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Risk-Limiting Audits in Arizona

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Introduction¹

In the face of record-breaking voter turnout and a global pandemic, Arizona election officials and poll workers successfully administered a safe and secure November 2020 general election. In large part, that was because of the coordinated effort of state, local, and federal officials to ensure that Arizona was well prepared for the election effort.

Two of the most important election security measures in use in Arizona today, paper ballots and postelection audits, were first implemented more than a decade ago.² Currently, Arizona is one of at least 24 states that conduct postelection audits, which require hand review of paper ballots, prior to certification of the election results.³ However, as we discuss in detail below, there are two substantive deficiencies in Arizona’s current audit law: (1) local election officials are prevented from completing an audit if one or more political parties refuse to participate and (2) the type of postelection audit required (a “traditional” postelection audit) limits the efficacy and the flexibility of the audit.⁴

To address these shortcomings, Arizona should (1) require postelection audits by eliminating the audit stop order triggered by a political party’s failure to participate and (2) replace the currently required postelection audit with the more effective and typically more cost-efficient risk-limiting audit. A risk-limiting audit (RLA) is a check on the election outcome. Through the use of proven statistical methodologies, an RLA provides voters with confidence in the accuracy of election results. It can be conducted publicly and is designed to detect, and correct, counting errors or malicious attacks that change the outcome of an election.

Arizona should begin by establishing an RLA pilot program that will allow local election officials to test the procedure and give officials and the public time to provide feedback before issuance of uniform statewide procedures and documentation requirements.⁵

Part I: What Is a Risk-Limiting Audit?

In straightforward terms, a risk-limiting audit is an easy and efficient method for verifying the accuracy of unofficial election outcomes (i.e., winners and losers).⁶ Through hand counting a statistically meaningful sample of paper ballots cast in an election, an RLA can provide confidence that the election outcome was correct.⁷ These audits help “ensure that . . . the hardware, software, and procedures used to tally votes found the real winners.”⁸ The National Academies of Sciences, Engineering, and Medicine, election officials, statisticians, and cybersecurity experts have all endorsed these types of audits.⁹

RLAs are efficient in that they often require review of a smaller number of ballots than a traditional audit. Instead, election administrators select the smallest sample necessary to obtain an established level of confidence (the “risk limit”) in the accuracy of the outcome:

Statistical principles determine the size of the sample — but, in plain terms, more ballots are counted in a close race, while a race with a larger margin of victory would require fewer ballots to be counted. If testing of the sample is consistent with the original reported vote total, it is almost certain that the initially declared winner actually won the race. If, on the other hand, the sample has substantial discrepancies with the original tally, the audit continues until there is “sufficiently strong statistical evidence that the apparent outcome is right, or until all the ballots have been manually counted.”¹⁰

RLAs are also flexible in that the standard protocols remain the same whether a jurisdiction relies primarily on precincts or vote centers for in-person voting. RLAs provide a check on election outcomes (not results at individual precincts or vote centers), so even if a jurisdiction relies primarily on vote centers, RLAs still provide confidence in the election outcome accuracy without requiring election officials to manually sort the ballots into precincts.

The risk limit is a number (generally expressed as a percentage) either chosen by an authorized official or body, established in statute or regulation, or selected by an authorized official or body within parameters created by statute, regulation, or rule. The risk limit is “the largest probability that, if an outcome is wrong, the audit does not correct that outcome.”¹¹ In Colorado, the secretary of state is authorized to select the risk limit but is prohibited from selecting one in excess of 10 percent.¹² This approach, tasking the secretary of state with selecting a risk limit subject to statutory parameters, could also work in Arizona. As an alternative, Arizona’s Vote Count Verification Committee, currently tasked with selecting the audit margin discrepancy rate, which is required for traditional audits but not for RLAs, could be tasked with selecting the risk limit within a range established by statute.¹³

To conduct an RLA, election officials enter the risk limit selected, total number of votes cast, and votes received by each candidate into a software calculator called an “audit tool.” The audit tool determines the number of ballots for manual review and randomly selects them.¹⁴ Auditors then retrieve these ballots and record the results of the manual review in the audit tool, which “calculates the measured risk based on a statistical analysis of these results.”¹⁵

