Submission No 8

PREFERENCE COUNTING IN LOCAL GOVERNMENT ELECTIONS IN NSW

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Submission to the NSW

Joint Standing Committee on Electoral Matters

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Table of Contents

Recommendations 1

1 Authors' Background 2

2 Recommended Change to the Method of Transferring Surpluses 3

3 Second and Further Transfers of Surplus Votes 5

4 Countback or Recounts for Local Government 6

5 Open source software? 7

6 Scrutiny of Computer Based Counts 8

7 Application of similar principles to Legislative Council count 9

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Recommendations

The authors commend the following recommendations for the Committee's consideration.

Recommendation 1

The committee recommend to government that they replace the random selection transfer method in Schedule 5 of Local Government (General) Regulation 2005, with the deterministic Weighted Inclusive Gregory fractional method.

Recommendation 2

The committee recommend to government that regulations be finalised so as to implement s 291A of the Local Government Act 1993 providing for the filling of vacancies by a recount of the votes from the previous election, subject to some preliminary modelling to check that recounts will produce a realistic result in a system where the marking of preferences is voluntary.

Recommendation 3

The committee recommend to government that they establish a whole of government ~~a~~ policy on making select agency computer code available to researchers on request. Assessment of the requests should be done by a panel comprising agency and academics assessing the application on competence and public interest.

Recommendation 4

The committee recommend to government that the Act or the General Regulations be amended to provide more expressly for the satisfactory scrutiny of the votes when a computer is used to count all the of the votes in a given contest. This should include enabling scrutineers to both randomly check that votes in the count are the same as paper ballots and independently verify the count process on a separate computer.

Recommendation 5

The committee recommend to government that at some future time consideration should be given to amendments to Schedule 6 of the Constitution Act 1902, so that the same system of preference distribution can be used for Local Government and Legislative Council elections, should the local government method be changed.

1 Authors' Background

Ian Brightwell[1]

I am a consultant, adjunct academic[2] and experienced CIO. I help clients manage and utilise their technology investments. I specialise in program and portfolio management and technology governance with a particular focus on information security. In addition to postgraduate qualifications in information systems and management he is Certified by ISACA[3] in the Governance of Enterprise IT (CGEIT) and a trained Gateway Reviewer for NSW ICT programs.

I provide advice to organisations on how to improve their technology and program governance. I am a gateway reviewer for government providing program assurance advice. I also provide executive advice on how organisations can effectively and efficiently improve their security posture.

I was CIO and Director of IT at the New South Wales (NSW) Electoral Commission in Australia. My role was responsible for the provision of all IT infrastructure and information security for the Commission and led NSW electronic voting initiative (iVote) at the 2011 and 2015 elections.

I was responsible for the design and development the current PRCC[4] counting system in 2008 used for both Local Government Councillor elections and Legislative Council elections. I also managed the NSW's award-winning iVote system which supported NSW's technology assisted voting legislation. NSW is one of the few jurisdictions in the world with on-going requirement for remote internet and phone voting at parliamentary elections. This technically complex project was the largest internet based voting system in the world for a public election. In 2015 election iVote took 283,669 votes.

John Pyke

I have degrees in Science (majoring in Physics and Mathematics) and in Law. While doing my LLM degree at the University of Sydney I received the Otto and Emma Bondy Prize for top marks in the subject Uses of Logic in the Service of Law. I lectured in Constitutional Law at QUT for 25 years, before retiring in 2014. My textbook *Constitutional Law* was published by Palgrave Macmillan in 2013 and Thomson Reuters has recently published an updated and expanded version of it under the title of *Government Powers Under a Federal Constitution*.

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[2] Adjunct Senior Lecturer, School of Computer Science and Engineering, Faculty of Engineering and the University of NSW.

[3] Information Systems Audit and Control Association, ISACA http://www.isaca.org/about-isaca/Pages/default.aspx

[4] NSWEC's Proportional Representation Computer Count system used to capture and count the local government councillor and state Legislative Council and Legislative Assembly elections.

I have made many submissions to Parliamentary Committees, some of which have resulted in changes to the law; eg, the inclusion of ss 10 and 65 in the *Constitution of Queensland 2001*. I have been engaged from time to time by Mr Peter Wellington MP (now the Speaker) as a consultant on law reform and legislative drafting, again resulting in a few specific changes to Queensland statutes.

