EVALUATION REPORT Denver Elections Division *Risk-Limiting Audit Process*February 2018

Office of the Auditor
Audit Services Division
City and County of Denver



Timothy M. O'Brien, CPA
Denver Auditor



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February 15, 2018

AUDITOR'S REPORT

We have completed an evaluation of the Denver Elections Division's risk-limiting audit (RLA) process. The objective of the evaluation was to determine whether the division's implementation and performance of the RLA process met the requirements established by the Colorado Secretary of State.

As described in this report, our evaluation revealed that the Denver Elections Division has established an RLA process that fully aligns with state law and rules promulgated by the Colorado Secretary of State. However, we identified three areas of the process that can be improved. First, the ballot manifest that is sent to the Colorado Secretary of State is created with data manually entered into a spreadsheet, which makes it more susceptible to human data entry errors. Second, the Secretary of State's RLA sample selection process does not account for multiple-page ballots, which Denver utilized during the November 2017 coordinated election, leading to reduced efficiency. Finally, the division has not yet developed a comprehensive procedure for capturing metrics that would allow for the division to monitor their performance of the RLA process. By addressing these areas, the Denver Elections Division will continue to strengthen its RLA processes and procedures and establish the division as a pioneer in ensuring correct election outcomes using the RLA method. Our report lists three recommendations to achieve this end.

This evaluation is a non-audit service that was requested by the Denver Elections Division to assist them in assessing the implementation of the RLA process and any areas for improvement as they prepare for future elections. This non-audit service is intended to provide information based on limited reviews or time-critical assessments or evaluations. Per generally accepted government auditing standards section 2.12, this non-audit service was not conducted in accordance with generally accepted government auditing standards. Despite the engagement not being bound by these standards, we planned and performed the evaluation to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our evaluation objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions.

We extend our appreciation to the Denver Elections Division and the personnel who assisted and cooperated with us during the evaluation.

Denver Auditor's Office

Timothy M. O'Brien, CPA Auditor



Risk-Limiting Audit Process February 2018

Objective

The objective of this evaluation was to assess the Denver Elections Division's implementation and performance of the risk-limiting audit process as required by state law and overseen by the Colorado Secretary of State.

Background

Colorado law requires that all counties perform a risk-limiting audit following each primary, general, coordinated, or congressional vacancy election starting with the November 2017 coordinated election. A risk-limiting audit (RLA) provides strong statistical evidence that an election outcome is right, and has a high probability of correcting a wrong outcome. The law directs the Colorado Secretary of State to promulgate rules to implement and administer the law.

REPORT HIGHLIGHTS

Highlights

Our evaluation of the Denver Elections Division's risk-limiting audit (RLA) process found that the division has established an RLA process that fully aligns with the law and rules promulgated by the Colorado Secretary of State. However, we identified the following three areas of the process that can be improved.

- The ballot manifest that is sent to the Colorado Secretary of State is created with data manually entered into a spreadsheet, which makes it more susceptible to human data entry errors. A more automated tracking system such as a database software should be implemented. If an automated system is not available, then compensating controls to validate the accuracy and reliability of the spreadsheets should be implemented.
- The Secretary of State's RLA sample selection process does not account for multiple-page ballots, which Denver utilized during the November 2017 election, causing inefficiency in the RLA process.
- The division does not have a comprehensive procedure for capturing metrics that would allow the division to monitor their performance of the RLA process.

Our report lists three recommendations for Denver Elections Division management to consider when addressing improvement in these areas.

For a copy of this report, visit www.denvergov.org/auditor or contact the Auditor's Office at 720.913.5000.

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BACKGROUND

A risk-limiting audit (RLA) is a type of election audit that uses statistical methods to limit, to acceptable levels, the possibility of certifying a preliminary election outcome that is incorrect. In other words, an RLA provides strong statistical evidence to show that an election outcome is accurate. The method also has a high probability of correcting an election outcome that is wrong.

In 2009, the Colorado legislature passed a law requiring RLAs, declaring the necessity of auditing election results to ensure effective election administration and public confidence in the election process. Although counties had already been conducting audits of election results, the legislation positioned RLAs as a more effective method because they require limited resources for election races with wide margins of victory while investing greater resources in closer races.

