2022 Risk-Limiting Audit Report

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EXECUTIVE SUMMARY

Pursuant to §24.2-671.1 of the Code of Virginia, the Virginia Department of Elections is required to coordinate a post-election risk-limiting audit annually of ballot scanner machines in the Commonwealth.[1] The 2022 Risk-Limiting Audit (RLA) took place during the month of January and audited contests in House of Delegate District 13 and House of Delegate District 75. The Virginia Department of Elections (ELECT) announced the successful completion of the audits on January 27, 2022. The results confirmed with over 99% confidence that the machines accurately reported the winners of the two contest.

In addition to facilitating the audit each year, §24.2-671.1 also requires ELECT to submit a report to the State Board of Elections (SBE) that details the results of the audit and provides analysis of any detected discrepancies.[2] The following report gives a comprehensive overview of the history, practice, and process of risk-limiting audits in the Commonwealth to both provide these essential details as well as promote transparency, knowledge and confidence in Virginia elections and the RLA process.

BRIEF INTRODUCTION TO RISK-LIMITING AUDITS

A risk-limiting audit (RLA) is a type of post-election audit that utilizes statistical methods and a manual review of paper ballots to check that the voting equipment accurately reported the correct outcome of a race. While RLAs do not guarantee that every vote was counted correctly, they provide strong statistical evidence that the declared winner of a contest actually received more votes.

RLAs provide a more cost effective and efficient alternative to other forms of post-election audits by reducing the total number of paper ballots needed to confirm election results. In order to conduct an RLA, a voting system must be in place that produces paper ballots. RLAs analyze a random sample of hand-counted ballots to confirm election results. If the margin of an election is wide, less votes are audited; if the margin is narrow, more votes will be audited until enough evidence can confirm the results of the contest. [3] The margin of an election also determines the *risk-limit* of the audit. A *risk-limit* is the maximum chance that the audit will fail to correct an incorrectly reported outcome. For example, a 10% risk-limit means that there is as a 90% chance that the audit will correct an incorrect outcome.

There are two main types of risk-limiting audits: *ballot-comparison* and *ballot-polling audits*. *Ballot-comparison* audits manually examine randomly selected paper ballots and compares the results to the voting system's interpretation of the same ballot. *Ballot-polling audits* manually review a random sample of ballots to determine if the overall outcome of an election was correctly reported. Ballot polling requires more ballots to be audited, although it is simpler to complete; while ballot comparisons, audit fewer ballots and require more data. Calculations for

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[1] Code of Va., §24.2-671.1¸ https://law.lis.virginia.gov/vacode/title24.2/chapter6/section24.2-671.1/

[2] Code of Va., §24.2-671.1, https://law.lis.virginia.gov/vacode/title24.2/chapter6/section24.2-671.1/

[3] Risk-Limiting Audits, Postelection Audits, A Summary, https://www.ncsl.org/research/elections-and-campaigns/risk-limiting-audits.aspx

both ballot-polling and ballot-comparison audits are meant to be simple and can be independently verified by the public, allowing for more transparency in the auditing process.[4]

While RLAs may be conducted without software, technology helps manage the data and performs the statistical calculations necessary to confirm the results of the audit. Software programs provide an objective tool for collecting local ballot manifests, estimating the sample size, selecting ballots for audit, recording discrepancies in audited ballots, as well as determining the scope of the audit.[5]

RISK-LIMITING AUDITS IN VIRGINIA

Throughout the United States, risk-limiting audits are attracting attention and gaining in popularity with election administrators nationwide. The Brennan Center for Social Justice called RLA's the "gold standard" of post-election audits.[6] Several states have administrative pilot programs, while others have instituted statutory pilot programs. Along with Colorado and Rhode Island, Virginia is one of three states that has adopted a statutory requirement to coordinate risk-limiting audits annually, making Virginia a national leader in this type of post-election audit. [7]

History of RLA in Virginia
In 2017, the Virginia General Assembly passed legislation that amended the Code of Virginia to include risk-limiting audits of ballot scanner machines in use in the Commonwealth (*to reference the full text please see appendix*.) [8] Pursuant to code [§ 24.2-671.1](), the changes went into effect on July 1st, 2018 and stipulated that:

- The localities shall be chosen at random with every locality participating in the Department's annual audit at least once during a five-year period.
- The audit will have no impact on the election results.
- No audit will be conducted until after an election has been certified and the period to initiate a recount has expired.
- Audits will be conducted by the local electoral boards and general registrars in accordance with guidelines established by ELECT.
- Candidates and political parties may have representation observe the audits.[9]

[4] A Gentle Introduction to Risk-Limiting Audits, Mark Lindeman and Phillip B. Stark, IEEE Security and Privacy, Special Issue on Electronic Voting, 012, https://www.stat.berkeley.edu/~stark/Preprints/gentle12.pdf

[5] National Conference of State Legislatures, Risk-Limiting Audits, https://www.ncsl.org/research/elections-and-campaigns/risk-limiting-audits.aspx

[6] Brennan Center for Justice, Post-Election Audits, Post-Election Audits | Brennan Center for Justice

[7] National Conference of State Legislatures, Risk-Limiting Audits, https://www.ncsl.org/research/elections-and-campaigns/risk-limiting-audits.aspx

[8] Code of Virginia, 24.2-671.1 Audits of ballot scanner machines, https://law.lis.virginia.gov/vacode/title24.2/chapter6/section24.2-671.1/

[9] Code of Virginia

Over the past three years, Virginia held twelve Risk-Limiting Audit pilots with forty-two localities participating and one successful statewide audit that confirmed the results of the 2020 Presidential and Senate elections.

2022 Risk-Limiting Audit of the 2021 General Election

The 2021 Risk-Limiting Audit of the 2020 General Election demonstrated that Virginia's voting systems provided accurate results statewide in races that garnered national attention including contest for both the Presidential and United States Senate. With House of Delegate races occurring in nearly every locality, the 2021 General Election provided ELECT with an opportunity to take a deep-dive into smaller contests; therefore, bolstering confidence in Virginia's elections at all levels.

DESIGN

Considerations

When evaluating which races to audit, ELECT staff selected contests that had both Democratic and Republican winners and that also represented various geographical regions in the Commonwealth. Additionally, the following considerations were taken into account:

- **The margin of the race**: Contest with margins greater than 2% are the best candidates for Risk-Limiting Audits, since they require the least amount of ballots to be reviewed.
- **Number of ballots in the race**: Contest with few votes, may be better candidates for hand recounts. If the number of ballots to be sampled exceeds 15% of the total number of ballots cast then a full hand-recount is also recommended.
- **Past RLAs:** While all localities participated in the 2021 Statewide Risk-limiting Audit by creating and uploading ballot manifests, eleven localities were not selected into the random sample and therefore did not have to retrieve any ballots for the statewide audit. Those localities were: Bath County, Greensville County, Lunenburg County, Richmond County, Dickenson, Highland, Prince Edward, Emporia City, Floyd County, Lexington City, and Radford City. Contests in these localities were prioritized to allow for those localities to participate in the full-auditing process.

Based on this criteria, ELECT reviewed all 100 contests for the Virginia House of Delegates and selected multiple races that would make the best candidates for this year's RLA. Using a tool developed by the University of California Berkeley, ELECT was able to estimate the sample size of any potential audit by plugging in the total votes cast along with the votes received by candidates from both major political parties. While the sample size was not exact, it was a useful tool that informed the selection process.[10]

Potential Races

After analyzing all contest for the Virginia House of Delegates, ELECT provided the State Board of Elections with five House of Delegates races to be considered for a risk-limiting audit in 2022

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[10] Tools for Ballot Polling Risk-Limiting Audits, University of California Berkeley, https://www.stat.berkeley.edu/~stark/Vote/ballotPollTools.htm

(for additional analysis, please see appendix.) Races were broken up into the following categories and represented in the graphic below:

- 2021 RLA Follow-Up
- Northern Virginia
- Hampton Roads
- Central Virginia
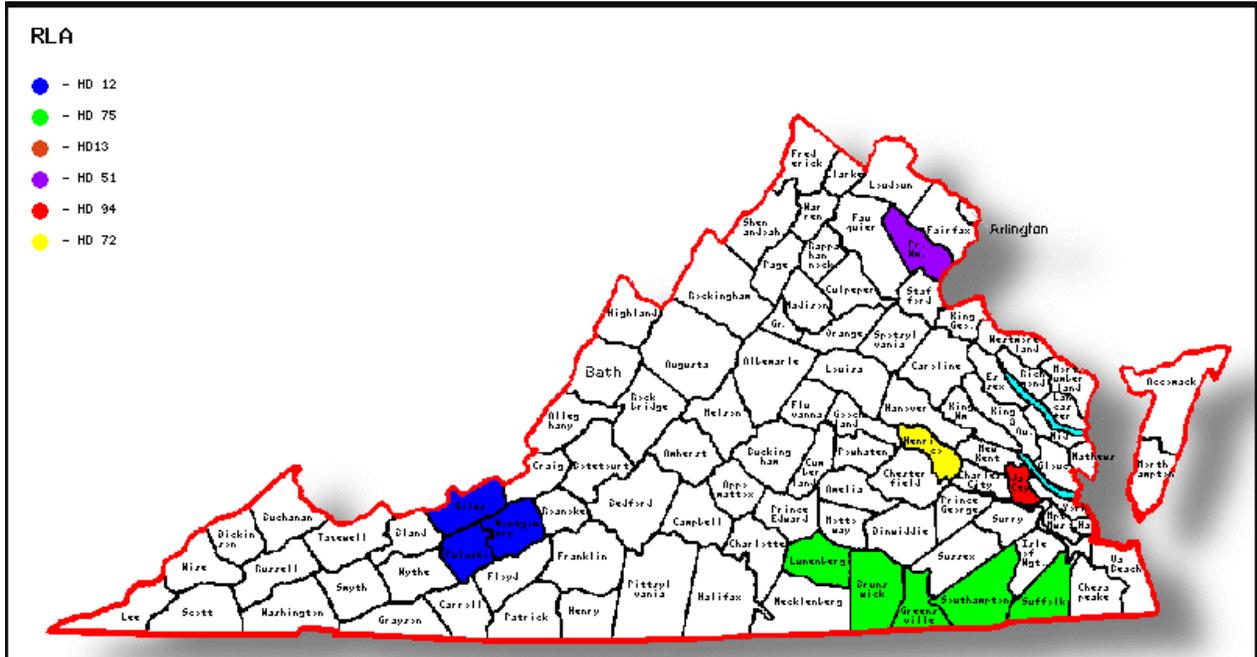
The districts/contests were:

House District 12 – Chris Hurst and Jason Ballard

House District 13 – Danica Roem and Christopher Stone

House District 51 – Tim Cox and Briana Sewell

House District 75 – Otto Wachsman and Roslyn Tyler

House District 94 – Shelly Simonds and Ross Harper

2022 Contest Selection

During the December 13, 2021 State Board of Elections meeting, the SBE randomly selected two districts for the 2022 Risk-Limiting audits. Potential contest were placed into a bowl and then the winners were chosen with Ms. Chang and Delegate Merricks participating. House of Delegate Districts 13 and 75 were selected.

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[11] Do It Yourself Maps, Virginia, http://diymaps.net/va.htm

ADMINISTERING THE AUDIT

Overview

The following is an illustrated timeline of the 2022 audit:

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┌─────────────────────────┐     ┌─────────────────────────┐     ┌─────────────────────────┐
│ December 13 - random    │ →   │ December 17th- Kickoff   │ →   │ December 20th- Kickoff   │
│ selection of RLA        │     │ Meeting for 13th District│     │ Meeting for 75th District│
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┌─────────────────────────┐     ┌─────────────────────────┐     ┌─────────────────────────┐
│ December 28th- Random   │ →   │ January 3-5th - 75th     │ →   │ January 27th Press       │
│ Seed Number Generated   │     │ District January 5th -   │     │ Release, March 1st Final │
│ at 11:00 AM             │     │ Round 1 and January 11,  │     │ Audit Results Announced  │
│                         │     │ 18-20 Round 2 - 13th     │     │ at SBE                   │
│                         │     │ District (Ballot Retrieval)│   │                          │
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Administrative Process

ELECT and localities used Arlo, an open-source audit software created by VotingWorks, a non-profit, nonpartisan organization, to perform all the statistical calculations and manage the data for the audit.[12] Arlo estimated that a sample size of 1,696 ballots would be officially required for the 75 House of Delegates District and 636 ballots would be officially required for the 13 House of Delegates District to conduct the first round of the audit. The *risk-limit* for the audit was set at 10%, a *risk-limit* is the largest probability that the audit will fail to correct an incorrect outcome; this RLA was conducted using the *ballot polling method*.