The audit tool handles the mathematical computations, and the software is open source, permitting observers to inspect and verify the code, which is free and nonproprietary. In practice, performing a risk-limiting audit is straightforward and does not require “complicated calculations or in-house statistical expertise.”¹⁶

In contrast to RLAs, traditional postelection audits, like those currently conducted in Arizona, require auditors to hand count a percentage of ballots fixed by statute or regulation, even when counting that many ballots is unnecessary to provide confidence in the election outcome, due to a wide margin of victory. For the reasons described above, RLAs can frequently alleviate some of the administrative burden Arizona election administrators face while simultaneously ensuring that enough ballots are hand counted to provide confidence in the state’s postelection audits.

Part II: What Is a Hybrid Risk-Limiting Audit?

All RLAs require a consistent record-keeping regimen and a ballot manifest (a simple log with information on all ballots cast and their storage locations). However, not all RLAs are the same. There are four basic RLA methods: ballot comparison, ballot polling, batch polling, and hybrid, which we recommend for the state of Arizona. Batch polling is not described or defined in this paper, as it is least likely to be suitable for use in Arizona.

In a ballot comparison audit, “auditors manually review randomly selected paper ballots” and compare those ballots to “the voting machine’s record of how that ballot was originally tallied.”¹⁷ These audits are suitable in jurisdictions with voting machines that preserve cast vote records (CVRs) for all votes and which rely primarily on mail-in voting.¹⁸ This method is the most efficient, as fewer ballots need to be reviewed to statistically

support the outcome.¹⁹ Still, election officials must ensure that ballots audited with this method are stored and organized “in the order they were scanned and tabulated,” so that auditors can identify which ballots must be retrieved and reviewed.²⁰

Similarly, in a ballot-polling audit, auditors review randomly selected paper ballots by hand. However, these audits do not require matching individual paper ballots to the electronic record associated with that ballot. Instead, auditors review the sampled ballots, aggregate the results, and enter them into the audit tool, which analyzes the input and the reported vote shares. This method is best suited for paper ballots in localities with voting machines that do not retain CVRs and/or rely primarily on in-person voting. Although ballot-polling audits generally require more ballots for review than a ballot comparison RLA, the administrative burden for a ballot-polling RLA is still typically lighter than it is for traditional hand-count audits.²¹

Audit Methods²²

METHOD	OVERVIEW	REQUIREMENTS
Ballot comparison	Auditors manually review randomly selected paper ballots; for each ballot, their visual interpretation of each vote is recorded and compared by the audit tool (software calculator) to the voting machine’s record of how that ballot was originally tallied.	<ol style="list-style-type: none"> 1. The voting system retains a record of how the ballots were counted (a cast vote record) in the order scanned. 2. A paper ballot management system is in place to ensure that paper ballots are retained in order scanned and/or paper ballots have unique ID numbers applied during scanning.
Ballot polling	Auditors manually review randomly selected paper ballots; the results are aggregated and analyzed in stages by the audit tool (software calculator).	A log (called the ballot manifest) identifies all ballots cast in the election and their storage location.
Hybrid	Auditors review randomly selected ballots. These ballots are sorted into two different groups: one for ballot comparison and the other for ballot polling. The results are analyzed as described above.	<ol style="list-style-type: none"> 1. A voting system meets the requirements for a ballot-comparison audit. 2. A voting system meets the requirements for a ballot-polling audit. <p>(E.g., a DS450 tabulates absentee ballots and a DS200 tabulates ballots cast in precinct.)</p>

There is a clear trade-off between these two methods. A ballot-comparison audit is more efficient but requires more information from a vote tabulation system, which is unavailable for some voting systems or election administration systems.²³ A ballot-polling audit does not require tabulation information for individual ballots but is less efficient.²⁴ However, in election administration ecosystems such as Arizona’s, in which more than 50 percent of the ballots are typically cast by mail but in-person voting still accounts for approximately 10 percent or more of total votes cast, a hybrid RLA is feasible. A hybrid RLA would work best in Arizona because it allows for the use of the ballot-comparison method on the ballots cast by mail and the ballot-polling method on ballots cast in person and/or tabulated on machines that do not retain a CVR, which maximizes efficiency and reduces administrative costs.

