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Knowing It's Right, Part One

A Practical Guide to Risk-Limiting Audits

by Jennifer Morrell



ABOUT THE AUTHOR

Jennifer Morrell is a nationally recognized election official with over eight years of experience managing local elections. Her work in Colorado was instrumental in the successful implementation of the first statewide risk-limiting audit and she has been an outspoken advocate of implementing election audit standards beyond just post-election audits and has a vision of creating uniform audit and testing standards for all critical components of the voting system. Bringing extensive expertise in election administration, Morrell serves as a consultant leading the Election Validation Project at Democracy Fund.

ABOUT DEMOCRACY FUND

Democracy Fund invests in organizations working to ensure that our political system is able to withstand new challenges and deliver on its promise to the American people. We work to encourage leaders across the political spectrum to find common ground to help reduce barriers to voting, improve integrity and public trust in the electoral system, and reduce the dependency of our leaders on special financial interests.

For more information, please visit www.democracyfund.org.

ABOUT OUR PHOTOGRAPHS

The photographs used throughout this report are provided courtesy of the author. Some capture real-world examples of risk-limiting audits being performed by election officials from around the country. The use of these photos is intended solely to illustrate how this work is done and should not suggest the subjects' endorsement of the content in this report.

On Cover: A polling place on Election Day 2018 in Montgomery County, MD.
Photo by Danny Sax.

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What Is a Risk-Limiting Audit, and Why Should We Do It?

What motivates voters to participate? The love of a charismatic candidate? The dislike of a less-than-desirable one? Passion for a specific ballot initiative? Habit? The answer is as varied as the voting population, as is the reason that voters do not participate. Research shows that while voters' confidence in their own vote being counted accurately remains relatively constant, their belief that results at the national level are correct is in decline.¹ The threat of interference in our elections by another nation-state has heightened this sentiment.

At Democracy Fund, we believe that our election system can remain both accessible and secure. We invest in organizations working to bolster public confidence in our elections through modern, voter-centric election administration and registration, as well as other projects that are helping to identify and elevate best practices and protocols to improve the American voting experience.

With these goals in mind, Democracy Fund launched the Election Validation Project, which aims to increase trust in elections through rigorous audits, standards, and

testing. We are proud to support Jennifer Morrell, a nationally recognized election official with over eight years of experience managing local elections, to lead this project. Morrell's work in Colorado was instrumental in the successful implementation of the first statewide risk-limiting audit (RLA), a type of post-election audit that has become a hot topic in the past few years. Yet the what and how of an RLA are not well understood.

This guide, with its overview report and implementation workbook, seeks to capture where we currently stand on risk-limiting audits; what

policymakers need to know; and how practitioners can prepare to implement. The reason to use RLAs, according to some observers, is because they are "cheap and easy," a consequence of the smaller subset of ballots to review than in a more traditional hand-count audit. It is true that RLAs are an efficient post-election audit compared to other types. Yet, as this report and workbook demonstrate, there is much work for election officials, policymakers, vendors, and interested parties to do before the widespread adoption of RLAs—including planning, standardization, training, and changes to current processes for a successful implementation.

For instance, our nation's elections infrastructure must be adequately funded, enabling jurisdictions to modernize their equipment and have the training and tools available to do the audit work well. In addition, election officials need sufficient time to do their work, without untoward pressure and influence compromising the integrity of the process for expediency's sake.

We believe sound election administration policy and its practical application can ensure that the American electorate is well served and that our democracy is strong.

The legitimacy of an election – the peaceful transference of power based on the will of the people – necessitates diligence in assuring that the correct outcome was announced and certified. Election administration incorporates many aspects of performance management, security, and quality control, and pre-election testing and robust post-election auditing protocols can identify issues that impact the legitimacy of an election. Programming issues, printing mistakes, human error, as well as malfeasance and security breaches are valid motivations for auditing an election.

