifying that the Constitution places a higher value on avoiding subdivision splits than on compactness. See *generally Holt*, 67 A.3d at 1242 (indicating that achieving population equality and avoiding subdivision splits may "necessitate[] a certain degree of unavoidable non-compactness in any reapportionment scheme." (internal quotation marks and citation omitted)). For example, a total weight of 10 could be assigned to compactness, 7 or 8 to avoiding subdivision splits, and 3, 4, or 5 to the subordinate historical considerations.

The maps presented to us, and the data contained in the expert reports concerning those maps, reveal that all meet the contiguity and population-equality criteria, which are essentially binary in nature.<sup>9</sup> As noted, moreover, none are alleged to violate federal law. See *supra* note 3. This leaves only the compactness and adherence-to-political-boundaries criteria on which to form a judgment concerning which is the best of the maps under review.

Twelve maps have been submitted for this Court's consideration: the Carter Petitioners' map ("CARTER"), the Gressman Petitioners' map ("GRESSMAN"), Governor Wolf's map ("GOV"), the map approved by the General Assembly ("HB-2146"), the first map by the Senate Democratic Caucus ("SEN-DEM-1"), the second map by the Senate Democratic Caucus ("SEN-DEM-2"), the House Democratic Caucus's map ("HOUSE-DEM"), the first map by the Reschenthaler group ("RESCH-1"), the second map by the Reschenthaler group ("RESCH-2"), the map submitted by the "Voters of the Commonwealth of Pennsylvania" group ("VOTERS-PA"), the map submitted by the "Draw

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<sup>9</sup> Pursuant to the 2020 census, Pennsylvania's population was 13,002,700, resulting in 17 districts with an average population of 764,864.7 per district. See Special Master Report at 3 n.6. Because the population is not a multiple of 17, there must be a population deviation, that is, the population of the most-populous district minus the population of the least-populous district must be at least one person.

I am aware that some of the maps have a population deviation of two persons. However, I do not consider the difference between a one-person and a two-person deviation to be legally significant, particularly as the census numbers are only approximate due to imperfections in data gathering combined with subsequent births, deaths, and relocations. Put differently, discounting two-person-deviation maps as compared to one-person-deviation maps would, in my view, be an exercise in false precision. Whether or not the Constitution allows for a *de minimis* population deviation, I would find a deviation of two persons to be *sub-de minimis*. For purposes of this case, then, I consider all maps with a one- or two-person deviation as satisfying the constitutional equal-population criterion.

the Lines” citizens’ group (“DRAW-LINES”), and the map submitted by the “Citizen Voters” group (“CITIZEN-VOTERS”).<sup>10</sup>

These twelve maps have been given a compactness score for each of six different mathematical compactness measurements: Polsby-Popper, Schwartzberg, Reock, Convex Hull, Population-Polygon, and Cut Edges.<sup>11</sup> Each map, in fact, has 17 scores for these metrics because each has 17 districts for which a compactness measure can be calculated. Helpfully, for each map the record contains average scores for each of these quality metrics – that is, an average score which comprises the mean value for the 17 districts contained on a particular map. It is these averages that are used in the pairwise comparisons between maps. Per the above discussion, each of the compactness metrics is assigned a weight of 1.67 (10 divided by 6, rounded to the nearest hundredth).

The averages for the twelve maps on four of the six compactness metrics were given by Dr. Daryl DeFord, see Majority Op. at 24, the expert who testified on behalf of the Gressman Petitioners. The only two compactness metrics missing from Dr. DeFord’s data are the Schwartzberg and Population-Polygon measures. Fortunately, however, those are reflected in a table supplied by Dr. Moon Duchin, Governor Wolf’s expert, which

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<sup>10</sup> A thirteenth map was submitted by the Khalif Ali amici. It has been excluded because, unlike all of the other maps, its boundaries were drawn based on data which attempted to assign prisoners to their last known home address without first establishing a legal basis for doing so. When assessed according to the data used by all the other maps, its population deviation was too high to meet the constitutional requirement of equi-populous districts. In any event, the record suggests it would not be the highest-scoring map in terms of compactness and subdivision splits even if accepted on its own terms.