The 2009 legislation also required the Colorado Secretary of State to establish a pilot program in select counties to determine what would be required to carry out RLAs statewide, including identifying technical modifications that would need to be made to voting equipment. Subsequent to the pilot program, all Colorado counties were required to conduct an RLA after each statewide election, beginning with the 2017 coordinated election and following each primary, general, coordinated, or congressional vacancy election held thereafter.² Therefore, Colorado's 2017 coordinated election was the first state-wide RLA conducted in the country.

Colorado's Previous Post-Election Audit Process

The RLA ballot auditing process differs from Colorado's previous system of a fixed-percentage post-election audit of ballots. Under the previous system, the Secretary of State randomly selected 5 percent of all ballot scanners and 5 percent of all direct-recording electronic (DRE) voting machines to audit.³ All races on every ballot cast on a DRE voting machine were audited, and the county clerk for each county would randomly select up to 500 ballots for audit for votes tabulated on ballot scanners based on the total number of ballots tabulated on the scanner.

According to reports from the Colorado Secretary of State, this process had several drawbacks. First, due to the fixed sample sizes and an inability to expand the audit into a full recount, the audit process could not guarantee it would reveal errors if the outcome was wrong because of varying contest margins, or the difference in the number of votes received between the winner and the loser. In addition, the number of ballots audited using the previous system depended on the number of ballots tabulated on the selected DRE voting machines and ballot scanners. In contrast, the number of ballots audited in the RLA process depends on the contest margin and errors identified throughout the audit.

Colorado's Current Risk-Limiting Audit Process

Under the new post-election audit process, the Denver Elections Division uses comparison audits to certify the results of election outcomes. This process includes manually comparing randomly selected batches of ballots to the recorded votes from the ballot scanning machines until the audit's risk limit is met. The risk limit is a number, set by the Colorado Secretary of State, that is the

¹ Colorado Revised Statutes § 1-7-515.

² The initial legislation required all counties conduct an RLA beginning with the 2014 General Election. This deadline was extended in 2013 to begin with the 2017 Coordinated Election to allow more time for pilot testing.

³ Ballot scanners record the votes of all mail-in ballots, and DREs are the machines on which voters cast their in-person ballots.

largest statistical probability that an incorrect outcome is not detected and corrected by the RLA. The audit continues until this threshold is met or a complete hand recount occurs.

Preparation for the RLA begins before the election occurs as the Secretary of State must establish the audit's risk limit at least 32 days before election day. The responsibilities of counties for the RLA largely begin on election day as they are receiving and tabulating all the ballots received.

The Process at the County Level – As Denver Elections Division officials are receiving and tabulating ballots, they imprint each ballot card with a unique identifying number prior to running them through a ballot scanner for tabulation. This "imprinted ID" is not recorded by the tabulation system itself, but the number is stamped on the ballot card's image to facilitate pulling the correct ballot at a later date. The imprinted ID is used to create the cast vote record, which is a data export that shows how the ballot scanner recorded each vote from the ballot card. After the ballots are imprinted with an ID, Denver Elections Division officials place the scanned ballot cards into groups of approximately 100, known as a batch. The individual ballot card ID numbers are manually entered into a spreadsheet, with their assigned batch number and batch location. This spreadsheet is then used to create the ballot manifest, a document that tracks the number of ballots in the election and records how the ballots are organized and stored. Both the cast vote record and ballot manifest are sent to the Colorado Secretary of State by the ninth day after the election.

In addition to these duties, a designated election official from each county in Colorado must appoint an audit board to conduct the RLA with assistance from local county election officials. Audit board members are appointed based on nominations from both major political parties within the county at least 15 days before election day. An audit board must be appointed prior to every election.

The Process in the Colorado Secretary of State's Office – Once the Secretary of State's office receives the cast vote record and ballot manifest from each county, the Secretary of State chooses at least one statewide and one countywide contest for which to conduct the RLA. When determining which contest should be the subject of the RLA, the Secretary of State considers the narrowness of the margin of victory, as well as other factors. After selecting the race to be audited, the Secretary of State holds a public meeting to establish a 20-digit random seed number used to randomly select the ballot cards to be audited. This random seed number is used in conjunction with formulas created by statisticians to determine the number of ballot cards that must be audited to reach the established risk limit and the specific ballot cards to be audited. The list of selected ballot cards is then sent back to the individual counties.