My interest in electoral systems and proportional representation goes back to the 1970s. I have been the National Vice-President of the Proportional Representation Society of Australia since 2008. I should note that under the Society's Constitution I do not have authority to speak officially on its behalf, but I believe the views expressed below are held by nearly all the members and are consistent with policies recently adopted by the Victoria-Tasmania Branch. (My view on "countback" versus a full recount may be at odds with at least some of the members.)

As an expert in statutory interpretation and electoral systems, and having some knowledge of programming, I was engaged in 2009-10 as a consultant by the NSW Electoral Commission with the task of checking whether the flow chart relating to the Vote Count Module that they were supplying to their contracted programmers accurately mirrored the requirements of the statutory provisions regarding the election of Legislative Councillors and Local Government Councils, and was able to make suggestions to improve the specifications.

2 Recommended Change to the Method of Transferring Surpluses

Most Local Government Councillor elections in NSW are conducted using a proportional representation ("PR") approach. Where PR is used in Australia, some version of a "quota preferential" or "single transferable vote" system is always used. In these systems, once a candidate has reached the quota[5], one quota's worth or votes is (either physically or notionally) set aside, and the candidate's surplus votes are distributed. When votes could only be counted manually, the votes were physically separated into bundles – enough votes to represent the quota were selected at random, and the other votes were treated as representing the surplus. Those votes, and only those votes, were then examined to determine the next preference and were then added to the bundles of votes for the continuing candidates. The current approach, as defined by the NSW Local Government (General) Regulation 2005, Schedule 5 - Counting of votes under proportional system[6] - replicates that approach, although the "bundles" are now notionally assembled in the computer's memory.

[5] The quota universally used in Australia is the "Droop quota", found by dividing the number of formal votes by *one more* than the number of positions to be filled, i.e. $V_f/(n+1)$ and rounding up to the next integer. This is a logical extension of the requirement, when filling just one vacancy, that the winner receives over 50% of the votes after distribution of preferences. A few people advocate the "Hare quota", V_f/n. Though more intuitively obvious, this can produce a result in which the last quota can only be filled by artificially forcing together a collection of votes for parties whose policies may be from all over the political compass and even diametrically opposed to each other. This is only "proportional" representation in a very artificial sense.

[6] NSW Local Government (General) Regulation 2005, Schedule 5 - Counting of votes under proportional system https://www.legislation.nsw.gov.au/#/view/regulation/2005/487/sch5

This approach was appropriate for manually counted elections because it required less calculations at the time of vote transfer. However, since 2004 computers have been used to count votes in NSW Councillor elections; hence the use of a random selection approach is no longer necessary for computational reasons. It is just as easy for a computer to record that, say, 0.72 of every vote for an elected candidate is saved as part of his/her quota, and that the other 0.28 is being passed on to a continuing candidate. In fact. it is possibly easier, because the use of random selection involves the repeated running of sub-routines that generate random numbers, whereas treating the votes as divided between the preferred candidates is completely deterministic.

The use of computers in these elections actually highlights the greatest weakness of the random selection approach, which is that there can be a different final result every time the election distribution of preferences is run. This was always taken for granted, by those who thought about it, in the days of manual processing, but doing the count again would have been so much trouble that nobody, as far as we are aware, ever risked subverting faith in the system by bothering to do it. It is trivially easy to do with computers. Since 2012 elections the NSWEC has published both the full preference markings[7] on all ballots and the specification used to program the PRCC system[8]. The NSWEC in conjunction with political commentator Antony Green identified in early 2016[9] that the 2012 Councillors elected were impacted by statistical uncertainty due to the random selection process used when distributing preferences. This work was then reproduced by academics at University of Melbourne[10].

The general conclusion of all this work was that it was inappropriate to use random selection to transfer votes in Local Government Council elections and it should be changed to a fractional approach.

It should also be noted that testing a system which uses random selection is very difficult, currently the NSWEC uses a “fixed” seed approach to test the PRCC system. This involves setting the value of the random number seed to a set value when conducting tests which require comparison to known outputs. This means the random components of the system are never really tested adequately. This is another argument in favour of abandoning random selection for a completely deterministic fractional approach - it will not only help the Electoral Commission's programming task but also make it easier for the NSWEC to test the system and others to check the results from the NSWEC PRCC system if they use their own programs against provided election preference data.