<sup>11</sup> As explained, each such metric captures a different aspect of geometrical compactness, and each has its strengths and weaknesses. Further elucidation of this topic from a mathematical point of view is beyond the scope of this dissenting opinion. I only note at this juncture that, for each metric except “Cut Edges,” a number closer to 1.0 is better. With the Cut Edges metric, a lower number is better.

was endorsed by the Special Master. See Special Master Report at 141-43.<sup>12</sup> All six of these compactness measures are shown below in the row containing the map name. From these averages, raw Borda count scores are obtained using pairwise comparisons; as previously noted, a map’s raw score includes one point for each pairwise win, plus a half-point for each pairwise tie, and so a higher raw score indicates better performance on that metric. The raw scores are then multiplied by the weight for that metric to arrive at the weighted score for each map for each metric:

MAP	Polsby-Popper	Schwartzberg	Reock	Convex Hull	Population Polygon	Cut Edges
<i>Weight</i>	1.67	1.67	1.67	1.67	1.67	1.67
CARTER	.31	1.8103	.41	.78	.7416	5896
Borda raw score	2.5	3	6.5	2.5	1	2
Weighted score	4.175	5.01	10.855	4.175	1.67	3.34
GRESSMAN	.33	1.7351	.40	.80	.7582	5546
Borda raw score	5	5	4.5	8.5	5	4
Weighted score	8.35	8.35	7.515	14.195	8.35	6.68
GOV	.37	1.6534	.40	.81	.7834	5154
Borda raw score	9.5	10	4.5	10.5	11	8
Weighted score	15.865	16.7	7.515	17.535	18.37	13.36
HB-2146	.31	1.8197	.38	.78	.7524	5882
Borda raw score	2.5	1	1.5	2.5	3	3
Weighted score	4.175	1.67	2.505	4.175	5.01	5.01
SEN-DEM-1	.30	1.8144	.37	.77	.7519	6016
Borda raw score	1	2	0	1	2	1
Weighted score	1.67	3.34	0	1.67	3.34	1.67
SEN-DEM-2	.32	1.7478	.38	.79	.7601	5476
Borda raw score	4	4	1.5	5.5	6	5
Weighted score	6.68	6.68	2.505	9.185	10.02	8.35
HOUSE-DEM	.27	1.9693	.39	.75	.7205	6821
Borda raw score	0	0	3	0	0	0
Weighted score	0	0	5.01	0	0	0
RESCH-1	.35	1.6859	.43	.81	.7737	5061

<sup>12</sup> In Dr. Duchin’s report and table of map statistics, see Special Master Report at 141, the DRAW-LINES map is referred to as the “CitizensPlan.” See N.T., Jan. 27, 2022. This should not be confused with the CITIZEN-VOTERS map.

Borda raw score	8	8	9	10.5	10	11
Weighted score	13.36	13.36	15.03	17.535	16.7	18.37
RESCH-2	.34	1.7127	.41	.80	.7658	5208
Borda raw score	6.5	7	6.5	8.5	7	6
Weighted score	10.855	11.69	10.855	14.195	11.69	10.02
VOTERS-PA	.38	1.6069	.44	.79	.7681	5120
Borda raw score	11	11	10.5	5.5	8	10
Weighted score	18.37	18.37	17.535	9.185	13.36	16.7
DRAW-LINES	.37	1.6625	.44	.79	.7725	5202
Borda raw score	9.5	9	10.5	5.5	9	7
Weighted score	15.865	15.03	17.535	9.185	15.03	11.69
CITIZEN-VOTERS	.34	1.7133	.42	.79	.7575	5144
Borda raw score	6.5	6	8	5.5	4	9
Weighted score	10.855	10.02	13.36	9.185	6.68	15.03

