Lever Replacement Costs:
New York City Case Study

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Findings

- Ineligible costs: Not all costs are eligible for HAVA funds. City taxpayers will pay all ineligible costs starting in year 1.
- HAVA funds depletion: City taxpayers will pay all annual costs starting approximately year 4.
- Unavailable information: Our cost estimates are low because they are based only on public documents, and not all information is available to the public (see Sec. 1.b).
- Mayor Bloomberg's estimate of costs above HAVA funds shows how low our estimates are: "Sensing that [HAVA funds for replacement of levers] may be insufficient, the Mayor's Office of Management and Budget (OMB) has budgeted an additional $50 million in City tax-levy funds for the purchase of new voting machines. … The City's Capital Budget also includes an additional sum of $47.2 million for other purposes, including the outfitting of office and warehouse space."[1]

NYC's HAVA Funds vs. Costs

Year 1, equipment and software license	Low	High
HAVA funds for equipment to replace levers, Title I, §102 (Sec. 10.a.)	$21,230,319	$21,230,319
Year 1 costs for equipment & software license (Sec. 9.a)	$21,877,963	$27,800,370
Year 1 deficit for equipment & software license	**($647,644)**	**($6,570,051)**
Years 1-5, 'other' costs		
HAVA funds for 'other' (includes training, storage, voter registration database, tech support, ballot printing, audits) Title I, §101 and Title II, §251 (Sec. 10.a)	$44,188,427	$44,188,427
Year 1 (Sec. 9.a)	$5,078,161	$16,138,136
Years 2-5, each year (Sec. 9.c)	$5,286,361	$16,250,576
Years 1-5, total for the five years	$26,223,605	$81,140,440
Year 6 and after		
HAVA funds remaining for 'other'	$17,964,822	**($36,952,013)**
Year 6 and each year thereafter (same as years 2-5 plus maintenance)	$5,963,369	$16,887,744

[1] Hearing on the Fiscal 2010 Executive Budget for the Board of Elections. The Council of the City of New York Finance Division. 5/18/09. Page 3. www.wheresthepaper.org/ExecutiveBudget2010_NYCBOE_May18_09.pdf

[5/6/09] Please contact the authors with feedback or additional information that could make this document more comprehensive. Email to ellen@votersunite.org. Significant updates will be assigned a new major version number, and details will be recorded on this page. Minor additions or corrections will be assigned a new minor version number and will be noted in footnotes

[5/29/09] Cover page was updated to more accurately represent the HAVA funds available and costs of lever replacement.

[7/20/09] Cover page was updated for clarity.

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http://www.votersunite.org/info/LeverToOpScanCost_NYC.pdf

Lever-Replacement Costs:
New York City Case Study

1. Executive Summary

The costs of replacing lever voting machines with electronic machines will be enormous. The immediate costs – hardware, software, licenses – will rapidly deplete the City's HAVA funds.

The associated costs, which continue from year to year – training, printing paper ballots, pre-election testing, auditing elections, storage, inventory management, new personnel, and new procedures – have not yet been fully identified. Many, perhaps most, of them are not eligible for HAVA funds.

Even excepting the unknown costs, it is clear that the cost of lever replacement will be a heavy burden borne by City taxpayers, not only in the first year, but also in each subsequent year.

1.a Findings.
New York City is currently using a voting system that includes:

- ES&S AutoMark ballot marking devices in poll sites for people with disabilities.
- Lever voting machines in poll sites for other voters.
- Sequoia central count optical scanners for absentee ballots.

Current New York State law requires the replacement of lever voting machines.

New York City is planning to switch to a system of voter-marked paper ballots and precinct-based optical scanners, and is considering the purchase of DS200 scanners from Election Systems & Software (ES&S) to replace the lever machines.

