Chairman McManus, Vice-Chair Hogan, State Board of Elections Members, Members of the Public,

Thank you for the opportunity to address you today.

I am Poorvi L. Vora, tenured Professor of Computer Science at The George Washington University. Your post-election procedures for a federal election affect Maryland voters and other US citizens like me. I am here today to represent the views of about a dozen election integrity experts from across the country. We have collectively been involved in dozens of election audits in dozens of jurisdictions. Our names and affiliations are listed in the printed testimony; I will read out my own summary. We would like to offer a constructive proposal.

It's great that Maryland voters get to vote on paper ballots this year: paper ballots that voters can check are the best evidence of "the will of the people." Maryland's ballots will be scanned and then counted electronically. As required by hard-won state legislation passed in 2007, the paper ballots will be stored securely as durable evidence of what voters wanted. The state looks great; it has been prescient about the need for election verification, a very important characteristic of a good election, and particularly important this year.

We understand, however, that the State Board does not have any plans to manually review any of the paper ballots. The State will keep the ballots locked away and has contracted to, instead, provide only electronic scans to *another* software-based system to check on the first one. We have read claims, in the Post this week, that the proposed post-election method is "independent" of the voting system, but it isn't. It copies scan data from the voting system, assuming that the data are complete and correct. But part of the purpose of an audit is to determine that the data are complete and correct.

One is tempted to think that the scans consist of a set of images, untouched by any computers, that completely and correctly represent all ballots. Like a set of photographs on film, created by a physical process and not a computerized one, and hence not vulnerable to error or tampering. However, this is not correct.

The scans could differ from the ballots for reasons of scanner error, such as the inability to record very light marks or different inks. I should know about this. My PhD was on this topic, and, today, the most commonly-used measure of the color-recording capability of scanners is the Vora-value, named after me. Crucially, while the scans do originate through a physical process, they can only be delivered as ones and zeroes, *by* software, *through* the computerized scanner. They are computer data, handled by computer software, and can be deleted, replaced or tampered with.

I don't want to detract from the proposed post-election plans. We have heard that the State Board is planning reviews for all votes, contests and counties. The proposed reviews can detect many types of errors in the original counts. The planned procedure also adds considerable value by involving human input in vote interpretation. But it will not detect problems due to mismatches between the ballots and the scan data. There's no good reason not to review the paper ballots to ensure that there is no mismatch. Other states do. Modern audits can be highly efficient, reviewing only a small random sample of the ballots. There are risk-limiting audits, different from the methods considered by Maryland, that do not require ordered ballots.

If the Board relies only on the scans, it is required to provide, in the budget report—described in budget amendment D38I01 pages 22 and 23 of Report on the Fiscal 2017 State Operating Budget (SB 190) and the State Capital Budget (SB 191)—an explanation for why hand and eye inspection was not required to determine voter intent. It will need to explain why it began an audit of a computerized process by trusting that the computer records are right. Recall that the voter has not verified the scans.

The Board is also required to report on the risk level of the post-election procedure. Let's think about this. A capable malicious actor wanting to change election outcome will focus on changing scan data and derived results. Your procedures will not detect such an attack. The probability that such an attack will not be detected is 100%.

Finally, the budget report requires a description of "the manner in which the public was permitted to comment on the audit procedures before the audit, observe the audit, and comment on the conduct and results of the audit after the audit is complete". A sufficiently transparent and robust statistical audit of the electronic results against the paper ballots can satisfy budget reporting requirements, as well as produce strong evidence that election outcomes are correct.

In conclusion: the state just obtained the technology to move away from paperless black box voting. This year, other states probably wish they had done so too. But just having paper records is not sufficient. We fear that Maryland is undoing its strong leadership position by not taking the final, crucial step of an audit. In this contentious election, it is extremely important to Maryland and the nation to audit election results against the actual paper ballots. We can help you do so in addition to your planned post-election procedures, which do add value but do not make up an audit. We also look forward to the Board providing a robust opportunity for public comment on all methods.