Involvement by the County Audit Board – After the list of ballot cards selected for audit is received from the state, each county audit board must retrieve each selected ballot card to prepare for the RLA. Once the selected ballot cards have been retrieved, the Denver audit board and Denver Elections Division officials compare the original ballot cards to the responses recorded by the scanning machines already uploaded into the state's election reporting system, CORLA (Colorado Risk-Limiting Audit software). CORLA then generates information pertinent to the RLA, such as whether any responses did not match the scanner's interpretation, whether the audit has reached the risk limit established by the Secretary of State, and whether more ballots need to be selected to complete the RLA. If CORLA does not identify the need for any further ballots to be

⁴ For the 2017 coordinated election, the Colorado Secretary of State set the risk limit to 9 percent.

audited, the RLA is completed, and CORLA sends the results to the Secretary of State to be published.

The Denver Elections Division's Organization and Budget

The Denver Elections Division is under the Denver Office of the Clerk and Recorder and is responsible for providing comprehensive election services for the City and County of Denver. The goal of the division is to conduct fair, accurate, accessible, secure, transparent, efficient, and reliable elections.⁵ As shown in Figure 1, the division is divided into four separate departments: Administration, Voter Records, Operations, and Communications. The Operations Department is responsible for the tabulation and compilation of elections results and, therefore, the post-election audit process.

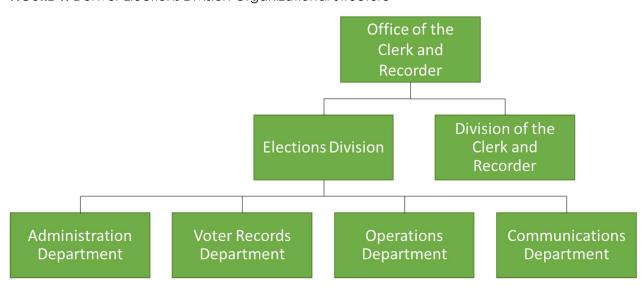


FIGURE 1. Denver Elections Division Organizational Structure

Source: City and County of Denver's Auditor's Office analysis of Proposed 2018 Budget and Denver Elections Division Organizational Chart.

The Denver Elections Division was appropriated just over \$4.5 million with 50 full time equivalent (FTE) positions in 2017. Of that, the Operations Department has 7 FTEs and was appropriated more than \$900,000 to perform its duties. However, Operations management is expecting the department's budget to increase to over \$1.1 million in 2018 due to preparations for the 2018 midterm elections.

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⁵ City and County of Denver 2018 Mayor's Budget

OBJECTIVE

The objective of this non-audit service was to evaluate the Denver Elections Division's implementation and performance of the risk-limiting audit process as required by state law and overseen by the Colorado Secretary of State.

SCOPE

The evaluation included assessing the design, implementation, and performance of the Denver Elections Division's policies, procedures, and other processes related to risk-limiting audits for the November 2017 coordinated election.

METHODOLOGY

We utilized the following methods when evaluating the risk-limiting audit (RLA) process:

- Obtained and documented an understanding of the requirements of RLAs, based on policies and procedures established by the Colorado Secretary of State, the Denver Elections Division, and best practices.
- Observed ballot processing and tabulation steps on or before election day and documented how these steps related to the RLA process to be performed by the Denver Elections Division after election day. To accomplish this, we:
 - Used procedures documented by Denver Elections Division personnel;
 - Compared processes and procedures to policy and other guidance issued by the Colorado Secretary of State to determine whether the division is complying with state requirements; and
 - Evaluated possible areas for process performance and efficiency improvements.
- Observed the Denver Elections Division's role in conducting RLAs as required by the state and compared the observed actions against the RLA policies and procedures established by the state, the county, and other best practices. Specifically, we:
 - Compared processes and procedures to policy and other guidance issued by the Secretary of State to determine whether the Denver Elections Division is complying with state requirements; and
 - Evaluated possible areas for process performance and efficiency improvements.
- Analyzed efficiency, accuracy, and cost differences between the previous random audit process versus the new RLA process.

FINDING

The Denver Elections Division Complies with State Risk-Limiting Audit Requirements

We determined that the Denver Elections Division has established a risk-limiting audit (RLA) process that fully aligns with the requirements established in the Colorado Revised Statutes (C.R.S.) and the Colorado Secretary of State's Election Rule 25.6.7 During observations, we found that the ballot manifest and cast vote record were created and submitted in compliance with state rules, and the audit board observed the retrieving of selected ballot cards for audit and made determinations of voter markings for the RLA as required by Election Rule 25.