Findings	------------------Estimates------------------		
	Low	Median	High
New York City's HAVA funds remaining.	$65,418,746	$65,418,746	$65,418,746
First year costs of lever replacement – *excluding many significant costs for which we do not have figures.*	$26,956,124	$35,447,315	$43,938,506
Annual, continuing costs after the first year – *excluding many significant costs for which we do not have figures.*	$5,286,361	$10,768,468	$16,250,576
Annual maintenance after the warranty expires.	$677,008	$713,308	$749,608

- Not all costs are eligible for HAVA funds. City taxpayers would pay for all ineligible costs starting from the first year.

- Assuming median costs, and excluding costs for which we do not have figures, *by the fourth year,* HAVA funds would be depleted and City taxpayers would bear all costs.

1.b Limitations.
Many significant costs associated with replacing lever machines are as yet unknown to the public, including:

    Voter education
    Storage for new electronic equipment and accessories between elections
    Electricity for charging batteries before each election
    Securing ballots on election day
    Storage for ballots after elections
    Inventory control and tracking for equipment and accessories
    Replacement of consumable accessories
    Security for equipment while out of the warehouse for election use
    Compensation for additional staff and consultants
    Manually counting 3% of ballots cast in special elections

Replacement may also include increased costs for:

    Poll worker training, and training facilities
    Transporting equipment to training facilities
    Transporting equipment for election use

For some costs, only a range can be estimated until decisions are made in the future or information is received, for example:

    The number of ballots to be printed for general, primary, and special elections.
    The number of annual licenses needed for ES&S election management software.
    The type of privacy booths to be purchased.

Other costs are unpredictable or dependent on unpredictable events, such as the number of special elections that will be held and the number of voters who will vote in them.

1.c Methodology.
No governmental agency or official has published a comprehensive study of the cost of replacing lever machines, nor the cost of using the optical scanner system in future years.

This document has been prepared in order to:

- Inform officials and the public about the financial impact to New York City of replacing lever machines with DS200 scanners.

- Highlight expenses that are unknown to the public at present.

The authors attempted to obtain accurate information from official documents and New York City officials. For example, the ES&S prices we quoted are based on "ES&S Response to New York State Office of General Services Pricing Forms." All documents we used to prepare this report are listed in Appendix A, "Reference Documents."

We tried to cover all areas that may involve cost to the public now and in the future. We are grateful to the Board of Elections in the City of New York for posting detailed information on their website, and by so doing, encouraging people to inform themselves. Without that data, especially RFI responses submitted to them by vendors, this document would have been impossible for private citizens to prepare. However, this document is still not comprehensive due to the many types information we were unable to obtain, listed in Section 1.b.

2. Hardware Purchases

To replace its lever machines with the new DS200 systems, the City would need to purchase scanners, accessories, voting booths, and a computer system on which the Board of Elections would run its central election management software. Most of these costs would be covered by HAVA funds, but after the first year, continuing costs of replacing consumable accessories would likely be borne by the City.

Summary of Initial Equipment Costs to New York City

	Range for 2,227 scanners and 19,829 booths	
	Low	**High**
DS200 Scanners	$17,245,888	$17,245,888
Privacy booths	$490,768	$6,246,135
First year accessories	$2,118,001	$2,118,001
BOE computers and peripherals *	$365,650	$365,650
Total	**$20,242,363**	**$25,997,730**

* Assumes the costs are comparable to Sequoia's costs for comparable components.

2.a DS200 Scanners.

New York City must purchase approximately 2,227 scanners.[2] Calculation details are shown in Appendix F and summarized here:

- 1,794 scanners for poll site use (one for each 4000 active registered voters per poll site[3])
- 358 scanners to provide 20% additional units for spares
- 75 scanners to provide machines for training

Using the ES&S price quote of $7,744[4] per DS200 scanner, the cost for 2,227 scanners will be $17,245,888. The following table shows the number of scanners needed per county, as well as units needed for spares and training.

	# of Scanners	**Cost per Scanner**	**Total Cost**
Bronx	277	$7,744	$2,145,088
Kings	527	$7,744	$4,081,088
New York	451	$7,744	$3,492,544
Queens	424	$7,744	$3,283,456
Richmond	115	$7,744	$890,560
Spare units	358	$7,744	$2,772,352
Training units	75	$7,744	$580,800
NYC Total	**2,227**		**$17,245,888**

As required by law[5], the purchase price will include the DS200 and five years of hardware and software maintenance.

