



Meeting Date: April 25, 2023

**From: MOA Elections Team**

**Subject: Risk Limiting Audit for the April 4, 2023 Regular Municipal Election**

**I. Executive Summary**

The MOA Elections Team conducted a post-election audit that contained three areas of focus.

1. **Hand-Count.** A pre-determined percentage of ballots in randomly specified contests was selected and the actual random ballots for those specified races were hand counted.
2. **Machine Review.** Cast Vote Records were produced from the tabulation system and tallied for the ballots selected.
3. **Comparison of Hand-Count and Machine Review.** The totals from the hand-count, detailed in paragraph 1, and the totals from the machine count, detailed in paragraph 2, were compared.

***The results of the MOA post-election Risk Limiting Audit are that the scanning, adjudication, and tabulation system performed as expected and the results reflect the will of the voters.*** All ballots were adjudicated and tabulated as expected. The results of the hand-count and the machine tabulation were identical.<sup>1</sup>

**II. WHAT IS A POST-ELECTION RISK LIMITING AUDIT?**

**A. Research.** Research defines a post-election audit as a check to confirm that the voting equipment and procedures used to count votes worked properly. Post-election audits are recommended by election security experts as one method of protecting the integrity of elections.

There are many types of “post-election audits” used to validate election results or outcomes. As a term of art, it refers to checking paper ballots (or records) against the results produced by the vote tallying equipment to ensure accuracy.

Risk limiting audits (RLA) use statistically developed audit techniques that allow selection of a number of ballots to be audited that provide statistical confidence that the tabulation system performed as expected. A RLA is an incremental audit system: If the percentage of risk selected in advance of the audit failed to demonstrate the tabulation system was

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<sup>1</sup> For more detailed information on the results of the audit, see Item G. Comparison of the Hand-Count to the Machine Count, Results of the Risk Limiting Audit, and Exhibit A – RLA Worksheet

performing as expected, election officials would review further ballots or conduct a full manual tally of the election.

The MOA Election Team conducts “Batch-Level Comparison Audits,” which is a type of RLA that most resembles a “traditional” audit. In a batch-level comparison audit, the voting system must export identifiable physical batches of ballots. In the MOA RLA, Election Officials physically selected random batches from the entire election to audit. In “Batch-Level Comparison Audits” and in the MOA RLA, Election Officials add up the selected batch-level results by hand to verify that they produce the reported contest outcomes. The votes in each selected batch were examined manually and hand-counted, and the audit counts were compared to the tabulation system’s report and subtotals. Depending on the number and type of discrepancies the audit finds in the sample, the audit either stops or examines more batches manually.

### ***B. Implementation of the Risk Limiting Audit at the MOA***

Successful implementation of any new election process requires careful thought and a considerable amount of planning. The MOA Elections Team began looking at post-election audits in 2020. One important step in preparing for the post-election audit, was obtaining the imprinters on the ballot scanners in 2020; the imprinters put a unique number – the scanner, batch, and ballot number – on each ballot, allowing elections officials the ability to pull the actual ballot to confirm the votes.

The MOA Elections Team conducted a practice audit after the 2021 Regular Municipal election in preparation for implementation of post-election audit in 2022. The practice was worthwhile: The Elections Team determined it tested too many ballots in one race and too few in another; the Elections Team pulled individual ballots which was incredibly time consuming. To address this shortcoming, the 2022 audits tested “batches” of ballots, which was more efficient to select and re-file rather than randomly selecting individual ballots and having to refile those.

Now, the Elections Team is happy to provide the results of the Risk Limiting Audit at certification.

## **III. PROCEDURES FOR THE RISK LIMITING AUDIT**

### ***A. Selection of Races and Measure to be audited.***

- 1. Selection of Race and Measure.*** The MOA Risk Limiting Audit Procedures requires the Elections Team to identify the races and measures to be audited by rolling a 6-sided die. In years where there is no Mayor’s race, the MOA Elections Team is to randomly select one Assembly race and one proposition to audit. The Elections Team first rolled the 6-sided die and the result was a 1, therefore the Assembly District 1 race was randomly selected to be audited. The Elections Team rolled the die again and the result was a 6. Since Proposition 6 was not an area-wide proposition, the die was rolled again, and

the result was a 4. Proposition 4 was an area-wide race therefore, Proposition 4 was also randomly selected to be audited.

- 2. Target Number of Ballots.** The target number of ballots per race or measure was calculated. 5% of the ballots cast in the proposition, or 3,200, were selected for the audit. 3% of the total ballots cast in the race, or 176, were selected for the audit.