There are many functions that constitute the intricate process of conducting an election.¹ At every juncture and every point where information and data are entered, transferred, or transmitted, there is an opportunity for error. Testing and auditing are necessary facets of election administration.

A risk-limiting audit is a post-election tabulation audit that uses a random sample of voted ballots to manually examine for evidence that the originally reported outcome is correct.
As its name suggests, an RLA limits the risk of certifying a contest with the wrong winner.

Pre-election testing and post-election audits are a way to mitigate outside or unintended influence on an election's outcome by identifying problems and, optimally, providing the opportunity to correct the situation.

There are some overarching concepts that need to be considered when contemplating election audits. First, determine WHY you are auditing – this will direct WHAT needs to be audited.

Second, once you know WHY and WHAT you are auditing, you need to determine HOW to go about such a review. What structural practices need to be in place to move forward?

This report contains information relevant to state and local stakeholders who want to know more about RLAs. If you are an election administrator tasked with implementing an RLA, read, **Part 2: Implementation Workbook**, for more detailed information about how to conduct an RLA.

i *America's Election Model: The Architecture of Elections* is a comprehensive, technical analysis of the myriad election procedures in the United States. Available at: <https://pages.nist.gov/ElectionModeling/>.

This practical guide to risk-limiting audits will cover a number of topics, including the following:

- **Vocabulary.** Audits evaluate processes and internal controls. Central to this report is identifying proper nomenclature and terminology to utilize when discussing processes as well as the relationship among the components in a risk-limiting audit . As such, key definitions related to auditing are summarized.
- **Voting equipment** used in a jurisdiction plays a major role in determining the type of audit that can be conducted. This includes the ability to produce a paper ballot that can be retrieved and examined as well as a cast vote record that will allow you to compare how the voting system interpreted each and every ballot. Because not all voting equipment is currently capable of conducting an RLA, knowing the capacity of the equipment in use that you want to audit will guide the type(s) of audits that a jurisdiction is able to contemplate and execute. The age of the equipment may not be an appropriate indicator, because even the most current equipment is sometimes not conducive to an RLA. However, voting equipment vendors are moving to offer the capacity to conduct RLAs in future iterations of their products.
- **Policy considerations.** Many auditing processes are relatively new to the field of election administration. As such, better policy should parallel the knowledge gained through practice in states where statutes and rules are not overly prescriptive, positioning jurisdictions to conduct audits as effectively and efficiently as possible. Colorado is touted for pioneering RLAs. However, it is important to remember that the process was long, taking almost a decade, before the first statewide RLA took place. Policy should not be overly prescriptive.
- **Implementation considerations.** Any jurisdiction considering implementing RLAs should conduct a pilot program, which provides a great opportunity to help election officials become familiar with terms and procedures. The best way to learn how an RLA works is through hands-on experience.



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This report seeks to advance the election field’s understanding of RLAs and provide practical information for effectively designing and implementing an RLA at the local and state levels. Indeed, what constitutes an RLA is still an ongoing debate for some jurisdictions and academics. This report is an attempt to further that conversation.



Introduction to This Practical Guide

As a society, we accept and rely on federal testing to ensure the integrity of our food and drugs. We look to other ratings and standards to identify high-quality goods like running shoes or coffee. We accept that local government institutions must have their financial records audited on a regular basis, in part to establish a bond rating. None of us would deposit money in a financial institution or invest in a corporation if we didn't trust that audits are performed to ensure their solvency. Why should we expect less from the institution at the heart of our democracy?

When I began this project in May 2018, three states required risk-limiting audits (RLAs) as a form of post-election auditing, and only one, Colorado, had conducted such an audit statewide. Today, that number has doubled, and there is pending legislation in an equal number of states to make RLAs a requirement, along with federal interest in post-election audits. As more states explore the use of RLAs to conduct post-election audits and validate election results, there is a need to transition from academic information about the practice to the

nuts-and-bolts work of conducting an RLA. This “Practical Guide” series is a tool for policymakers and election officials who are working on the ground to make RLAs a reality.