However, while the Denver Elections Division has implemented all legal requirements established by the state, the audit team identified three areas the division could improve upon to provide additional assurance of election outcomes. These areas are the use of manually entered spreadsheets to create the ballot manifest, the effect of the state's RLA sampling process on Denver's multi-page ballots, and the need for performance metrics about the RLA process.

Spreadsheets Are Used to Create the Ballot Manifest

The Denver Elections Division uses a system called Salesforce to track custody of ballots from the point of receipt through the end of the ballot cycle. We observed how Salesforce is used in managing the tracking process and noted a limitation in how extensively the system can be used as ballots are received and processed.

New RLA procedures require the division to group ballots into small batches. Multiple batches are then stored in boxes, which are used to track the batches and the individual ballots within each batch. The Salesforce program does not have the capability to track individual batches within each box. Each individual ballot card is processed through an imprinter, which assigns and marks the physical ballot with a unique number for later identification and retrieval. Division personnel must manually input batch data by imprinter ID into specific spreadsheets. These spreadsheets are then combined and reconciled by the count room judges.

Auditors recognize that manual processes are commonly used to make up for the limitations posed by certain information technology systems. However, manual processes are not as reliable. Guidance from the federal Government Accountability Office (GAO) emphasizes the reliability of automated control activities in contrast with manual control activities. Specifically, GAO standards state:

Control activities can be implemented in either an automated or a manual manner. Automated control activities are either wholly or partially automated through the entity's information technology. Manual control activities are performed by individuals with minor use of the entity's information technology. Automated control activities tend to be more reliable because they are less susceptible to human error and are typically more efficient. If the entity relies on

⁶ Colorado Revised Statutes § 1-7-515 establishes the use of risk-limiting audits for post-election auditing and requires the Secretary of State to promulgate rules establishing procedures to perform the RLA.

⁷ Election Rule 25 contains the procedures and requirements outlined by the Secretary of State for counties to perform the risk-limiting audit.

information technology in its operations, management designs control activities so that the information technology continues to operate properly.8

The use of spreadsheets with manually entered data to track batches of ballots has inherent risks, including data entry and calculation errors. If an automated system is not available, then compensating controls to validate the accuracy and reliability of the spreadsheets should be implemented. These controls could include automated error checking in the spreadsheets, reperforming calculations, and comparing batch totals from the original data entry sheets to the spreadsheets.

RECOMMENDATION 1.1

The Denver Elections Division should consider working with a Salesforce professional to identify possible system upgrades or modules that would allow for a more automated approach to gathering, documenting, and reporting ballot manifest information. If this is not feasible, compensating controls should be considered to validate the accuracy and reliability of the information in the spreadsheets.

Agency Response: Agree

The State's Risk-Limiting Audit Sampling Process Does Not Account for Denver's Multiple-Page Ballot, Reducing Efficiency

The goal of the Colorado Secretary of State in overseeing the statewide use of risk-limiting audits is to find a feasible solution that creates a repeatable post-election audit process and justifies increased confidence that ballots are being tabulated correctly. Additionally, the Secretary of State wants counties to be able to conduct a post-election audit in as little time as possible using as few resources as possible. Thus, the objective is to implement a process that minimizes the number of ballots that must be examined in order to verify the accuracy of the election outcome within the stated acceptable risk margin. 10

For the 2017 coordinated election, the Denver ballot contained two pages per ballot for those voters who chose to vote using a mail-in ballot. The two pages are known as ballot cards and were necessary as all races would not fit on one page. The ballot manifest listed every ballot card individually. When selecting a race to audit, the SOS randomly selects from the entire list of ballot cards cast. Due to the nature of random selection, not every ballot card randomly selected contained the contest selected for RLA procedures. The Denver Elections Division, like all other county elections offices, is required to submit a ballot manifest to the Secretary of State that lists all individual ballot cards cast. The submission includes a cast vote record, which identifies every ballot card cast. The ballot manifest, however, does not have enough detail to identify different

⁸ United States Government Accountability Office. *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: Sep. 10, 2014).

⁹ U.S. Election Assistance Commission, State of Colorado Risk-Limiting Audit – Final Report Post-Election Audit Initiative – Grant No. EAC110150E.