The exact calculations for target number of ballots are as follows:

- Calculate 5% of ballots cast in the in the Proposition selected, regardless of the number of votes cast or spread. Round down to nearest 1,000. E.g., change 64,724 to 64,000 for ease of count:
  - In 2023, total ballots cast = 64,000 x .05 = 3,200
- Calculate 3% of total votes cast in the Assembly race:
  - In District 3, total votes cast (note, this is different that total ballots cast used for areawide races) = 5,864 x .03 = 176

The audit actually reviewed 3,227 ballots in the areawide measure and 200 in the district-wide race because we count entire batches.

- 3. Random Selection of Batches.** To reach the 3,200 ballots targeted for review in the Municipal-wide Proposition 4 ballot measure, the MOA Elections Team estimated a minimum of 320 batches would be required to be audited since during the processing of the election, approximately 100 ballots were scanned per batch. (3,200/100 = 32; we realized later the mental math error we made.) Because the ballot was a two-card ballot, the Team selected 660 batches for this audit – in the event that some of the batches could contain less than the 100 ballots typically scanned per batch.

Then, staff calculated the percentage of total ballots processed in the election on ICC 1 (scanner 1), ICC 2 (scanner 2), and ICC 3 (scanner 3) The result is that 310 batches from ICC1, 205 batches from ICC2 and 145 batches from ICC3 would be pulled for audit.

The exact calculations for the number of batches selected from each scanner are as follows:

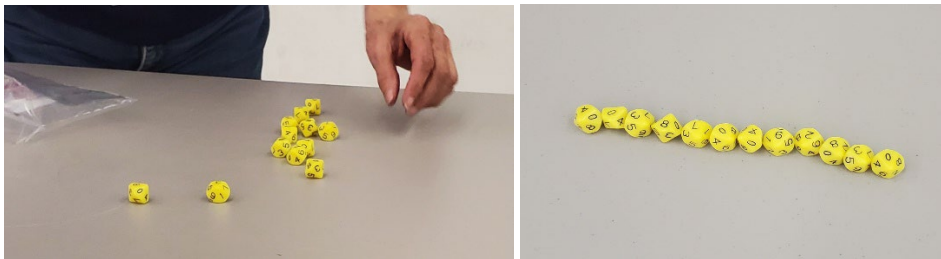
1. Determine the total number of batches scanned by each selected ICC:
  - ICC 1= 913 batches
  - ICC 2 = 611 batches
  - ICC 3 = 433 batches
  - 1,957 total batches to possibly be verified

2. Determine the percentage of total batches each ICC scanned:
  - ICC 1 =  $913/1,957 = 47\%$
  - ICC 2 =  $611/1,957 = 31\%$
  - ICC 3 =  $433/1,957 = 22\%$
3. For each ICC selected, use the percentage of total batches each ICC scanned to determine the random number of batches needed from each ICC, and then to determine which batch numbers for each ICC to pull. Since 30 batches were selected for verification, the total number of batches for verification from each ICC is as follows:
  - ICC 1 =  $47\%$  of total batches x 660 batches for verification = 310
  - ICC 2 =  $31\%$  of total batches x 660 batches for verification = 205
  - ICC 3 =  $22\%$  of total batches x 660 batches for verification = 145

**B. Use Pseudo-Random Number Generator for Random Selection of Batches.**

The staff then used the Pseudo-Random Number generator at <https://www.stat.berkeley.edu/~stark/Java/Html/sha256Rand.htm> to randomly select the batches of ballots from each ICC. Following the instructions on the Pseudo-Random Number Generator, the selected were as follows:

- (1) Roll the ten, ten-sided dice one time, and then a second time and input all twenty numbers into the “Seed”. “Seed,” is the starting point of a random number generator.



- (2) Enter the “Seed” and other information into the random number generator and press “Draw Sample.” The result is the list of randomly selected items.