Implementing a robust but efficient post-election audit has many benefits. When I listen to conversations about RLAs or read draft legislation, it seems to be described as a singular method for how an audit will be performed. I think of RLAs more as a methodology – a broader strategy for auditing paper ballots that includes several methods for sampling and conducting the audit.

The information presented in this report is designed to provide a broader understanding about RLAs as a methodology. It is drawn from both practical experience and research. As a local election official in Arapahoe County, Colorado, I implemented and conducted RLAs. I also gathered information in meetings and interviews with subject-matter experts in the fields of statistics, cryptography, political science, and auditing, and I read much of the research in this area.

The report provides plain-language descriptions for RLA terms and practices, considerations around the technology and equipment needed to conduct an RLA, and resources for individuals interested in more thorough and technical information. These terms and technology specs help establish a baseline for policymakers and other interested parties who want to learn the basics of RLAs. Additional definitions and explanations are available in the Implementation Workbook part of this guide, which also includes recommended steps for implementing and conducting a ballot-level comparison audit. The report also lists a number of considerations for policymakers as state laws and rules regarding RLAs are passed and written, as well as recommendations for implementing pilot RLAs.

While this issue can be complex and require specific implementation efforts, my hope is that this report will provide a strong foundation for state and local election officials, lawmakers, advocates, and others to build a standard practice for conducting such audits in their own state or jurisdiction.



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Auditing and Risk-Limiting Audits

Audits have played a role in U.S. companies since the creation of the Securities and Exchange Act of 1934. The Securities and Exchange Commission established audits as a way to ensure financial records and transactions were reported accurately and a system of internal controls was established and followed.

Historically, audits provided a backward-looking view of the financial health of a company by relying on a manual process of collecting, processing, and reporting information. Today, audits evaluate processes and internal controls by providing real-time information. They can alert companies to errors and fraudulent activity and highlight areas for process improvement.²

Similar auditing standards can be applied to elections.ⁱⁱ The components of an audit are relatively simple. At its essence, an audit is a check that the ballots cast are the ballot correctly counted. They center on a documented process for obtaining relevant and verifiable

evidence, then evaluating that evidence against a set of audit criteria. How much evidence to collect is a central question in risk-limiting audits. The standards of the Public Company Accounting Oversight Board (PCAOB) state that “as the risk increases, the amount of evidence that the auditor should obtain also increases.” PCAOB standards also highlight the need for quality evidence. They state that “obtaining more of the same type of audit evidence...cannot compensate for the poor quality of that evidence.”³

This paper discusses the relationship among the components in a risk-limiting audit, and how they relate to the sample size, or the amount of evidence you need to collect. It also summarizes key definitions related to auditing and voting technology. It makes sense to rely on standard, national definitions, even though the logistics and process will vary somewhat state to state depending on the election model and voting equipment. The report does not address best practices for ballot

security, chain of custody, or ballot reconciliation. Those are all practices that determine the quality of the evidence. Having a trustworthy audit trail is critical to the validity of the audit, and that subject deserves a comparable report of its own.

Finally, by looking at auditing literature we can establish that audits are meant to detect errors, provide accountability, deter fraud, limit risk, determine accuracy, and provide feedback. When we extend this idea to elections, an audit can deliver the same benefits, including:

- detect errors in the voting equipment and other elements of the election system;
- provide accountability to voters;
- deter fraudulent activity (hacking or altering voting equipment);
- limit the risk of certifying an incorrect outcome;
- determine that votes were counted and reported accurately; and
- provide feedback to the election official for process improvement.

ii This paper does not address how to create election-audit standards, but a good starting point for exploring this idea can be found in a project conducted by the Maryland State Board of Elections, “Development of a Pilot Election Audit Program.”

Risk-Limiting Audits

An RLAⁱⁱⁱ is a post-election tabulation audit in which a random sample of voted ballots is manually examined for evidence that the originally reported outcome of the election is correct. If the originally reported outcome is incorrect, there is a pre-specified minimum chance that the audit will correct the result. The correction is made by performing a full manual tally. As its name suggests, an RLA limits the risk of certifying a contest with the wrong winner.