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[7] Preferences for 2012 LG Councillor elections
http://www.pastvtr.elections.nsw.gov.au/LGE2012/Results/LGE2012/PRCC/

[8] Functional Requirements Specification for the Vote Count, Sept 2016, version 3.4
http://www.elections.nsw.gov.au/__data/assets/pdf_file/0007/254995/PRCC_LG_Count_v1.1.0.2_Test_Certificate_.pdf

[9] NSW Electoral Law and the Problem of Randomly Elected Candidates, Antony Green Blog January 13, 2016
http://blogs.abc.net.au/antonygreen/2016/01/nsw-electoral-law-and-the-problem-of-randomly-elected-candidates.html

[10] An analysis of New South Wales electronic vote counting, November 2016.
https://arxiv.org/pdf/1611.02015.pdf

3 Second and Further Transfers of Surplus Votes

Another carry-over from the days of manual counting is that, even in several counting systems that are now computerised (including NSW Local Government and Legislative Council, and the Senate), when votes are passed on as part of an elected candidate's surplus, those that have "arrived" in a candidate's bundle with a fractional weighting are counted equally with those that had a weighting of one on "arrival". So a large number of votes that previously had a small weighting, and have contributed marginally to a candidate's election, can unfairly dominate that candidate's surplus. This may sound like a fairly technical or trivial point – and indeed for some years it was thought to be unlikely that it would affect a result in the real world – but for an example of where this actually *changed* the result of an election see Antony Green's discussion of the Victorian Legislative Council, Northern Victoria Region, election[11].

We therefore recommend that the counting rules should spell out that when transfer values are calculated, the previous transfer value of votes is taken into account. That is, on successive transfers of surpluses the transfer values should be multiplied, further reducing the value of those that had already had a fractional value. We have not used PR wonks' jargon up to this point, but we note that the system of transferring votes with a fractional value has been christened the Gregory Method. In the original Gregory Method only the votes in the last parcel received by the candidate just elected were transferred, so the method of transferring *all* votes with a fractional value has become known as the Inclusive Gregory Method. Where the transfer values are allowed to jump back up it is called the Unweighted Inclusive Gregory Method, and where the values are multiplied at successive stages it is called the Weighted Inclusive Gregory Method (WIGM).[12] Clearly, we are recommending that the Parliament should adopt the latter. It has been used for the Legislative Council of Western Australia for some time, so a drafting precedent is available in the Electoral Act 1907 (WA), Schedule 1. A publication[13] prepared for the Western Australian Electoral Commission provides an excellent overview of both the history and options available for transferring surplus votes when using a proportional representation system.

There is also an even more sophisticated system known as the Meek System, which copes with the possibility, under optional preferences, that some votes will terminate by successively recalculating the quota. It is a bit complex, and we note the cautious resolution of the Victoria-Tasmania Branch of the PRSA – that it should be adopted where "the written rules, the expertise of those conducting the count, the communication of the method to the electors and candidates, and the reliance on computerised counting are not problematic."[14] We also note, however, that the perceived difficulty of comprehension has not prevented its

[11] Transfer Values in Northern Victoria Region, December 16, 2014, Antony Green Blog
http://blogs.abc.net.au/antonygreen/2014/12/transfer-values-in-northern-victoria-region.html

[12] For the PR Society's page on this, and for as much as is known about Mr Gregory, see
http://www.prsa.org.au/gregoryj.htm

[13] DETERMINING THE RESULT: Transferring Surplus Votes in the Western Australian Legislative Council, July 2002
https://www.elections.wa.gov.au/sites/default/files/content/documents/Determining_the_result.pdf

[14] For further information provided by the PRSA see http://www.prsa.org.au/meek_stv.htm

adoption for municipal elections in New Zealand. We suggest that the Committee might like to ask the relevant committee in New Zealand whether there have been any problems with using ”Meek”. Certainly, if you do not want to go that far, we strongly recommend replacing NSW’s random selection method with the Weighted Inclusive Gregory Method.