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[2] Appendix F shows how the number of scanners per county was calculated. Quantities for spares and training are based on the AutoMark purchases. "Plan B BMD Implementation 2008 Cost Analysis Results V-1.0."

[3] Specified by New York State Regulation 6210.19.

[4] ES&S prices quoted in this document are from "ES&S Response to New York State Office of General Services Pricing Forms," listed in Appendix A, "Reference Documents."

[5] "State of New York 2008 Election Law," Section 7-204, page 235. [Note: this paragraph was corrected in Version1.1.]

2.b Privacy booths.

Section 6210.19 of New York State regulations[6] specifies the minimum number of privacy booths required per poll site for a presidential or gubernatorial election. It is based on the number of active registered voters at each site:

> Poll sites with 6000 or fewer voters: one booth per 250 voters
> Poll sites with more than 6000 voters: one booth per 350 voters.

The number of privacy booths required is 16,524, plus 20% more for spares.[7]

Bronx	2,546
Kings	4,956
New York	3,963
Queens	4,031
Richmond	1,028
Subtotal	16,524
+ 20% spares	3,305
Total	**19,829**

The cost of one non-accessible voting booth from ES&S ranges from $24.75 to $315.00, and the following table shows a sampling of them. The total cost of these booths ranges from $490,767.75 to $6,246,135.00.

Voting Booth in ES&S Price List	Cost Each	Cost for 19,829
Cardboard Kora-Booth with no Light	$24.75	$490,767.75
Tote-A-Vote Portable Voting Booth	$92.35	$1,831,208.15
Pollstar Voting Booth with Lamp	$138.60	$2,748,299.40
Pollstar Standard Voting Booth without Lamp	$145.00	$2,875,205.00
Model VI Voting Booth without Lamp	$220.50	$4,372,294.50
Pollmaster I Voting Booth with Light & Shelf	$250.00	$4,957,250.00
Model VI Voting Booth with Lamp	$257.25	$5,101,010.25
Model VII Gemini Dual Voting Booth with Lamp	$278.25	$5,517,419.25
1 stall voting booth	$315.00	$6,246,135.00

2.c ES&S consumable accessories for the first year.

The ES&S price list for New York suggests that the city may also need the following consumable accessories for each scanner.

It is unknown whether any of these accessories will be included in the price of the scanners. If they are not included, the table shows the cost for the first year with estimated quantities based on the best information available.

Accessories needed for Scanners		--Per Scanner--		---For 2,227 Scanners----	
Accessory	Cost Each	#	Cost	#	Cost
UPS[8]	$215.00	1	$215.00	2,227	$478,805.00
Cancellation Stamp	$15.65	1	$15.65	2,227	$34,852.55

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[6] "6210 Regulations," page 45.

[7] Appendix F shows how the number of booths per county was calculated.

[8] Uninterruptible power supply.

Accessories needed for Scanners		--Per Scanner--		---For 2,227 Scanners----	
Accessory	Cost Each	#	Cost	#	Cost
Mother Board Battery	$4.95	1	$4.95	2,227	$11,023.65
Key	$7.98	3	$23.94	6,681	$53,314.38
Lithium ion battery	$98.95	2	$197.90	4,454	$440,723.30
Thermal Paper Roll	$1.95	3	$5.85	6,681	$13,027.95
8-gigabyte Jump Drive	$214.50	2	$429.00	4,454	$955,383.00
Accessories for Scanners			**$892.29**		**$1,987,129.83**

Secrecy Sleeves needed[9]	Cost Each	---Per Booth---		----For 19,829 Booths----	
"T" Secrecy Sleeve	$3.30	2	$6.60	39,658	$130,871.40

Citywide Total for Consumable Accessories	
Accessories for Scanners	**$1,987,129.83**
Secrecy Sleeves	**$130,871.40**
Total Accessories needed	**$2,118,001.23**

2.d Dedicated Election Management Computers and Peripherals.