¹⁰ Risk margins in elections are calculated as the difference in votes cast between the candidates divided by the total number of votes cast.

page numbers for each ballot. This reduces the ability of the Secretary of State to narrow the focus of the sampling procedures and forces the assumption that all ballot cards could potentially have the contest selected for audit.

The effect on the process then becomes two-fold. First, when calculating the margin of victory, the assumption that all ballot cards could potentially include the contest selected for audit decreases the margin of victory. In a normal contest, victory is determined by who earns the most votes. The difference between the number of votes for the winning candidate and losing candidate divided by the total number of votes cast in the race equals the margin of victory.¹¹

By decreasing the margin of victory, the algorithm used to calculate the sample size or number of ballots to audit increases. The inability to narrow the focus of the sampling produces a second effect of the need to double, once again, the number of ballots to be examined. To mitigate the risk of selecting ballot cards that did not contain the contest under audit, the Secretary of State chose to double the sample size calculated by the algorithm from 60 to 120 ballot cards for the race selected for audit. Increasing the number of ballot cards to be examined reduces the efficiency of the RLA process for any county with multi-page mail-in ballots, which runs contrary to the Secretary of State's goal of minimizing the duration of any RLA conducted.

When we discussed this issue with Denver Elections Division personnel, they said that the Secretary of State's office has already recognized this problem and possible solutions have been discussed among representatives from the state, counties, voting software providers, and academics. Discussions are ongoing and a final solution is still being developed.

RECOMMENDATION 1.2

The Denver Elections Division should continue to work with the Colorado Secretary of State's Office to determine how to identify specific contests in multiple page ballots in order to produce optimal ballot sample sizes in the risk-limiting audit process.

Agency Response: Agree

Performance Metrics Are Not Available for the Risk-Limiting Audit Process

Performance metrics are used to measure and evaluate an entity's performance of an objective. One of the Denver Elections Division's stated goals is to conduct efficient elections, and the division measures performance toward this goal using a cost per vote metric. However, the division does not currently track metrics for most of the RLA process steps. The only metric related to the RLA process, which the division started tracking during the November 2017 coordinated election,

¹¹ For example, candidate A earns 75 votes while candidate B earns 25 votes for a total of 100 votes cast. Candidate A has won by a margin of 50 votes (75-25). Expressed as a percentage, candidate A has achieved a 50% margin of victory (margin/total votes cast=50/100). When there is a two-card ballot, the assumption changes because the current system cannot narrow the ballots to select from by race. Since the system cannot be trusted to identify the specific race, the Secretary of State currently assumes that all cards potentially have the race under audit. Therefore, using the previous example assuming there are two-card ballots candidate A would still win by 50 votes, however the total ballot cards cast would increase to 200. This will now decrease the margin of victory from 50% to 25% (margin/total ballot cards cast=50/200).

is the time it took to imprint a unique, sequential identification number on each page of each ballot shortly after ballots were received into the Denver Elections Division's office. The division has not recorded metrics for the post-election RLA process steps, such as data related to the retrieval of ballots selected for audit and the audit examinations themselves.

The audit team contacted statistics professor Philip B. Stark, PhD., of the University of California, Berkley to ask whether other municipalities have established RLA performance metrics. Election auditing is among Dr. Stark's research focuses, and he helped the State of Colorado establish its RLA process and ballot sampling procedure. Dr. Stark confirmed that, at this time, there are no available RLA performance metrics that would be useful to the Denver Elections Division. This is because RLA is a relatively new practice, and the November 2017 coordinated election was the first time most counties in Colorado used it. This lack of peer performance metrics makes the monitoring and evaluation of the Denver Elections Division's performance of the RLA process more difficult.

After further follow up with Dr. Stark, he agreed that, in the absence of RLA performance metrics from peer municipalities, Denver Elections Division officials should create RLA performance metrics for Denver, such as time and cost per ballot retrieved and time and cost per ballot reviewed. These metrics will help them assess performance over time and measure the impact of any changes in their process from one year to the next.

RECOMMENDATION 1.3

The Denver Elections Division should consider creating risk-limiting audit performance metrics, such as time and cost per ballot retrieved and time and cost per ballot reviewed, to measure risk-limiting audit performance over time.