An RLA does not verify that every vote was counted correctly. It verifies “that the reported results of the contest are correct; that is, they agree with the results that a full hand-count would reveal.”⁴ Stated another way, it is “an ‘intelligent’ incremental recount that stops when the audit provides sufficiently strong evidence that a full hand-count would confirm the original (voting system) outcome.”⁵

An appropriate initial sample size for the audit is determined based on the contest margins, the total number of votes cast, and the desired confidence in the outcome of the audit. This allows election officials to retrieve and examine the fewest ballots possible,^{iv} while still achieving strong statistical evidence that the outcome is correct. If the sample does not provide strong enough evidence that the outcomes under audit are correct, more ballots are inspected, with the possibility that the audit could ultimately lead to all ballots being manually examined.

Traditional Audits

RLAs are meant to be a more efficient and statistically sound process than traditional post-election audits that rely on hand tallying a fixed number or fixed percentage of voted ballots. Both RLAs and traditional audits require some type of voter-verifiable paper record, such as paper ballots, that voters have the opportunity to inspect and correct before casting.

The ballots selected for a traditional post-election audit normally come from several randomly selected batches, precincts, or voting machines. While RLAs can also be based on such sampling, this is not an efficient approach to ensuring that the outcome will be corrected if it is wrong. More efficient is selecting individual ballots at random. Traditional audits may sample more or fewer ballots than required to confirm the outcome of a race of interest, but they will not, in general, correct tabulation errors, even if they altered the reported outcome. Additional terms and definitions are provided in **Part Two: Implementation Workbook**.

iii The RLA definition provided here is a heuristic, based on the author’s interpretation from the sources listed in Appendix A and the Endnotes along with numerous discussions on the topic.

iv It is perfectly fine to audit more ballots than the initial sample size requires.

ELECTIONS MUST BE AUDITED END TO END

Auditing how votes are tabulated plays an important role in validating the outcome of an election. However, it is only one of several elements in the election system that needs to be examined. An RLA only provides a modest benefit if you cannot provide evidence of a solid chain of custody from the beginning of an election to the end, for both ballots and voting equipment. As you start incorporating audit principles into election administration, consider other critical components of the election system that can be audited:

- Voter registration databases
- Voter district and precinct assignments
- Security procedures (physical and cybersecurity)
- Voting equipment testing (focused on paper ballots)
- Ballot reconciliation and chain of custody
- Ballot layout and design
- Resource planning and allocation (enough equipment, supplies, and people to meet demand)



3

Voting Equipment and Technology

Voting equipment plays a major role in determining the type of audit that can be conducted. This includes the ability to produce a paper ballot that can be retrieved and examined, as well as a cast vote record that will allow you to compare how the voting system interpreted each and every ballot. **Part Two: Implementation Workbook** provides a more detailed look at the technology requirements associated with RLAs, as well as further definitions of methods of auditing. The summary below is intended to help policymakers and others understand some of the requirements and limitations of voting equipment.

Cast Vote Record

A cast vote record (CVR) is the digital representation of each individual ballot card that has been scanned and tabulated. It represents the votes cast in each contest after adjudication for voter intent or any other tabulation rules have been applied, e.g., write-in candidates.

A ballot-level comparison audit is one method for conducting a risk-limiting audit. It requires voting systems to produce and export CVRs in a way that the corresponding paper ballot can be identified and retrieved. Not every voting system generates CVRs, and not every voting system that generates CVRs can export them in a way that allows the corresponding individual physical ballot card to be identified and retrieved, which is required for ballot-level comparison audits. Understanding the role of the CVR in conducting an RLA is important and should be a consideration before purchasing new voting equipment.