ICC-1 summary in Word (cut + pasted from Random# Generator)

Items Selected:

452,899,396,546,701,835,292,564,776,681,424,376,674,633,645,618,790,132,128,54,44,87,72,908,146,710,338,253,9,8  
11,682,559,637,223,361,85,103,902,170,517,109,713,313,80,195,635,597,244,300,867,479,855,226,472,591,350,512,20  
8,840,73,524,187,551,22,507,76,7,148,639,799,77,408,897,513,589,847,624,251,826,312,194,410,895,785,861,147,896,  
410,700,495,433,531,135,562,683,83,841,328,226,256,204,111,725,119,800,609,806,262,778,765,563,811,887,86,638,5  
10,883,270,175,16,566,901,808,385,392,640,766,358,107,377,367,162,189,621,881,279,892,329,750,512,270,220,665,1  
04,151,198,892,527,675,524,265,785,285,376,633,113,352,499,842,731,73,7,166,722,890,524,816,143,159,278,365,699  
,507,336,589,204,723,700,449,860,326,480,644,533,613,161,725,59,192,853,510,564,185,699,368,371,837,642,703,523  
,50,250,136,761,374,388,607,883,626,211,202,873,426,115,414,817,390,736,402,204,202,126,532,155,59,238,791,370,  
475,519,423,402,845,321,419,38,155,374,709,895,522,590,885,795,330,356,382,311,834,550,856,180,637,606,697,184,  
235,304,90,878,285,257,414,33,344,239,867,173,384,813,873,410,532,835,100,217,436,356,151,502,616,762,273,21,58  
2,430,607,151,742,906,718,838,453,688,172,675,888,329,430,309,337,243,621,186,893,126,787,164,138,482,308

The process was repeated for ICC 2:

ICC-2

### Pseudo-Random Number Generator using SHA-256

Input a random seed with at least 20 digits (generated by rolling a 10-sided die, for instance), the number of objects from which you want a sample, and the number of objects you want in the sample.

Pseudo-Random Sample Using SHA-256

Seed:

Number of objects from which to sample:

Current sample number:  Draw this many objects:

Hashed value (for testing):

Randomly selected item:

Items selected:

70, 313, 97, 200, 267, 596, 414, 246, 95, 92, 574, 63, 274, 267, 123, 313, 74, 17, 370, 233, 441, 577, 5  
52, 428, 326, 409, 273, 111, 372, 113, 159, 86, 31, 155, 142, 472, 337, 399, 481, 540, 93, 31, 440, 275  
, 28, 470, 216, 417, 90, 94, 162, 99, 343, 135, 269, 107, 352, 250, 363, 7, 106, 342, 337, 519, 591, 66,  
454, 412, 137, 303, 470, 91, 489, 441, 448, 291, 467, 209, 437, 203, 194, 146, 160, 70, 124, 416, 336,  
3, 176, 210, 33, 216, 122, 516, 323, 460, 248, 394, 494, 592, 206, 210, 600, 267, 356, 186, 607, 455, 4  
70, 75, 249, 271, 253, 54, 380, 466, 431, 47, 384, 588, 370, 463, 263, 461, 352, 386, 419, 536, 428, 59  
5, 368, 408, 579, 183, 491, 189, 136, 508, 137, 452, 232, 279, 362, 356, 284, 414, 603, 24, 233, 110, 2  
76, 232, 71, 505, 285, 148, 36, 282, 261, 269, 524, 100, 98, 509, 454, 578, 585, 144, 337, 367, 572, 19  
6, 401, 191, 81, 209, 457, 140, 56, 446, 176, 211, 459, 100, 265, 11, 161, 240, 482, 509, 354, 170, 60,  
192, 305, 18, 428, 601, 219, 91, 227, 83, 343, 503, 171, 378

The process was repeated for ICC 3:

ICC-3

### Pseudo-Random Number Generator using SHA-256

Input a random seed with at least 20 digits (generated by rolling a 10-sided die, for instance), the number of objects from which you want a sample, and the number of objects you want in the sample.

Pseudo-Random Sample Using SHA-256

Seed: 1,6,3,6,6,2,8,3,8,3,0,4,3,7,5,7,1,7,9,1

Number of objects from which to sample: 433

Current sample number: 145      Draw this many objects: 145     

Hashed value (for testing):  
 aebae77264a16a3cfe1ab6a7e9f1e0db61a18062d10acdbc19a55a1cc0d3daf