To prepare for the audit, ELECT hosted two-planning calls in December to coordinate and advise localities. On December 28, ELECT conducted a live drawing to generate the *random seed number*, which would be used by Arlo, to arbitrarily select ballots to be reviewed for each audit.[13] Localities then created a ballot manifest, which accounts for every ballot stored in a locality, and recruited a number of non-partisan audit boards, composed of two registered voters in their localities, to retrieve and hand tally the list of ballots provided by the RLA software. Additionally, registrars planned to host a public meeting on the day of the audit.

The following steps were taken by ELECT and General Registrars to conduct the audit; for a more detailed overview of the administrative process please refer to the RLA Manual found on ELECT's website:[14]

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[12] VotingWorks, VotingWorks
[13] RLA Random Seed Number Generator, Department of Elections Youtube Channel, https://www.youtube.com/watch?v=Jw1DaJGxvxQ
[14] Virginia Department of Elections, Risk-Limiting Audit Manual, RLA-Manual_Final.pdf (virginia.gov)

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┌──────────────┐      ┌──────────────┐      ┌──────────────┐
│  Submit an   │ ───▶ │    Ballot    │ ───▶ │    Ballot    │
│  ELECT 659   │      │   Manifest   │      │   Retrieval  │
│     Form     │      │              │      │              │
└──────────────┘      └──────────────┘      └──────────────┘
        │                                            │
        ▼                                            ▼
┌──────────────┐      ┌──────────────┐      ┌──────────────┐
│              │      │              │      │              │
│ Ballot Tally │ ───▶ │ Ballot Entry │ ───▶ │   Results    │
│              │      │              │      │              │
└──────────────┘      └──────────────┘      └──────────────┘
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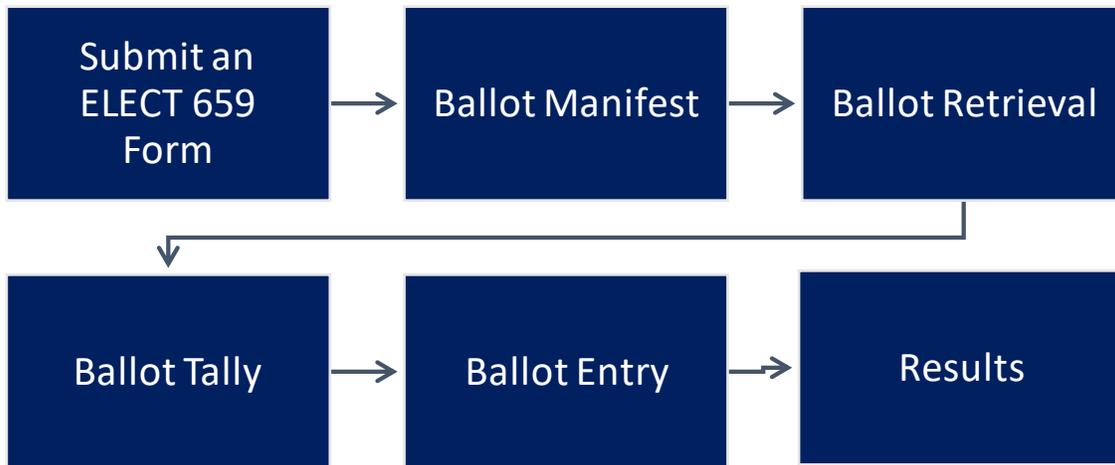
Submit an ELECT 659: Prior to the audit, localities were required to submit an ELECT-659 form. An ELECT-659 is a request to Inspect Sealed Election Materials sent to ELECT for signature authorization to present to the Clerk of the Circuit Courts to access ballots from the 2021 November General Election.[15] A copy of this form is listed in the appendix.