Imprinting Centrally Scanned Ballots

Identifying the exact location of a specific ballot among thousands of others is the biggest challenge in a ballot-comparison audit. Having a unique identifier on each ballot that can be tied to the CVR in some way helps ensure the correct ballot

has been retrieved.^v Mechanical imprinters are available on certain models of high-speed scanners (used when ballots are centrally scanned). They provide a way to print a unique identifier on each ballot to assist in the process of retrieving ballots in a comparison audit.

Voter-Facing Scanned Ballots

Currently, there is no voting system on the market that provides a way to imprint a unique number in conjunction with a precinct scanner. Because ballots scanned in a polling location can be directly tied to a voter, the order of the CVRs are normally not sequential, and the CVR number assigned to each ballot is a random, nonsequential number. This makes retrieving specific ballots difficult, if not impossible. Ballots scanned in a polling location will need to be audited using the ballot-polling method or by conducting a transitive audit.

^v Audit discrepancies can come from the audit board retrieving an incorrect ballot.

RLA Tool & User Interface

RLAs can be made easier with the help of audit software designed to perform the calculations necessary to conduct the audit, including: determining the starting sample size (based on the method of RLA, the diluted margin, and the set risk limit); randomly selecting ballots for audit from the ballot manifest (using a random seed and pseudorandom number generator [PRNG]); accounting for discrepancies; and calculating when the risk limit has been met and the audit can stop.

The software can also provide a user interface for audit boards or others who are examining ballots, making it easier to record the voter

markings for comparison to the CVR. This is especially important since the comparison needs to be done blind, without knowledge of how the voter's selections on the ballot were interpreted by the voting system.

Conducting a statewide RLA is impossible without audit software. Colorado has invested in the development of an RLA tool designed around the voting systems and audit methods used in the state.^{vi}

The next phase of the Election Validation Project is to work with nonprofit organizations and academic institutions to explore the development of a low-cost tool, similar to the one used by Colorado, that will work with a variety of voting systems and methods for sampling and auditing ballots.



Gilberto Zelaya, outreach and early voting coordinator for the Montgomery County Board of Elections (Maryland) reviews vote-by-mail ballots on Election Day in November 2018.



An electronic voting booth in Fairfax County, Virginia, on Election Day in November 2018. It is critical to be aware of whether equipment can produce a paper ballot or a cast vote record.

vi The Colorado Department of State has invested approximately \$300,000 to develop software used to conduct statewide RLAs.

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Policy Considerations

When developing and establishing RLA policy, lawmakers and administrators should focus on the central goal of strengthening voter confidence and election transparency. By establishing a framework that is both easy to understand and implement, while not being overly prescriptive, policymakers can provide the foundation for solid post-election tabulation audit procedures that generate voter confidence in election administration and operations. Outlined below are considerations for effective RLA policy.

Statutes

The statutory requirements for risk-limiting audits should not prescribe the process or the calculations involved in conducting a risk-limiting audit, such as setting a specific risk limit. At a minimum, these requirements should establish risk-limiting audits as the method for conducting a post-election tabulation audit, provide any necessary definitions, an implementation date, and how further rules, regulations, and procedures will be established. This allows for innovation as new methods of auditing are developed

and voting system technology advances. Two good examples come from Washington and Colorado.

- **Washington 29A.60.185 (1)(c)(iii):** “The secretary of state shall...establish procedures for implementation of risk-limiting audits, including random selection of the audit sample, determination of audit size, and procedures for a comparison risk-limiting audit and ballot-polling risk-limiting audit as defined.”
- **Colorado 1-7-515 (4):** “The secretary of state shall promulgate rules...as may be necessary to implement and administer the requirements of this section. In connection with the promulgation of the rules, the secretary shall consult recognized statistical experts, equipment vendors, and county clerk and recorders, and shall consider best practices for conducting risk-limiting audits.”