Randomly selected item: 432

Items selected:  
 374, 284, 125, 278, 30, 25, 417, 107, 113, 209, 7, 50, 322, 277, 328, 387, 76, 35, 245, 361, 156, 182, 1  
 91, 306, 14, 286, 237, 50, 143, 214, 261, 374, 406, 97, 153, 120, 188, 267, 432, 372, 387, 250, 228, 15  
 , 130, 164, 112, 174, 419, 300, 276, 34, 1, 348, 339, 59, 390, 353, 261, 39, 256, 40, 116, 387, 164, 222  
 , 53, 43, 399, 163, 296, 103, 309, 90, 51, 58, 81, 355, 193, 111, 218, 180, 219, 251, 290, 96, 235, 284,  
 377, 79, 215, 22, 57, 35, 118, 409, 185, 154, 81, 115, 122, 364, 188, 295, 277, 423, 150, 207, 22, 380,  
 25, 50, 419, 224, 94, 366, 155, 333, 359, 57, 202, 425, 53, 103, 232, 113, 175, 34, 234, 324, 15, 161, 3  
 09, 154, 304, 173, 87, 52, 212, 307, 149, 398, 332, 364, 36, 432

The batches were pulled and delivered to counting teams.

### C. Hand-Count Results

**Assembly District 1** – Only the top two candidates in the batches were hand-counted. The ballots were sorted by Candidate A, Candidate B, and other. The results of the hand-count are as follows:

Category	Hand-Count
Candidate 1	147
Candidate 2	53
<b>Total</b>	<b>200</b>

**Proposition 4** – The ballots were sorted by Yes, No, and other. The results of the hand-count are as follows:

Category	Hand-Count
Yes	2,015
No	1,212
<b>Total</b>	<b>3,227</b>

**Machine Count Verification**

After the batches of ballots were hand-counted, the Cast Vote Records for the selected batches of ballots were produced and tallied. The batch totals were transferred to the RLA Worksheet<sup>2</sup> and are as follows:

**Assembly District 1**

Category	Machine-Count Total
Candidate 1	147
Candidate 2	53
<b>Total</b>	<b>200</b>

**Proposition 4**

Category	Machine-Count Total
Yes	2,015
No	1,212
<b>Total</b>	<b>3,227</b>

**Comparison of the Hand-Count to the Machine Count**

The third and final step in the post-election audit was to compare the hand-count to the machine count. The comparison is as follows:

**Assembly District 1**

Category	Hand-Count	Machine-Count Total
Candidate 1	147	147
Candidate 2	53	53
<b>Total</b>	<b>200</b>	<b>200</b>

**Proposition X**

Category	Hand-Count	Machine-Count Total
Yes	2,015	2,015
No	1,212	1,212
<b>Total</b>	<b>3,227</b>	<b>3,227</b>

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<sup>2</sup> See Exhibit A – RLA Worksheet

Risk Limiting Audit

***The result of the post-election audit are that of 3,200 randomly selected ballots, the hand count and machine count of those ballots was identical. The conclusion is that the scanning, adjudication, and tabulation system performed as expected and the results of the election demonstrated the will of the voters.***

Respectfully Submitted:

MOA Elections Team

Jamie Heinz, Election Administrator

Barbara A. Jones, Municipal Clerk



Exhibit A

Scanner & Batch #	Handcount Column A		Handcount Column B N=3200	Machine Batch Level Results		Total Proposition	Handcount Column D		Handcount Column E		Machine Batch Level Results		Total Race
	Yes	No		Prop Yes	Prop No		Candidate 1	Candidate 2	n=176	Candidate 1	Candidate 2		
1-452	29	20		29	20		0	0		0	0		
1-899	34	13		34	13		0	0		0	0		
1-396	31	19		31	19		1	0		1	0		
1-546	22	26		22	26		0	0		0	0		
1-701	21	27		21	27		0	0		0	0		
1-835	1	0		1	0		0	0		0	0		
1-292	13	4		13	4		5	0		5	0		
1-564	13	10		13	10		0	0		0	0		
1-776	0	0		0	0		0	0		0	0		
1-681	20	11		20	11		3	1		3	1		
1-424	41	9		41	9		0	0		0	0		
1-376	35	14		35	14		0	0		0	0		
1-674	33	17		33	17		25	15		25	15		
1-633	27	16		27	16		0	0		0	0		
1-645	18	19		18	19		0	0		0	0		
1-618	30	21		30	21		0	0		0	0		
1-790	0	0		0	0		0	0		0	0		
1-132	34	9		34	9		0	0		0	0		
1-128	28	21		28	21		0	0		0	0		
1-54	3	5		3	5		0	0		0	0		
1-44	18	8		18	8		0	0		0	0		
1-87	18	6		18	6		0	0		0	0		
1-72	16	9		16	9		0	0		0	0		
1-908	30	9		30	9		6	4		6	4		
1-146	19	9		19	9		0	0		0	0		
1-710	11	12		11	12		0	0		0	0		
1-338	39	10		39	10		21	1		21	1		
1-253	29	20		29	20		0	0		0	0		
1-9	19	6		19	6		0	0		0	0		
1-811	0	0		0	0		0	0		0	0		
1-682	28	13		28	13		0	0		0	0		
1-559	25	24		25	24		0	0		0	0		
1-637	26	21		26	21		0	0		0	0		
1-223	28	6		28	6								
1-361	34	16		34	16								
1-85	18	6		18	6								
1-103	23	27		23	27								
2-70	26	17		26	17		1	3		1	3		
2-313	18	20		18	20		0	0		0	0		
2-97	13	12		13	12		0	0		0	0		
2-200	6	1		6	1		6	1		6	1		
2-267	21	20		21	20		0	0		0	0		
2-596	30	20		30	20		0	0		0	0		
2-414	17	14		17	14		0	1		0	1		
2-246	26	15		26	15		0	0		0	0		
2-95	3	0		3	0		0	0		0	0		
2-92	26	9		26	9		0	0		0	0		
2-574	29	25		29	25		0	0		0	0		
2-63	21	19		21	19		0	0		0	0		
2-274	36	16		36	16		5	1		5	1		
2-123	15	8		15	8		7	1		7	1		
2-74	20	5		20	5		11	1		11	1		