The ES&S price list indicates that servers, server backups, printers, cables, and laptop computers are needed for the central office. ES&S does not indicate the price per component, nor how many of each component the city would need.

Since ES&S would sell the items to the city at "Cost + 20%", the city may do well to purchase the items elsewhere *if ES&S agrees to provide the same service regardless of whether the items are purchased from them or other vendors.*

The cost of each item and the needed quantity of each item remain unknown. However, assuming the items needed and the prices are comparable to Sequoia's election management system, we can provide an approximation of the cost.

For approximation: the cost of Sequoia's "EMS Datacenter Standard." Sequoia includes election management computers and peripherals in its price list. Sequoia says that the "EMS Datacenter Standard" is suitable for more than 100 Election Districts. This suggests that New York City would need to purchase components comparable to the EMS Datacenter Standard for each of the five counties.[10]

The following table shows the cost for one Sequoia EMS Datacenter Standard for all five New York City counties.

Sequoia EMS Datacenter Standard Components	Cost Each	#	Cost All
EMS Application Server Hardware	$5,800	5	$29,000
EMS Database Server Hardware	$5,800	5	$29,000
EMS Network Attached Storage Server Hardware	$5,800	5	$29,000
Cisco Catalyst Gigabit Switch Hardware (48 ports)	$6,500	4	$26,000
Cisco Catalyst Gigabit Switch Hardware (24 ports) *	$3,250	1	$3,250
APC UPS Backup Devices (2 per EMS Datacenter)	$975	10	$9,750

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[9] Assumes two secrecy sleeves per privacy booth: one for the voter going into the booth, one for the voter taking the ballot to the scanner. See Section 2.b for calculations estimating the number of booths needed.

[10] This list of components is consistent with the "Network Topology" defined for small to medium jurisdictions in Sequoia's response to New York City's request for information, page 45.

Sequoia EMS Datacenter Standard Components	Cost Each	#	Cost All
Datacenter 25U Rack Hardware	$1,560	5	$7,800
Network and power cables	$650	5	$3,250
HP Laser Printer	$650	5	$3,250
Windows Server 2003 R2 Standard	$1,950	5	$9,750
Windows Server 2003 R2 Enterprise	$5,200	10	$52,000
SQL Server 2005 Enterprise	$32,500	4	$130,000
SQL Server 2005 Enterprise *	$15,600	1	$15,600
EMS EED Workstation Hardware with 20" LCD Screen	$1,500	5	$7,500
Windows XP Professional SP2	$300	5	$1,500
EMS RTR Workstation Hardware with 20" LCD Screen	$1,500	5	$7,500
Windows XP Professional SP2	$300	5	$1,500
Total for five EMS Datacenters Standard			**$365,650**

* Prices for these two components would be lower for Richmond County because it is a smaller jurisdiction, with fewer than 500 Election Districts.

3. Software Licenses

The Unity Election Management System (EMS) is required to program the scanners for election-specific ballots, upload results from the scanners via memory cards, tally results, "adjudicate" ballot images,[11] and print reports. This software would run on the BOE servers (see 2.d above).

ES&S does not sell Unity EMS software; rather ES&S licenses it for an annual fee. This annual cost would continue for as long as New York City used the EMS. (The annual license fee for Unity is in addition to the annual license fee for the AutoMark IMS, which serves a similar purpose for programming ballots for the AutoMark ballot marking devices. Firmware license fees for the scanners are included in the cost of the scanners and are not ongoing.)