The time frame for implementing the audit is another important consideration. For example, Colorado accelerated the conversation about RLAs once the majority of counties purchased new

voting equipment that provided a CVR (2016–2017). Throughout 2017, various stakeholders spent an intensive year writing and passing election rules, regularly meeting with the state’s RLA advisory group to decide on how the audit would be implemented, working to develop an RLA software tool, creating a training program, and conducting mock audits. After a multiyear process, the first statewide RLA happened in November 2017. Administering a pilot program over several elections prior to implementing an official RLA allows states to establish solid procedures for performing the audit. This process includes understanding and exploring various methods for conducting a risk-limiting audit and working through the technology requirements to assist in completing the audit.

Ensuring that the RLA can be performed prior to certification of the election is another policy change that needs to be considered. In addition, there should be a way to change the outcome of the election if the audit escalates to a full manual tally and concludes that the originally announced outcome was incorrect.

STEPS ON THE PATH

Conducting an RLA does not need to be an immediate destination but can be viewed as a path with steps along it. Here are some suggested steps to help ease the transition toward RLAs:

- Maintaining strong collaboration among state and local election officials
- Making the RLA terms and definitions a regular part of your vocabulary
- Creating documented voter-intent guidelines
- Developing a well-crafted plan for ballot storage and organization
- Requiring precise ballot reconciliation
- Implementing dates and deadlines to allow time for a post-election audit prior to certification
- Basing the number of ballots selected for audit on the contest marginsⁱ
- Using dice or a similar method to randomly select the ballots, precincts, voting machines, etc., that will be audited
- Purchasing a voting system that produces a voter verifiable paper ballot and cast vote record

i Similar to the way post-election audits are conducted in New Mexico.

DEFINITIONS IN STATE LAW

Some of the terms used to describe the RLA process are unique enough to require drafting definitions for clarity. The challenge is drafting language that can be interpreted and understood by the non-RLA expert, while still being precise enough to ensure good auditing practice. It will be helpful to review the definitions used by other states as well as the definitions found in this report. Listed below are three examples of how an RLA has been defined in election statute.

It is important that policy not limit the use of auditing software by specifying that a risk-limiting audit will be conducted exclusively by a “hand tally” or “manual tally” of the ballots. An alternative option might be defining the human component as a “hand-to-eye, human interpretation of voter markings from the corresponding ballot marked by the voter,” as California did with AB-2125.

TABLE 1: EXAMPLES OF STATE STATUTES

RHODE ISLAND ELECTION LAW	COLORADO REVISED STATUTES	WASHINGTON ELECTION LAWS
<p>§ 17-19-37.4: for post-election audits defines an RLA as “a manual tally employing a statistical method that ensures a large, predetermined minimum chance of requiring a full manual tally whenever a full manual tally would show an electoral outcome that differs from the outcome reported by the vote-tabulating system for the audited contest. A risk-limiting audit shall begin with a hand tally of the votes in one or more audit units and shall continue to hand tally votes in additional audit units until there is strong statistical evidence that the electoral outcome is correct. In the event that counting additional audit units does not provide strong statistical evidence that the electoral outcome is correct, the audit shall continue until there has been a full manual tally to determine the correct electoral outcome of the audited contest.”</p>	<p>C.R.S. 1-7-515: for risk-limiting audits defines an RLA as “an audit protocol that makes use of statistical methods and is designed to limit to acceptable levels the risk of certifying a preliminary election outcome that constitutes an incorrect outcome.”</p>	<p>RCW 29A.60.185: for the audit of results defines an RLA as “an audit protocol that makes use of statistical principles and methods and is designed to limit the risk of certifying an incorrect election outcome.”</p>

ADMINISTRATIVE RULES

Administrative election rules provide a flexible and efficient way to further define RLA laws and create policies and procedures as lessons are learned in the pilots conducted by a jurisdiction. Additionally, the field is still evolving in its understanding of the optimal approaches to implementation. Allowing policy to improve parallel to the knowledge gained through practice, and not codifying the specifics of the audit in statute, positions a jurisdiction to be able to conduct audits as effectively and efficiently as possible. See **Part Two: Implementation Workbook** for a list of considerations when creating election rules or regulations.