In fact, Arizona is one of approximately 16 states able to take advantage of the cutting-edge hybrid RLA procedure. According to the U.S. Election Assistance Commission, Arizona was one of 16 states in 2016 with “more than 50 percent ballots cast via early, mail and absentee voting.”²⁵ Just over 2 million mail-in ballots were cast in the state’s 2016 general election, nearly 75 percent of all ballots cast.²⁶ This figure rose in the 2020 general election, with over 2.4 million voters casting a mail ballot.²⁷ By using the ballot-comparison method on the maximum number of ballots possible when conducting a hybrid RLA, election officials can drastically reduce the amount of time, energy, and labor necessary for postelection audits of elections with wide margins in the state.

Part III: Improve Arizona’s Audit System by Making Risk-Limiting Audits Mandatory

State law currently requires election officials to conduct a postelection audit (referred to as a “hand count”) that is classified as a traditional postelection audit. As described by National Conference of State Legislatures, these audits “are usually conducted manually by hand counting a portion of the paper records and comparing them to the electronic results produced by an electronic voting machine” and “look at a fixed percentage of voting districts or voting machines. . . . Even in a landslide election, they will count the same number of ballots as they would in a nail-biter election.”²⁸ This inflexibility limits the efficacy of traditional postelection audits, and generally prevents them from being considered “statistically sound” audits, the implementation of which is a key recommendation of the U.S. Senate Select Committee on Intelligence.²⁹ In our view, for the reasons of efficacy outlined above, the RLA is clearly superior to the traditional audit, and our primary recommendation is that Arizona change the type of audit it conducts.

As it stands, election officials are required by law to conduct traditional audits to assess the accuracy of the tabulators in accordance with procedures established in Arizona’s election and procedures manual.³⁰ However, the actual completion of an audit is not mandatory but contingent upon political party participation.³¹ In fact, state law expressly prohibits the audit from proceeding if the political parties fail to provide a list of designated audit participants or if a sufficient number of political party designees required to conduct the audit fail to appear (an “audit stop order”).³² In the November 2020 general election, five counties did not conduct hand-count audits because a political party did not designate participants for the Hand Count Election Board.³³

Audits give election officials the opportunity to check for potentially serious errors or security breaches and to reassure the public that they can be confident in the election results. Given the importance of postelection

audits as a tool for retaining voters' confidence and the state's extensive experience performing audits, Arizona should eliminate the statutory audit stop order and require postelection audits after all primary, special, and general elections. The state should continue to encourage and authorize participation by political parties, but no postelection audit should be contingent on political party participation.³⁴

Finally, although we favor RLAs over traditional audits, we recommend that the state retain the majority of the remainder of its audit law, which already incorporates several best practices into the auditing process.³⁵ The process is transparent, allowing political party representatives serving as observers to film the hand-count audit in accordance with A.R.S. § 16-602(B). Audit procedures are also released for public comment and published well before an election.³⁶ Election officers and audit board members receive concise instructions in statute and in the elections and procedures manual regarding an audit's preparation and conduct.³⁷ Additionally, audit boards and election officials must comply with a standardized record-keeping system that simplifies the review and results reporting process.³⁸ Arizona should maintain these practices and measures, regardless of whether the legislature adopts risk-limiting audits.

Part IV: Risk-Limiting Audit Implementation

Pilot programs have been key to the successful implementation of RLAs across the country. Multiple states that are transitioning or have transitioned to RLAs, including Colorado, Georgia, Indiana, Michigan, Nevada, and Pennsylvania, have conducted or are currently planning pilots that will precede the formal implementation of RLAs and establishment of statewide procedures and documentation requirements.³⁹ Such grace periods ensure that officials and the public have sufficient opportunities to practice new procedures and allow for appropriate uniform statewide procedures.