In addition to the compactness metrics, there are five quality metrics relating to how well a map keeps political subdivisions intact: counties split, county pieces, municipalities split, municipality pieces, and wards split. Including a score for “ward pieces” would amount to double-counting, as Dr. DeFord’s data reflect that no ward is split more than once. The combined weight of these individual metrics will be set to approximately 10, in accordance with the decision mentioned above to give equal weight to compactness and respect for subdivision boundaries. Still, it is something of a judgment call whether to consider these five quality metrics equally important and assign each a weight of 2.0. In my view, doing so would diminish the importance of ward splits without constitutional warrant, as all types of subdivisions are listed in Article II, Section 16 on equal terms. See PA. CONST. art. II, § 16 (“Unless absolutely necessary no county, city, incorporated town, borough, township or ward shall be divided[.]”).

Separately, giving county splits and county pieces each a weight of 2.0 would involve double-counting as the number of county pieces will depend, to a large extent, on the number of split counties (and similarly for split municipalities and municipality pieces). To ameliorate these concerns, I am assigning a weight of 2.00 for county splits, 1.34 for

county pieces, 2.00 for municipality splits, 1.34 for municipality pieces, and 3.34 for ward splits.<sup>13</sup> The total weight is 10.02, the same as the total weight for the compactness measures (6 x 1.67).<sup>14</sup> The scores are set forth below in a manner similar to that for compactness:

MAP	Counties split	County pieces	Municipalities split	Municipality pieces	Wards split
<i>Weight</i>	<i>2.00</i>	<i>1.34</i>	<i>2.00</i>	<i>1.34</i>	<i>3.34</i>
CARTER	14	31	23	44	21
Borda raw score	8	7	2.5	1	5
Weighted score	16	9.38	5	1.34	16.7
GRESSMAN	15	32	19	36	15
Borda raw score	5	5	10.5	10.5	10
Weighted score	10	6.7	21	14.07	33.4
GOV	16	35	22	41	25
Borda raw score	2	1	4.5	4	1.5
Weighted score	4	1.34	9	5.36	5.01
HB-2146	15	33	21	39	18

<sup>13</sup> The county and municipal pieces metrics include all pieces, not merely “extra” pieces. I note this because the data supplied by Dr. DeFord only includes the number for extra pieces. For example, if a map splits, say, 20 municipalities into two pieces each, Dr. DeFord’s data shows 20 split counties and 20 split pieces rather than 20 split counties and 40 split pieces. The Borda counts will not change, however, as the ranking of maps according to the “pieces” metrics is the same regardless of whether all pieces, or only “extra” pieces, are counted.

As a separate matter, for consistency with the majority opinion, per Dr. DeFord’s data the splits and pieces shown in the table include boroughs split by county lines. See Majority Op. at 32.

<sup>14</sup> A reasonable argument could be made that these items should be weighted differently. One possibility would be to consider each type of municipality – cities, incorporated towns, boroughs, and townships – on equal terms. But this could be distortive as there are different numbers of the different types of municipalities. For example, Pennsylvania has only one incorporated town (Bloomsburg). In the end, since counties are the basic sub-units of governance, and because splitting wards can be especially problematic, I am assigning a weight of 3.34 to counties, 3.34 to wards, and 3.34 to all other municipalities combined.

Borda raw score	5	4	6.5	5.5	7
Weighted score	10	5.36	13	7.37	23.28
SEN-DEM-1	17	36	25	45	17
Borda raw score	0	0	0	0	8
Weighted score	0	0	0	0	26.72
SEN-DEM-2	16	34	21	38	14
Borda raw score	2	2.5	6.5	7	11
Weighted score	4	3.35	13	9.38	36.74
HOUSE-DEM	16	34	24	43	21
Borda raw score	2	2.5	1	2	5
Weighted score	4	3.35	2	2.68	16.7
RESCH-1	13	29	20	37	25
Borda raw score	10.5	10.5	8.5	8.5	1.5
Weighted score	21	11.39	17	11.39	5.01
RESCH-2	13	29	20	37	24
Borda raw score	10.5	10.5	8.5	8.5	3
Weighted score	21	11.39	17	11.39	10.02
VOTERS-PA	15	31	23	42	41
Borda raw score	5	7	2.5	3	0
Weighted score	10	9.38	5	4.02	0
DRAW-LINES	14	30	22	39	16
Borda raw score	8	9	4.5	5.5	9
Weighted score	16	10.72	9	7.37	30.06
CITIZEN-VOTERS	14	31	19	36	21
Borda raw score	8	7	10.5	10.5	5
Weighted score	16	9.38	21	14.07	16.7