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Implementation Considerations: Pilot RLAs

Any jurisdiction considering implementing RLAs should first conduct a pilot, which provides a great opportunity to help election officials become familiar with the terms and procedures. The best way to learn how an RLA works is through hands-on experience.

To make the pilot as effective as possible, limit the number of ballots that will be subject to audit to just a few precincts or a handful of scanned batches. Anywhere from 1,000 to 4,000 ballots (depending on the size of staff and estimated sample size) should be enough. The goal of the pilot is for staff to perform as many of the audit functions as possible, including the role of the audit team in retrieving and examining ballots.

Ideally the pilot should be conducted immediately after an election has been certified, and the period to request a recount has passed. This ensures the processes involved in handling, scanning, and accounting for ballots is still fresh in everyone's mind. It will also provide an opportunity for everyone involved to reflect on the way ballots are organized and stored after scanning.

Go through all the steps for conducting an audit found in **Part Two: Implementation Workbook**.

If the pilot is limited to just a single county, it will still be beneficial for staff to take on the "state" role and perform those functions as well. This is a chance for everyone involved to learn how RLAs work and ask questions.

In addition to state and county staff, it is important to include a representative from the voting system vendor. This provides the vendor with a chance to learn more about the RLA process and ensure the CVR can be exported correctly and will work with the audit software being used.

Provide enough time to ensure the ballot manifest, batch and container labels, and any other forms or reports work well at each step of the process. This is also a good time to test the audit software and ensure logins work, files can be uploaded, reports can be generated, and everything seems to function correctly.

Pilot RLAs should be designed to create a safe learning environment.

That means giving people the freedom to ask questions, make mistakes, and get comfortable with the terms and steps of the process. Take the opportunity to stop at points along the way to allow for questions and determine if any problems have been encountered. After the pilot RLA is complete, take time for a post-audit discussion to talk about the process, to resolve unanswered questions, and to solicit suggestions for how the process might be improved or made more efficient.

Some other important considerations for the pilot:

- Is the physical space adequate for staging ballot storage containers and for retrieving and examining ballots? Will the same space be able to accommodate observers?
- Were the ballots selected for audit correctly retrieved? If not, what was the cause?
- Was the audit software easy to use? Did ballot manifests and CVRs upload correctly? How much time and effort were needed to format the list of ballots selected for audit?



6

Conclusion and Other Considerations

Election management problems seem to increase as the margin of victory decreases and public perception outweighs the assurances of experts and election officials. We must find a way to change this. Audits, standards, and testing are not the only remedy. They are, however, one way for election administrators to provide the American electorate with a modern, voter-centric election system that runs efficiently and inspires trust in the electoral outcome.⁶

This report summarizes some of the basic information and steps for implementing an RLA. The questions and guidelines presented in **Part Two: Implementation Workbook** are a starting point for state and local jurisdictions to build on as they craft RLA policies, plans, and best practices that work within their own election framework. As state and federal policy is being considered to require RLAs, election officials need to be able to confidently explain their process decisions and needs to policymakers, voters, vendors, and their staffs.

There are, however, still several other considerations in the field of RLAs that should be mentioned.

First, the steps outlining how to prepare for and conduct a ballot-level comparison audit in these reports are not meant to discount other valid methods for conducting an RLA. I anticipate a further installment in this series that will outline how to prepare for and conduct other methods of RLAs, including alternate procedures for efficiently selecting ballots in a ballot-polling audit.

In addition, the theories and application of post-election tabulation audits continue to evolve. Along with more efficient ways to select ballots in a polling audit, there continues to be discussion and research about other methods for conducting post-elections tabulation audits. They include formulas for hybrid audits, combining ballot comparison and ballot polling, along with other forms of stratified sampling. Several jurisdictions have run pilot RLAs using a transitive audit method, where ballots have been completely rescanned and retabulated on different voting equipment.