We recommend an RLA pilot period of at least 12 months, along with a formal implementation date of no later than November 2022. This implementation schedule will ensure that election officials develop sufficient experience with this procedure prior to the 2024 presidential election.

Part V: Conclusion

The Arizona legislature should require risk-limiting audits after all primary, special, and general elections as of November 2022 and establish an RLA pilot program that will ensure a smooth transition to these more efficient audits. Arizona's strong election administration infrastructure will make the transition to RLAs relatively easy. RLAs are the most effective type of postelection audit and can help retain and restore voters' confidence in the accuracy of election outcomes.

About the Authors

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Endnotes

¹ This white paper was prepared at the request of the Arizona secretary of state. The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the official policy or position of the secretary of state.

² Among the most important recommendations the Senate Select Committee on Intelligence made in its July 2019 report were that states should (1) replace outdated and vulnerable voting systems with “at minimum . . . a voter-verified paper trail” and (2) adopt statistically sound audits. *Report of the Select Committee on Intelligence United States Senate on Russian Active Measures Campaigns and Interference in the 2016 U.S. Election Volume 1: Russian Efforts Against Election Infrastructure with Additional Views*, U.S. Senate Select Committee on Intelligence, July 15, 2019, 59, https://www.intelligence.senate.gov/sites/default/files/documents/Report_Volume1.pdf.

³ Andrea Córdova McCadney, Elizabeth Howard, and Lawrence Norden, *Voting Machine Security: Where We Stand Six Months Before the New Hampshire Primary*, Brennan Center for Justice, August 13, 2019, <https://www.brennancenter.org/our-work/analysis-opinion/voting-machine-security-where-we-stand-six-months-new-hampshire-primary>.

⁴ “Traditional post-election audits are usually conducted manually by hand counting a portion of the paper records and comparing them to the electronic results produced by an electronic voting machine. . . . [They typically] look at a fixed percentage of voting districts or voting machines and compare the paper record to the results produced by the voting system. Even in a landslide election, they will count the same number of ballots as they would in a nail-biter election.” National Conference of State Legislatures, *Post-Election Audits*, October 25, 2020, <https://www.ncsl.org/research/elections-and-campaigns/post-election-audits635926066.aspx>.

⁵ Nevada Secretary of State Barbara Cegavske (R) and Georgia Secretary of State Brad Raffensperger (R) both implemented a pilot period for their respective states’ risk-limiting audits. “Nevada SB 123 required risk-limiting audits to be phased in. A pilot program for conducting risk-limiting audits will be conducted in November 2020 and each county clerk must conduct a risk-limiting audit beginning in 2022. Nevada previously had a traditional post-election audit in place.” National Conference of State Legislatures, *Post-Election Audits*. “The Secretary of State shall conduct a risk-limiting audit pilot program with a risk limit of not greater than 10 percent in one or more counties by December 31, 2021.” O.C.G.A. § 21-2-498(e).

⁶ Christopher Deluzio, *A Smart and Effective Way to Safeguard Elections*, Brennan Center for Justice, July 25, 2018, <https://www.brennancenter.org/our-work/analysis-opinion/smart-and-effective-way-safeguard-elections>.

⁷ Deluzio, *A Smart and Effective Way*.

⁸ Elizabeth Howard, Ronald L. Rivest, and Philip B. Stark eds., *A Review of Robust Post-Election Audits*, Brennan Center for Justice, November 7, 2019, 1, https://www.brennancenter.org/sites/default/files/2019-11/2019_011_RLA_Analysis_FINAL_0.pdf.

⁹ “States should mandate a specific type of audit known as a ‘risk-limiting’ audit prior to the certification of election results.” National Academies of Sciences, Engineering, and Medicine, “Securing the Vote – New Report,” September 6, 2018, <https://www.nationalacademies.org/news/2018/09/securing-the-vote-new-report>; and Howard, Rivest, and Stark, *Robust Post-Election Audits*.