Agency Response: Agree

RECOMMENDATIONS

We make the following recommendations to the Denver Elections Division management for consideration to further improve its risk-limiting audit process:

1.1 Automate Ballot Manifest Information – The Denver Elections Division should consider working with a Salesforce professional to identify possible system upgrades or modules that would allow for a more automated approach to gathering, documenting, and reporting ballot manifest information. If this is not feasible, compensating controls should be considered to validate the accuracy and reliability of the information in the spreadsheets.

Agency Response: Agree

Agency Narrative: We fully recognize that an automated solution, perhaps via Salesforce, in the future will be beneficial to this process. However, due the compressed development timeline specified by the vendor through the Secretary of State's office for implementing the CORLA tool, there was not adequate time for a Salesforce process to be developed prior to the election. We also anticipate further changes in the Secretary of State's RLA tool and thus once the CORLA tool is stable, we will be able to develop an aligned Salesforce solution.

1.2 Continue Working with Secretary of State to Address Multi-Page Ballot Efficiency – The Denver Elections Division should continue to work with the Colorado Secretary of State's Office to determine how to identify specific contests in multiple page ballots in order to produce optimal ballot sample sizes in the risk-limiting audit process.

Agency Response: Agree

Agency Narrative: We will continue to work with the Secretary of State's office to ensure that the CORLA tool is capable of handling multi-page ballots in an efficient and effective way. We hope to be a part of future development discussions and testing processes for the CORLA tool.

1.3 Create RLA Performance Metrics – The Denver Elections Division should consider creating risk-limiting audit performance metrics, such as time and cost per ballot retrieved and time and cost per ballot reviewed, to measure risk-limiting audit performance over time.

Agency Response: Agree

Agency Narrative: As noted in this audit report, since this was the first RLA conducted, there were not baseline metrics. Now that we have completed this first process, we are in the process of developing baseline metrics that can be used for comparative analysis in the future.

AGENCY RESPONSE







Auditor Timothy O'Brien, CPA Office of the Auditor City and County of Denver 201 West Colfax Avenue, Dept. 705 Denver, Colorado 80202

Dear Auditor O'Brien,

The Office of the Auditor has conducted a non-audit service evaluation of Denver Elections Division's Risk-Limiting Audit Process.

This memorandum provides a written response for each reportable condition noted in the Auditor's Report final draft that was sent to us on January 31, 2018. This response complies with Section 20-276 (c) of the Denver Revised Municipal Code (D.R.M.C.).

AUDIT FINDING

The Denver Elections Division complies with state risk-limiting audit (RLA) requirement, but further improvements can strengthen the division's RLA process.

RECOMMENDATION 1.1

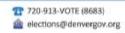
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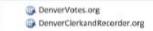
Agree or Disagree with Recommendation

Agree

Narrative for Recommendation 1.1

We fully recognize that an automated solution, perhaps via Salesforce, in the future will be beneficial to this process. However, due the compressed development timeline specified by the vendor through the Secretary of State's office for implementing the CORLA tool, there was not adequate time for a Salesforce process to be developed prior to the election. We also anticipate further changes in the Secretary of State's RLA tool and thus once the CORLA tool is stable, we will be able to develop an aligned Salesforce solution.











RECOMMENDATION 1.2

The Denver Elections Division should continue to work with the Colorado Secretary of State's Office to determine how to identify specific contests in multiple page ballots in order to produce optimal ballot sample sizes in the risk-limiting audit process.

Agree or Disagree with Recommendation

Agree

Narrative for Recommendation 1.2

We will continue to work with the Secretary of State's office to ensure that the CORLA tool is capable of handling multi-page ballots in an efficient and effective way. We hope to be a part of future development discussions and testing processes for the CORLA tool.

RECOMMENDATION 1.3

The Denver Elections Division should consider creating risk-limiting audit performance metrics, such as time and cost per ballot retrieved and time and cost per ballot reviewed, to measure risk-limiting audit performance over time.

Agree or Disagree with Recommendation

Agree

Narrative for Recommendation 1.3

As noted in this audit report, since this was the first RLA conducted, there were not baseline metrics. Now that we have completed this first process, we are in the process of developing baseline metrics that can be used for comparative analysis in the future.

Thank you for your work on this advisory project. We appreciate your partnership and look forward to future engagements. Please contact Jimmy Flanagan at 720-865-4965 or myself at 720-865-4850 with any questions.

Sincerely, Ambert Makey rolds

Amber McReynolds

Director of Elections, Office of the Clerk and Recorder

cc: Debra Johnson, Denver Clerk and Recorder

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