3.a First year software license fee.
The ES&S price list for New York State[12] determines the license fee according to:

1. the number of licensed users,
2. whether the users are individual named users or concurrent users.
3. the number of active registered voters

ES&S recommends installing the Unity EMS on computer systems at six locations in New York City: the central administrative Board of Elections and at each of the five county Boards of Elections.[13] Since the number of active registered voters in each county is greater than 100,000, the cost range of the Unity EMS license fee would be as follows:

Type of Unity license	Cost for one license	Cost for 6 licenses
5 individual/named users	$272,600	$1,635,600
10 concurrent users	$286,520	$1,719,120
20 concurrent users	$300,440	$1,802,640

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[11] Adjudication is the process of duplicating a ballot image electronically so that it will be accurately counted by the software, without altering the original image of the ballot. For example, if stray marks on a ballot are likely to cause the ballot to be counted incorrectly, the stray marks can be removed.

[12] See Appendix B for a sampling of software license fees charged by ES&S in other states.

[13] "5.0 Requirements & Requirements Response from ES&S." Page 33.

3.b Future software license fee increases.
In other jurisdictions ES&S software license fees have increased from one year to the next. For example, in Charlotte County, Florida, the fee increased 5% from 2008 to 2009.[14] Therefore, although the ES&S price list for New York State gives the current license fee schedule for the state, it is unclear what the fee will be in future years.

4. Training for Election Workers, Voting Machine Technicians, and Voters

Poll worker training classes for the DS200 would be longer than comparable classes for the lever machines, and would likely require higher pay for trainees. New training facilities may be needed, and scanners would need to be transported to and from the facilities during the training season.

ES&S support would be needed to train:

- Trainers for the poll workers
- Board of Election personnel to use the Unity election management software
- Voting machine technicians to maintain and repair the equipment.

Voters would need to be educated on how to use the new system.

4.a Poll worker training for the first year.
A typical New York City election requires 30,000 to 36,000 poll workers.[15]

In its Request for Information ("RFI"), the Board of Elections in the City of New York suggests that the Board plans to have ES&S conduct DS200 training for 40,000 poll workers for the Primary and General elections in the first year.[16] Poll worker training is not included in the price of the hardware or software and will be an ongoing cost.

ES&S costs for poll worker training. ES&S limits the class size to 20 participants and holds each class for one-half day. ES&S charges $1,800 per training day.

Thus, the cost for ES&S to train 40 poll workers, by conducting two classes on one day for 20 poll workers each, would be $1,800. At this rate, for each 1,000 poll workers, ES&S training requires 25 training days at a cost of $45,000. These estimates assume that all classes are full and no vacancies occur that would result in fewer than 20 poll workers being trained per half-day class.

Poll Workers to Train	Training Days Required	ES&S Cost
5,000	125	$225,000
10,000	250	$450,000
15,000	375	$675,000
20,000	500	$900,000
25,000	625	$1,125,000
30,000	750	$1,350,000
35,000	875	$1,575,000
40,000	1000	$1,800,000

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[14] Emails from Blanche House, the Charlotte County Assistant Supervisor of Elections, state that ES&S charged a license fee of $13,891.50 for 2008 and increased the fee by 5% to $14,586.08 for 2009.

[15] "New York City Board of Elections Request For Information III." App B

[16] "5.0 Requirements & Requirements Response from ES&S."

Two factors would reduce the costs of poll worker training. First, the city might conduct its own poll worker training, thus reducing the cost of training the poll workers on the new equipment. Second, New York City now conducts poll worker training on the lever machines. The cost of this training is unknown, but if this training is no longer needed the savings would somewhat offset the cost of training on the new equipment.

4.b ES&S "train the trainer" courses.

If the city conducts its own poll worker training, trainers would have to be prepared. ES&S offers a 3-day course to become a certified poll worker trainer. The course consists of a 2-day "train the trainer" class, one half-day AutoMark operation class, and one half-day DS200 operation class.

For each 20 trainers, the course recommended by ES&S will require 3 days of ES&S time at a cost of $1,800 per day, for a total of $5,400.

Trainers to Prepare	Days Required	ES&S Cost
20	3	$5,400
40	6	$10,800
60	9	$16,200

4.c Poll worker pay for training days.