¹⁰ Deluzio, *A Smart and Effective Way*.

¹¹ Howard, Rivest, and Stark, *Robust Post-Election Audits*, 1.

¹² 8 Colo. Code Regs. § 1505-1:25.2.2(a). In 2020, Secretary of State Jena Griswold set a risk limit of 4 percent for the 2020 general election comparison risk-limiting audit.

¹³ What follows are the risk limits for previous comparison RLAs in Colorado: for the 2020 general election, the risk limit was set at 4 percent (Colorado Secretary of State, “Risk Limit Set for the 2020 General Election,” last updated September 28, 2020, <https://www.sos.state.co.us/pubs/elections/RLA/2020/general/riskLimit.html>); for the 2020 state primary election, 4 percent (Colorado Secretary of State, “Risk Limit Set for the 2020 Primary Election,” last updated May 29, 2020, <https://www.sos.state.co.us/pubs/elections/RLA/2020/statePrimary/riskLimit.html>); for the 2020 presidential primary election, 1 percent (Colorado Secretary of State, “Risk Limit Set for the 2020 Presidential Primary Election,” last updated March 5, 2020, <https://www.sos.state.co.us/pubs/elections/RLA/2020/presidential/riskLimit.html>); for the 2019 coordinated election, 5 percent (Colorado Secretary of State, “Risk Limit Set for 2019 Coordinated Election,” October 4, 2019, <https://www.sos.state.co.us/pubs/elections/RLA/2019/background.html>); for the 2018 general election, 5 percent (Colorado Secretary of State, “2018 RLA Background - General Election,” October 5, 2018, <https://www.sos.state.co.us/pubs/elections/RLA/2018/general/background.html>). When the state of Colorado launched its RLA in 2017, Republican Secretary of State Wayne Williams selected 9 percent as the risk limit because it was the highest single-digit number. Colorado Secretary of State, “2017 RLA Background,” last accessed December 1, 2020,

<https://www.sos.state.co.us/pubs/elections/RLA/2017/background.html>; Howard, Rivest, and Stark, *Robust Post-Election Audits*, 1; and A.R.S. § 16-602(K)(4).

¹⁴ This process requires a “random seed,” a randomly selected number used to generate a pseudorandom ballot sample for auditing, which is entered into the audit tool. Howard, Rivest, and Stark, *Robust Post-Election Audits*, 1.

¹⁵ Howard, Rivest, and Stark, *Robust Post-Election Audits*, 5.

¹⁶ Mark Lindeman and Philip B. Stark, *A Gentle Introduction to Risk-limiting Audits*, IEEE Security and Privacy Special Issue on Electronic Voting, March 16, 2012, 1, <https://www.stat.berkeley.edu/~stark/Preprints/gentle12.pdf>.

¹⁷ Howard, Rivest, and Stark, *Robust Post-Election Audits*, 6.

¹⁸ A cast vote record (CVR) is an “archival record of how the voting system interpreted all votes produced by a single voter. CVRs are generated by the voting system, but may be stored in electronic, paper, or other form.” Howard, Rivest, and Stark, *Robust Post-Election Audits*, 1.

¹⁹ Howard, Rivest, and Stark, *Robust Post-Election Audits*, 7.

²⁰ Howard, Rivest, and Stark, *Robust Post-Election Audits*, 11.

²¹ “From a procedural perspective, RLAs are not difficult. Ballot-polling audits require no pre-election preparation and the execution of the audit is like a hand recount but with significantly less work.” Howard, Rivest, and Stark, *Robust Post-Election Audits*, 16.

²² Table adapted from Howard, Rivest, and Stark, *Robust Post-Election Audits*, 6.

²³ Lindeman and Stark, *A Gentle Introduction*, 2.

²⁴ Lindeman and Stark, *A Gentle Introduction*, 2.