4 Countback or Recounts for Local Government

Another consequence of adopting a fractional approach to transfers of surpluses is that it will make it easier for the Parliament and executive to properly implement s 291A of the Act, which provides for vacancies in Councils to be filled by “countback” rather than by-elections. Like the transfer process itself, a countback or recount becomes easier when the original count has been conducted by computer and the preference distributions simply have to be recovered from stored files, and it then becomes yet more straightforward when the count has been done deterministically rather than by using random selection of votes. As Parliament seems to have acknowledged already by the passage of s 291A, a recount (to use a general word) maintains the proportionality of representation reached at the general election, at least while the original candidates or parties are still “on the scene” (as to this point, see below). They also allow casual vacancies to be filled rapidly and economically.

As to the actual form of recount we note that there are 2 main forms - one in which only the votes that formed the quota for the former member are re-examined (for which the word "countback" is reserved by the PRSA) and one in which a full, or total, recount is performed, omitting only the vacating member and candidates who are known to have died or who have indicated that they do not want to be considered[15]. The former version has, up till now, been used in the ACT and Tasmania, and in Victoria for local government, while the latter version is used in Western Australia for the Legislative Council. On the page just cited the PRSA (Victoria-Tasmania Branch) claims that the partial countback is better because of "its strict adherence to the principle that the only votes that should determine who should fill a casual vacancy are those votes that formed the quota of votes that elected the vacating candidate".

We are not persuaded by this statement. Where the former councillor was elected as part of a “ticket”, it can be expected that most of the next preferences of the voters who elected him/her will pass to the next person on the ticket, so either a partial countback or a full recount would elect that next person. However, where there have been several truly independent candidates, the preferences of the independent-minded voters may not form much of a pattern, and a replacement member/councillor may well be elected with a bare half-quota, so there is in fact some deviation from PR principles in such cases. This was recognised in "Act for the Future", the Directions Paper for the current Review of Local Government in Victoria. The authors suggested a change to a full recount and explained[16]:

> *The proposed change to the method of conducting countbacks addresses the concern that the current process—by depending exclusively on the preferences of the vacating councillor—often denies the election of another candidate preferred by the rest of the electorate and on the cusp of being elected at the general election. It*

[15] http://www.prsa.org.au/casu_vac.htm

[16] Directions Paper for the current Review of Local Government in Victoria, see page 54 http://www.yourcouncilyourcommunity.vic.gov.au/16888/documents/37297

achieves the efficiency of the current countback arrangement and better reflects the independence of candidates in council elections.

We believe that the latter argument is the stronger one.

There are of course some limits to the usefulness of a recount. Perhaps the greatest worry is that sometime after an election not all candidates will be willing to be considered. It would be anomalous if someone whose views were diametrically opposed to those of the vacating councillor were elected simply because he/she was the only one still interested. Hence, we agree with the provision in s 291A(1)(a) that a recount should only apply in the first 18 months of the term. Further, since NSW has optional preferential voting there may be a significant number of votes that have no preferences expressed for the candidates who were originally thought to have little hope but have now become "live" candidates in the recount.

We suggest therefore that it might be worthwhile to commission some people with expertise in this field to do some modelling of the recount process, using historical results, to check whether, in realistic scenarios, a realistic result is achieved – by which we mean that a replacement candidate is not elected with, say, less than 40% of a quota. If the answer is that it hardly ever is, then we concede that there is little point in providing for a recount. If the answer is that realistic results are sometimes, but not always achieved, if may be worthwhile to have a provision for a recount to be done as quickly as possible, and if it produces a result based on too few "live" votes, to discount it and hold a by-election.

It seems to be thought by some that there is a danger that a recount with some candidates removed might "unelect" persons who were elected on the original count. Certainly, this is possible when preferences are subject to random selection, but once this is removed from the system it would take an extremely freaky set of preferences for this to happen. However, even in Western Australian it was thought necessary to include a section (*Electoral Act 1907* s 156D(9)) providing that any non-vacating already-elected candidate cannot be displaced by the recount. This should probably be copied here.

5 Open source software?

There is a strong view within sections of the academic computer science community that agencies like the NSWEC should make all their vote counting code open source[17]. It is fair to say that governments and agencies have struggled with this approach regardless of various half-hearted policies in the past which support its adoption. The main problem agencies have is its potential impact on resources versus the lack of potential for any real benefits to be realised. This is reinforced by the fact that supporters of open source have acknowledged that it does not guarantee that all errors or security problems will be detected, as demonstrated below.