Exhibit A

Scanner & Batch #	Handcount Column A		Handcount Column B N=3200	Machine Batch Level Results		Total Proposition	Handcount Column D			Handcount Column E			Machine Batch Level Results Candidate 1	Machine Batch Level Results Candidate 2	Total Race
	Yes	No		Prop Yes	Prop No		Candidate 1	Candidate 2	n=176	Candidate 1	Candidate 2				
2-17	13	12		13	12		0	0		0	0		0	0	
2-370	16	22		16	22		0	0		0	0		0	0	
2-233	28	11		28	11		0	0		0	0		0	0	
2-441	16	8		16	8		0	0		0	0		0	0	
2-577	23	27		23	27		0	0		0	0		0	0	
2-428	13	10		13	10		0	0		0	0		0	0	
2-326	26	13		26	13		5	0		5	0		5	0	
2-409	18	19		18	19		0	0		0	0		0	0	
2-273	27	11		27	11		2	3		2	3		2	3	
2-111	11	7		11	7		0	0		0	0		0	0	
2-372	39	11		39	11		16	7		16	7		16	7	
2-113	14	10		14	10										
2-159	14	6		14	6										
2-86	35	10		35	10										
3-374	29	17		29	17		0	0		0	0		0	0	
3-284	12	7		12	7		0	2		0	2		0	2	
3-125	18	14		18	14		0	0		0	0		0	0	
3-278	22	12		22	12		0	0		0	0		0	0	
3-30	20	5		20	5		0	0		0	0		0	0	
3-25	17	8		17	8		0	0		0	0		0	0	
3-417	23	25		23	25		0	0		0	0		0	0	
3-107	16	8		16	8		15	4		15	4		15	4	
3-113	21	11		21	11		0	0		0	0		0	0	
3-209	13	12		13	12		0	0		0	0		0	0	
3-7	17	8		17	8		0	0		0	0		0	0	
3-50	0	2		0	2		0	0		0	0		0	0	
3-322	21	29		21	29		0	0		0	0		0	0	
3-277	22	16		22	16		0	0		0	0		0	0	
3-328	39	11		39	11		0	0		0	0		0	0	
3-387	45	9		45	9		2	1		2	1		2	1	
3-76	16	2		16	2		1	2		1	2		1	2	
3-35	17	12		17	12		0	0		0	0		0	0	
3-245	26	25		26	25		0	1		0	1		0	1	
3-361	14	9		14	9		0	0		0	0		0	0	
3-156	10	13		10	13		0	0		0	0		0	0	
3-182	13	11		13	11		0	0		0	0		0	0	
3-191	16	8		16	8		0	0		0	0		0	0	
3-306	24	25		24	25		0	0		0	0		0	0	
3-14	18	5		18	5		0	0		0	0		0	0	
3-286	27	22		27	22		0	0		0	0		0	0	
3-237	18	5		18	5		11	4		11	4		11	4	
3-143	6	4		6	4		4	0		4	0		4	0	
3-214	16	9		16	9		0	0		0	0		0	0	
3-261	14	10		14	10										
3-406	31	17		31	17										
	2015	1212	3227	2015	1212	3227	147	53	200	147	53	200			