Finally, there is also much debate and discussion about the role of ballot images in election audits. Auditing ballot images alone

provides no evidence that ballots were not omitted from scanning, scanned twice, misinterpreted by the voting system, or altogether recorded incorrectly. However, they are being used in many states to improve tabulation accuracy by allowing for electronic adjudication and have the potential to help augment, but not replace, the human examination of voted ballots.

All these developments make it a fascinating time to be working in elections and in the area of election audits. Administering elections and inspiring public confidence in election results require more skills and expertise than ever before. Adding auditing expertise is one more element that puts election administration into a professional and technical field of its own and provides greater transparency that can help write the future of voting.

Risk-Limiting Audit Resources

- **A Gentle Introduction to Risk-Limiting Audits.** A significant but concise technical overview of risk-limiting audits. Available at: <https://www.stat.berkeley.edu/~stark/Preprints/gentle12.pdf>.
- **An Introduction to Risk-Limiting Audits and Evidence-Based Elections.** Testimony provided by Philip Stark to the California Little Hoover Commission regarding compliance audits, efficient methods for conducting RLAs, required resources, and principles for audit legislation. Available at: <https://www.stat.berkeley.edu/~stark/Preprints/lhc18.pdf>.
- **Election Rules, Colorado Secretary of State, Rule 25. Post-Election Audit.** A well-vetted resource for drafting administrative election rules pertaining to risk-limiting audits. Available at: http://www.sos.state.co.us/pubs/rule_making/CurrentRules/8CCR1505-1/Rule25.pdf.
- **Post-Election Audits.** A review of post-election audit practices, recent legislative action, and the post-election requirements in all 50 states. Available at: <http://www.ncsl.org/research/elections-and-campaigns/post-election-audits635926066.aspx>.
- **Cast Vote Records Common Data Format Specification, Version 1.0.** (NIST Special Publication 1500-103). Common data format specification for cast vote records that might be included in RFPs for voting system purchases. Available at: <https://github.com/usnistgov/CastVoteRecords/blob/master/NIST%201500-103%20CDF%20Specification%20WERB%202019-02-08.pdf>.
- **Sample Voter Intent Guidelines.**
 - Colorado Secretary of State, Determination of Voter Intent for Colorado Elections. Available at: <http://www.sos.state.co.us/pubs/elections/docs/VoterIntentGuide.pdf>.
 - Virginia Department of Elections, Ballot Examples: Hand Counting Printed Ballots for Virginia Elections or Recounts. Available at: <https://www.elections.virginia.gov/Files/ElectionAdministration/ElectionLaw/ExamplesforHandcounting.pdf>.
 - Washington Secretary of State, Voter Intent: Statewide Standards on What Is a Vote. Available at: https://www.sos.wa.gov/_assets/elections/administrators/2018_voter-intent_web.pdf.
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- **Tools for Ballot-Polling Risk-Limiting Election Audits.** Provides several tools for conducting a ballot-polling RLA, including a tool to determine the initial sample size of a particular contest to be audited, a tool to generate a pseudo-random sample of ballots, and a tool for determining if the audit can stop. Available at: <https://www.stat.berkeley.edu/~stark/Java/Html/ballotPollTools.htm>.
- **Tools for Comparison Risk-Limiting Audits.** Provides several tools for conducting a ballot-level comparison RLA, including a tool to determine the initial sample size of a particular contest to be audited, a tool to generate a pseudo-random sample of ballots, and a tool for determining if the audit can stop. Available at: <https://www.stat.berkeley.edu/~stark/Java/Html/auditTools.htm>.

Endnotes

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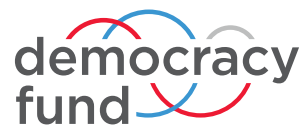
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READ MORE

Continue on to “Part Two: Risk-Limiting Audit Implementation Workbook” for soup-to-nuts information on how election officials can conduct a ballot-comparison audit and a complementary workbook to the overview of the field provided in Part One.



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