²⁵ The 16 states are Arizona, Arkansas, California, Colorado, Florida, Georgia, Hawaii, Montana, Nevada, New Mexico, North Carolina, Oregon, Tennessee, Texas, Utah, and Washington. U.S. Election Assistance Commission, “EAVS Deep Dive: Early, Absentee and Mail Voting,” October 17, 2020, table, <https://www.eac.gov/documents/2017/10/17/eavs-deep-dive-early-absentee-and-mail-voting-data-statutory-overview>.

²⁶ U.S. Election Assistance Commission, *The Election Administration and Voting Survey: 2016 Comprehensive Report*, 2017, 23, https://www.eac.gov/sites/default/files/eac_assets/1/6/2016_EAVS_Comprehensive_Report.pdf.

²⁷ U.S. Elections Project, “Arizona Early Voting Statistics,” last updated November 2, 2020, <https://electproject.github.io/Early-Vote-2020G/AZ.html>.

²⁸ National Conference of State Legislatures, *Post-Election Audits*, National Conference of State Legislatures.

²⁹ *Report of the Select Committee on Intelligence United States Senate on Russian Active Measures Campaigns and Interference*, 59.

³⁰ A.R.S. § 16-602.

³¹ A.R.S. § 16-602.

³² A.R.S. § 16-602(D).

³³ Arizona Secretary of State, “Summary of Hand Count Audits - 2020 General Election,” last updated November 17, 2020, <https://azsos.gov/election/2020-general-election-hand-count-results>. See also Jeremy Duda, “Several Counties Didn’t Hand Count Ballots Because Political Parties Didn’t Participate,” *AZ Mirror*, November 17, 2020, <https://www.azmirror.com/2020/11/17/several-counties-didnt-hand-count-ballots-because-political-parties-didnt-participate/>.

³⁴ If the state chooses to retain traditional postelection audits, then the legislature should consider (1) establishing a margin discrepancy rate by statute and dissolving the Vote Count Verification Committee (VCVC) or (2) requiring the VCVC to provide justification for its margin rate selections and/or establish margin discrepancy rate parameters in statute.

³⁵ Verified Voting, *Principles and Best Practices for Post-Election Tabulation Audits*, December 2018, <https://verifiedvoting.org/wp-content/uploads/2020/05/Principles-and-Best-Practices-For-Post-Election-Tabulation-Audits.pdf>.

³⁶ Verified Voting, *Principles and Best Practices*; and Arizona Secretary of State, "Election Procedures Manual Draft to be Released for Public Comment," August 8, 2019, <https://azsos.gov/about-office/media-center/press-releases/1016>.

³⁷ Verified Voting, *Principles and Best Practices*, 10.

³⁸ Arizona Secretary of State, *Arizona Secretary of State 2019 Elections Procedures Manual*, 2019, 228, https://azsos.gov/sites/default/files/2019_ELECTIONS_PROCEDURES_MANUAL_APPROVED.pdf.

³⁹ Colorado Secretary of State, "Audit Center," <https://www.sos.state.co.us/pubs/elections/auditCenter.html>; Stephen Fowler, "Fulton County Performs Risk-Limiting Audit Pilot of Presidential Primary," Georgia Public Broadcasting, June 29, 2020, last updated August 13, 2020, <https://www.gpb.org/news/2020/06/29/fulton-county-performs-risk-limiting-audit-pilot-of-presidential-primary>; Jay Bagga, "Looking Beyond Colorado: Risk Limiting Audits in Indiana," Voting System Technical Oversight Program, December 7, 2018, <http://electionlab.mit.edu/sites/default/files/2018-12/eas-bagga.pdf>; Office of Secretary of State Jocelyn Benson, "Pilot Audit of March Presidential Primary Results Showcases Security, Accuracy of Michigan Election System," June 10, 2020, news release, <https://www.michigan.gov/sos/0,4670,7-127-93094-531561--,00.html>; Verified Voting, "Nevada Audit Laws," <https://verifiedvoting.org/auditlaw/nevada/>; and Pennsylvania Pressroom, "Pennsylvania's First Enhanced Statewide Election Audit Confirms Presidential Primary Outcome," August 26, 2020, news release, <https://www.media.pa.gov/pages/State-details.aspx?newsid=395>.