Create a Ballot Manifest: Registrars created a *ballot manifest*. A *ballot manifest* is a two column spreadsheet that includes a list of the "Batch Name" (column A) and the "Number of Ballots" (column B). All types of ballots are included (in person, mail-in, provisional, etc.) in the manifest. The ballot manifest creates an inventory of every ballot in a locality.

Batch Name	Number of Ballots
Pct 101	75
Pct102	112

Upload the Ballot Manifest: Once the ballot manifest was created, localities saved the manifest as a csv file and uploaded the spreadsheet into Arlo, VotingWorks' audit software. General registrars/Director of Elections were automatically enrolled in the open-source software to complete the audit.

Generating a Random Seed Number & Ballot Selection: ELECT and VotingWorks held a virtual public meeting to generate the random seed number. The number was generated by rolling a ten-sided die five-times each to create the 20 digit number. The random seed number was entered into the audit system software to generate the list of ballots needed to be examined by each locality.

Ballot Retrieval Lists: Localities received a list of ballots to review directly from Arlo. The lists included which batches to open and which ballot to audit. See below:

Batch Name	Ballot Number
Pct 101	17
Pct 102	88

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[15] Virginia Department of Elections, Memo RE: Statewide Risk Limiting Audit, February 8th, 2021

The ballot number reflects the numerical order of a specific ballot. In order to locate ballot number 17, a member of the audit board must count, starting at the top of the stack of ballots, each stored ballot until they reach the 17 ballot in the batch.

Ballot Retrieval Process: Localities hosted a public meeting, where ballots were retrieved, tallied and uploaded into Arlo. An Audit Board retrieved each specified ballot and recorded the results for the office on a tally sheet. The Audit Board inputs the results of the tally sheet into the audit software and submits their results.

Public Announcement of Results: A press release was sent out from Commissioner Christopher Piper announcing the results of both the 13 and 75 District audits on January 27, 2022. Additionally, the results were announced for the 75 District at the January 18 State Board Meeting. The results of the 13 District audit were announced at the State Board of Elections public meeting held on Tuesday, March 1st, 2022.

RESULTS AND FINDINGS

The audits confirmed that the original count of the votes accurately reflected the winners in Virginia for both the 13 and 75 Districts of the House of Delegates. The risk limit for the audit was met for both races with results falling significantly below the 10%.

In the 75 District of the House of Delegates contest, 1,696 votes were sampled. Of those votes, Otto Wachsmann received 926; Roselyn Tyler received 767. This resulted in a **.00256293556%** chance that the outcome of the 75 District race was inaccurate, meaning that election officials are over **99.743%** confident in the reported outcome.

Similarly, the 13 District of the House of Delegates contest, sampled 4,247 votes. Of those votes, Stone received 689; Roem received 822. This resulted in a **.002854934%** chance that the outcome of the 13 District race was inaccurate, meaning that election officials are over **99.715%** confident in the reported outcome of the election. [16]

Discrepancies

In the 13 District, while 4,247 ballots were pulled, some of the ballots retrieved did not include votes for that contest. Within Prince William County, there are eight House of Delegate Districts (02, 13, 31, 40, 50, 51, 52, and 87.) The first round of ballot retrieval did not contain enough ballots with the 13 District House Race to meet the risk limit; therefore, the 13 District had to conduct a second round of ballot retrieval. This was caused by two factors:

> **Undervotes:** With the Governor's race at the top, it is not uncommon for many people to only vote in the Governor's race and not the House of Delegates. This is commonly referred to as an *undervote*.

[16] Results of Risk-Limiting Audit of Nov. 3, 2020 General Election in Virginia, https://www.elections.virginia.gov/rla-results_nov-3-2020/

Ballot Storage: In larger localities that contain multiple House of Delegates Districts, ballots from several districts may be grouped and stored together. Therefore, when localities upload their ballot manifest, they are including ballots for races that are not being audited and increasing the *population* size of the audit without factoring that into the *sample*.