The final two steps are to compute the total weighted score for each map and select the one with the highest total. Doing so yields the following scores, from highest to lowest.<sup>15</sup> As can be seen, RESCH-1 is the top-scoring map, followed by DRAW-LINES:

<sup>15</sup> For the scoring in this opinion and the Appendix attached hereto, I have used a spreadsheet to facilitate the calculations. The weights, raw data, and raw Borda scores were entered manually. All other computations were performed by the spreadsheet program. All total weighted scores are rounded to two decimal places.

MAP	Place	Total weighted score
RESCH-1	1	162.83
DRAW-LINES	2	158.83
RESCH-2	3	142.79
CITIZEN-VOTERS	4	142.28
GRESSMAN	5	138.61
VOTERS-PA	6	121.92
GOV	7	114.06
SEN-DEM-2	8	109.89
HB-2146	9	81.66
CARTER	10	77.65
SEN-DEM-1	11	38.41
HOUSE-DEM	12	33.74

I note that I used Dr. DeFord's data to align my scoring with the data used by the majority (supplemented where necessary). To guard against possible distortion from the use of only one data set, I also scored the maps based on Dr. Duchin's table on page 141 of the Special Master's Report. While there were slight variations in placement as among all twelve maps, the top two scoring maps remained the same:

MAP	Place	Total weighted score
DRAW-LINES	1	166.51
RESCH-1	2	155.98
RESCH-2	3	138.45
CITIZEN-VOTERS	4	134.60
VOTERS-PA	5	131.27
GRESSMAN	6	129.26
SEN-DEM-2	7	116.57
GOV	8	113.89
HB-2146	9	83.15
CARTER	10	68.80
HOUSE-DEM	11	42.42
SEN-DEM-1	12	41.75



Thus, with Dr. Duchin's data the DRAW-LINES map was the top scorer, with RESCH-1 as the runner-up. As between those two maps, however, only RESCH-1 keeps Pittsburgh whole, whereas DRAW-LINES splits it in two.<sup>16</sup> If this factor were to be given weight as recommended by the Special Master, see Special Master Report at 150-51 (discussing evidence suggesting Pittsburgh should be kept within a single district); see *also id.* at 149 (finding that splitting Pittsburgh allows a map to achieve a higher compactness score), I would conclude that the RESCH-1 map should be chosen regardless of which data set is used.

In all events, the CARTER map does not come close to rising to the top of the pack. It seems notable, moreover, that, when compared with the other maps, the majority does not purport to find that the CARTER map scores particularly well on the neutral constitutional criteria on which the maps primarily compete, namely, compactness and respect for county and municipal boundaries. See Majority Op. at 28 n.23 (reflecting that the CARTER map is only a mid-level scorer in terms the compactness quality metrics listed); *id.* at 33 n.26 (same with regard to the split-municipalities quality metrics).

Whichever data set was used, the CARTER map placed tenth out of twelve – thus, in the bottom quartile. As the majority chooses that map for Pennsylvania, I respectfully dissent.

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<sup>16</sup> With a population of approximately 302,000, Pittsburgh is the second-largest city in Pennsylvania, and it is the largest city that does not need to be split to maintain population equality among congressional districts. The third-largest city, Allentown, has a far-lower population – around 125,000 as of the 2020 census. See <https://www.census.gov/quickfacts/allentowncitypennsylvania> (last viewed Mar. 4, 2022). Therefore, and because of the distinctly local emphasis of Pittsburgh's political culture as described by the Special Master, there appears to be particular importance attached to the precept that Pittsburgh should not be split. The Appendix to this opinion reflects the weighted quality scores of the maps if the handling of Pittsburgh were to be subsumed as a quality metric. In that scoring, the RESCH-1 map scores highest.