We believe a middle ground can be found between open source advocates' and agencies' views. We propose that instead of open source arrangements, source code should be made available to researchers but only those who are technically competent to assess the code.

[17] Open-source software (OSS) is computer software with its source code made available with a license in which the copyright holder provides the rights to study, change, and distribute the software to anyone and for any purpose.
https://en.wikipedia.org/wiki/Open-source_software

Also, those researchers must follow responsible disclosure practices and not require valuable government resources to support them in their investigations. The assessment of researcher competence should be undertaken by a panel comprising researchers and agency staff with terms of reference to address the competence of the applicant and benefits to the public of the proposed research. Finally, this policy should be a whole of government policy not just an agency specific policy.

The fact code is open source does not ensure the code is more secure or accurate. A number of open source code projects have been found to have bugs. It is interesting to note however that a very subtle bug found in the PRCC was found without the code being made open source. Academics from Melbourne University and ANU who confirmed earlier observations about the impact of random selection also found a very subtle programming bug in the PRCC system. This bug was found as a by-product of confirming the impact of random selection on the 2012 election.

To confirm the impact of random selection they had to write a parallel system from the same published specification and compare results, using the published 2012 election data set and results. In this data set one election was found to potentially have elected the wrong person. It is quite probable that this subtle bug would not have been found even if the code had been open sourced. It potentially may only ever have been found by an independent person writing a parallel system. Our conclusion from this is that the best guarantee of accuracy arises from outsiders checking the *results* of the official distributions by writing their own code and feeding the voting data into their own programs.

A final interesting point regarding open source is that some of the NSWEC code is used for commercial purposes at local government elections and as such needs to be kept confidential. Should the government decide to make the NSWEC PRCC vote counting code available then they will also need to consider requiring commercial providers to make their code available as it is just or even more likely to fail.

6 Scrutiny of Computer Based Counts

The *Local Government (General) Regulation 2005* currently provides for the appointment of scrutineers (clause 337) and the presence of scrutineers at the counting of the physical ballot papers (cls 346 and 348). This legislation was devised for situations which involved only manual counting of ballots and it did not envisage the use of a computer to capture ballot preferences and perform a count.

However, Councillor data from ballots is now completely managed by computers and entered into a database by keying. It is still important however that scrutineers be able to check the accuracy of the data entry process. The current process of just viewing ballots on a screen as they are keyed is not sufficient for effective scrutiny, because the data entry process does not have the same connection between the observed ballot and the final result as is afforded by a manually counted ballot.

The best and simplest way for scrutineers to check data entered ballots is by checking randomly selected batches of physical ballots against the corresponding data used in the count process. The NSWEC undertakes this type of checking internally but does not offered it to be witnessed by scrutineers other than at recounts, and scrutineers currently do not have a right to witness this type of check to validate data entry. We recommend that scrutineers be able to randomly select a limited number of batches for cross checking

against data to be used for counts and that this right should be entrenched in the appropriate Act or Regulation.

The public also needs to be confident the computer based count process used by the NSWEC for Councillor elections is operating as per the legislation. The simplest way to do this is for the Commission to provide the data used in the count to the public which will allow the final count to be validated by independent parties. This arrangement is currently being used by the Commission to good effect but we now believe it is appropriate for transparency that the right to independently check the final count should be expressly stated in the appropriate Act or Regulation by requiring the NSWEC to publish the data-entered preference markings.

7 Application of similar principles to Legislative Council count

We realise that if our recommendations are adopted NSW will have two different systems of PR counts. Therefore, we believe that eventually the same changes made to the election of local government Councillors should be made to the system for electing Legislative Councillors, at least as to the transfer of surpluses. (It may be thought that the Senate-style system for filling vacancies is working well enough in something which is essentially a party-based House).

We are of course aware that, since this system is “entrenched” in a Schedule of the Constitution Act 1902, it cannot be changed without approval by the people in a referendum. We also note that the referendum of 1991 demonstrated that if the major parties jointly recommend technical changes to Schedule 6, a majority is likely to approve. We recommend that at some time in the future, perhaps after the change to the Local Government system has been shown to work well, that the Parliament should present a referendum question to the voters, to approve similar changes to the distribution of preferences in Schedule 6.