In order to proceed with a second round, Manassas Park City and Prince William County had to host another public meeting to complete the audit. During the second round, Manassas Park City had to retrieve an additional 177 ballots. This round was held on January 11 and was completed within a few hours. Prince William County had to retrieve an additional 3,707 ballots. Prince William County completed the second round in three days January 18, 19, and 20. In order to accomplish the second round, Prince William County recruited 18 audit boards with the goal of retrieving 1,200 ballots per day. They also purchased two commercial quality scales and borrowed four scales from neighboring Fairfax and Loudoun Counties (two from each) to assist in expediting the process.

KEY TAKEAWAYS

Unlike during a statewide audit, RLAs of smaller races require more time and investment from localities. On average, one audit board can review approximately twenty-five ballots per hour. Sampling more ballots will either increase the amount of time necessary to complete the audit or increase the amount of volunteers required to successfully complete the audit. While the number of localities in each House District reduces the potential work load of each locality in an audit, it increases the logistical challenges and involves a great deal more coordination between localities. Audits involving multiple localities should take place concurrently, since *all* participating localities must upload their results in order to perform the statistical calculations required to complete the audit.

House Districts that encompass just one locality will need to increase the number of their audit boards to complete their audit in a reasonable amount of time. *Audit boards* consist of two people that will work as a team to record the results of each ballot. In most of the House of Delegate Districts profiled for the 2022 RLA, it was unlikely that the *ballot retrieval* portion of the audit would conclude in one day. ELECT and localities should plan for audits that take place over multiple-days. ELECT should work with localities to ensure that they have the appropriate volunteers and staff available to complete the audits. Audits that last multiple days could impose financial and logistical burdens on localities.

When evaluating contests for risk-limiting audits, the impact of district splits within the localities needs to be factored into the analysis. When the target contest is just one of eight House of Delegate races within a locality, as we saw with House District 13, all the votes cast in the election for that locality must be part of the initial analysis at the beginning. This is important because early voting and absentee ballots are not being sorted by precinct but instead go into a Central Absentee Precinct (CAP), which often bundles all the House of Delegates races in a locality into one group for ballot storage purposes.

CONCLUSION

The House of Delegates District 13 and 75 audits confirmed with over 99% confidence that the results of the 2021 General Election were accurately reported. The results reflect the hard work of election administrators and further exemplifies the integrity and validity of the 2021 November General Election. RLA's are an important tool in reassuring the public that every vote counts and provide an excellent check on the democratic process. ELECT remains a leader nationally in the administering of risk-limiting audits and intends to build on the success of these audits in the years to come to ensure safe, secure, fair, and free elections in the Commonwealth.

Appendix

i.   § 24.2-671.1. Audits of ballot scanner machines.

A. The Department of Elections shall coordinate a post-election Risk-Limiting Audit annually of ballot scanner machines in use in the Commonwealth. The localities selected for the audit shall be chosen at random with every locality participating in the Department's annual audit at least once during a five-year period. The purpose of the audits shall be to study the accuracy of ballot scanner machines.

B. No audit conducted pursuant to this section shall commence until after the election has been certified and the period to initiate a recount has expired without the initiation of a recount. An audit shall have no effect on the election results.

C. All audits conducted pursuant to this section shall be performed by the local electoral boards and general registrars in accordance with the procedures prescribed by the Department. The procedures established by the Department shall include its procedures for conducting hand counts of ballots. Candidates and political parties may have representatives observe the audits.

D. The local electoral boards shall report the results of the audit of the ballot scanner machines in their jurisdiction to the Department. At the conclusion of each audit, the Department shall submit a report to the State Board. The report shall include a comparison of the audited election results and the initial tally for each machine audited and an analysis of any detected discrepancies.

2008, c. 565; 2014, cc. 540, 576; 2017, c. 367.[17]

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[17] Code of Virginia, § 24.2-671.1, https://law.lis.virginia.gov/vacode/title24.2/chapter6/section24.2-671.1/

ii. ELECT 659-Request to Inspect Sealed Election Materials

★ VIRGINIA ★
DEPARTMENT *of* ELECTIONS

ELECT 659 - Request to Inspect Sealed Election Materials

Election Date: *   Election Type: *   Date of Request: *

2020-11-03   General ∨   2021-03-17

Name of Requester *

Position *

Email Address *   Phone Number *

Confirm Email Address *

Locality *   Precinct Name *   Precinct #: *

                          All Precincts   All

Specific Envelope which needs to be inspected:

Any and all envelope(s) and/or container(s) labeled 3 and/or 3A

The Envelope needs to be inspected to determine:

Statewide Risk Limiting Audit

Powered by 🗐 formsite

Submit

iii.   2022 RLA's: Potential Races

Locality	Contest	Date	Outcome	Analysis
Giles, Montgomery, Pulaski Counties and Radford City	House of Delegates – 12th District	November 2nd, 2021	**Total: 25,183** Delegate Chris Hurst; 11,224 Jason Ballard; 13,871 W/I:88 Margin 10.51%	To reach a 90% risk limit, the sample would have to include at a minimum 423 ballots.
Prince William County, Manassas Park City	House of Delegates 13th District	November 2nd, 2021	**Total: 28,782** Christopher Stone; 13,125 Danica Roem; 15,604 W/I: 53 Margin 8.61%	To reach a 90% risk limit, the sample would have to include at a minimum 636 ballots. *Total ballots for localities were: PWC; MPC:
Prince William County	House of Delegates 51st District	November 2nd, 2021	**Total; 35,647** Tim Cox; 16,566 Brianna Sewell; 19,038 W/I: 43 Margin 6.94%	To reach a 90% risk limit, the sample would have to include at a minimum 970 ballots
Brunswick, Emporia City, Franklin City, Greensville, Lunenburg, Southampton, Sussex	House of Delegates 75th District	November 2nd, 2021	**Total: 27,585** Otto Wachsmann; 14,487 Delegate Roslyn Tyler; 13,061	To reach a 90% risk limit, the sample would have to include at a minimum 1,740 ballots.

			W/I: 37	
			Margin 5.17%	
Newport News City	House of Delegates 94th District	November 2nd, 2021	**Total: 24,513** Delegate Shelly Simonds; 13,725 Russ Harper; 10,734 W/I: 54 Margin 12.2%	To reach a 90% risk limit, the sample would have to include at a minimum 316 ballots.
				Any locality with a split in House of Delegates Districts may have stored their ballots within the same batch. The ballot manifest may therefore include ballots from other races. The sample has the potential to pull ballots that may not have the race on them further complicated the RLA process.

iv. Glossary of Terms

Incorrect outcome means an electoral outcome that differs from the outcome that would be found by a full manual tabulation of the votes on all ballots validly cast in the election.

Post-election audit means a process conducted after an election to confirm the accurate reporting of the results of the election

Pre-certification audit means a post-election audit conducted prior to the state certification of the election results.

Risk-Limiting Audit of an election is a post-election, pre-certification audit with a pre-specified minimum probability of requiring a full hand tabulation of votes on all ballots validly cast in an election contest if the outcome reported by the voting system is incorrect. It involves hand-to-eye examination of printed ballots until there is strong statistical evidence that the reported election outcome is correct, or in the absence of such evidence, escalates to a full manual count of ballots to determine the election outcome.

The Risk limit of a Risk-Limiting Audit is the largest probability that the audit will fail to correct an election outcome that is incorrect.

Ballot Manifest is a two column spreadsheet created by localities that includes a list of the "Batch Name" (column A) and the "Number of Ballots" (column B). All types of ballots are included (in person, mail-in, provisional, etc.) in the manifest. The ballot manifest creates an inventory of every ballot cast in a locality.

Random Seed Number A random number sequence that is created and used to generate the ballots selected for auditing.

Ballot-Polling Audit a type of RLA in which individual paper ballots are randomly selected to confirm that the overall results of an election were correctly reported.

Ballot-Comparison Audit a type of RLA in which individual paper ballots are randomly selected, the voter intent is manually interpreted and compared with the voting system's interpretation of the same ballot, as reflected in the cast vote records.

v. Arlo Results

Contest Name	Sample Size	Risk Limit Met?	P-Value	Audited Votes
House of Delegates 75th District	1,696	Yes	.002854934	Wachsmann: 926 Tyler: 767
House of Delegates 13th District	4,520	After round 2 Yes	1st Round 0.303112361 2nd Round .002562936	Stone: 689 Roem: 922