## APPENDIX

As suggested in the attached dissenting opinion, the Borda-count scoring system is versatile enough to subsume virtually any quality metric. All that is needed is the ability to perform pairwise comparisons in reference to that metric. The handling of Pittsburgh can be used to illustrate this concept. Per the Special Master's report, it can be deemed best to keep Pittsburgh within a single district. At the same time, keeping that city whole via a normal-looking district can be viewed as superior to keeping it whole by grabbing it with what the Special Master termed a "Freddy Krueger-like claw," which gives the appearance of gerrymandering. Special Master Report at 152, 203. Thus, one can construct three quality levels in the following descending order of desirability: "whole," "claw," and "split." In that event, the seven maps that keep Pittsburgh whole would receive a raw score of 8 because each is superior to five other maps and tied with six ( $5 + (0.5 \times 6) = 8$ ); the "claw" map would receive a raw score of 4 by being superior to the four maps that split Pittsburgh; and those last four maps (the ones that split Pittsburgh) would receive a raw score of 1.5 because each is tied with three other maps. Giving the handling of Pittsburgh quality metric a weight of 4 (less than half as weighty as either of the neutral constitutional criteria which each received a weight of 10.02), the maps' handling of Pittsburgh can be folded into the scoring system with the following raw and weighted scores:

MAP	Handling of Pittsburgh
<i>Weight</i>	<i>4.00</i>
CARTER	Whole
Borda raw score	8
Weighted score	32
GRESSMAN	Whole
Borda raw score	8
Weighted score	32
GOV	Split
Borda raw score	1.5
Weighted score	6
HB-2146	Whole
Borda raw score	8
Weighted score	32
SEN-DEM-1	Split
Borda raw score	1.5
Weighted score	6
SEN-DEM-2	Split
Borda raw score	1.5
Weighted score	6
HOUSE-DEM	Claw
Borda raw score	4
Weighted score	16
RESCH-1	Whole
Borda raw score	8
Weighted score	32
RESCH-2	Whole
Borda raw score	8
Weighted score	32
VOTERS-PA	Whole
Borda raw score	8
Weighted score	32
DRAW-LINES	Split
Borda raw score	1.5
Weighted score	6
CITIZEN-VOTERS	Whole
Borda raw score	8
Weighted score	32

When these weighted scores are added to the previous totals, the following ranking emerges:

MAP	Place	Total weighted score
RESCH-1	1	194.83
RESCH-2	2	174.79
CITIZEN-VOTERS	3	174.28
GRESSMAN	4	170.61
DRAW-LINES	5	164.83
VOTERS-PA	6	153.92
GOV	7	120.06
SEN-DEM-2	8	115.89
HB-2146	9	113.66
CARTER	10	109.65
HOUSE-DEM	11	49.74
SEN-DEM-1	12	44.41

A similar ranking is generated when only the Dr. Duchin data are used:

MAP	Place	Total weighted score
RESCH-1	1	187.98
DRAW-LINES	2	172.51
RESCH-2	3	170.45
CITIZEN-VOTERS	4	166.60
VOTERS-PA	5	163.27
GRESSMAN	6	161.26
SEN-DEM-2	7	122.57
GOV	8	119.89
HB-2146	9	115.15
CARTER	10	100.80
HOUSE-DEM	11	58.42
SEN-DEM-1	12	47.75

The above tables show that, when the handling of Pittsburgh is taken into account, the RESCH-1 map scores highest, followed by either the RESCH-2 map (using the Dr. DeFord data supplemented by the Dr. Duchin data) or the DRAW-LINES map (using only the Dr. Duchin data). Moreover, the CARTER map is consistently in the bottom three even though it keeps Pittsburgh whole.

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