Poll workers must be trained on the DS200 as well as the AutoMark ballot marking device. ES&S recommends one half-day of training for each type of equipment – more than twice as long as the current 3-hour training session.[17] Anticipating extended training time, the Board of Elections has requested that poll worker pay for training be increased from $25 to $100.[18]

The following table shows the cost of current poll worker pay for training, and the *increase* in cost if pay is raised to $50, $75, or $100 per poll worker.

Poll Workers	Current Pay $25	Increased Cost if Pay is Raised to......		
		$50	$75	$100
5,000	$125,000	$125,000	$250,000	$375,000
10,000	$250,000	$250,000	$500,000	$750,000
15,000	$375,000	$375,000	$750,000	$1,125,000
20,000	$500,000	$500,000	$1,000,000	$1,500,000
25,000	$625,000	$625,000	$1,250,000	$1,875,000
30,000	$750,000	$750,000	$1,500,000	$2,250,000
35,000	$875,000	$875,000	$1,750,000	$2,625,000
40,000	$1,000,000	$1,000,000	$2,000,000	$3,000,000

4.d Additional poll worker training facilities.

Currently, the city has 61 facilities used for training 30,000 to 35,000 poll workers over a period of six weeks, with a class size of 62, which increases as the election approaches.[19] It is likely that additional facilities would be needed.

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[17] "New York City Board of Elections Request For Information III." App B

[18] "Testimony of Marcus Cederqvist before the New York City Council." March 12, 2009. Page 5.

[19] "New York City Board of Elections Request For Information III." App B

A full day of training would be required to train poll workers on both the DS200 and the AutoMark. The current facilities would not be sufficient for providing one full day of training for 40,000 poll workers, with class sizes limited to 20, unless:

- All 61 facilities are available 5 days per week during the 6-week training season, and
- At least some of the facilities are available 6 days per week, and
- At least 61 trainers are available during the entire training season, and
- Each class is full so that more classes aren't needed as the election approaches.

4.e Transporting equipment to training facilities.
ES&S estimates a need for two or three DS200 scanners at each poll worker training session. However, if the city buys only 75 scanners for training, each training site could have only one.

The increase in the cost of transporting voting equipment to training facilities cannot be estimated, because the following are unknown:

- How many training sessions will be held concurrently.
- How many different facilities will be used.
- How much it would cost to transport the scanners to each facility.
- How much it currently costs to provide lever machines at the training facilities.

4.f Training for the BOE staff and Voting Machine Technicians
ES&S charges $1,800 per day for training election management system users, technical staff, other BOE staff, and voting machine technicians.

Initial training classes would teach BOE personnel and voting machine technicians to perform preventative maintenance. Class size is limited to 20 students. Other information about the training classes is unknown. In its response to the NYC Request for Information, ES&S said it would conduct training classes,[20] but it did not provide information about the number of days per class, so the cost of training is unknown.

Future training to allow the City to become vendor independent would require technicians to attend and pass a technician certification program. Hardware training classes are limited to 20 participants. Software training classes are limited to 10 participants. ES&S says that "Typically it takes 2-3 weeks to become fully certified on the hardware and 6-8 weeks to become certified on the software."[21]

If no more than 20 certified hardware technicians and no more than 10 software technicians would be needed, classes would cost from $72,000 to $99,000.

Certification Program	Min Days	Max Days	Cost per Day	Low Cost	High Cost
20 Hardware Technicians	10	15	$1,800	$18,000	$27,000
10 Software Technicians	30	40	$1,800	$54,000	$72,000
Both Programs				**$72,000**	**$99,000**

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[20] "5.0 Requirements & Requirements Response from ES&S." Page 47

[21] "5.0 Requirements & Requirements Response from ES&S." Page 89

4.g. Voter education.

New York City has a $6.5 million contract with Burson-Marsteller to provide voter outreach and education.[22] The amount spent on AutoMark education and the amount remaining for DS200 education are unknown.

5. Per Election Costs

It is unlikely that HAVA funds can be used for the costs of holding elections. Per election costs using scanners would be somewhat offset by not using levers, but such savings would fall far short of compensating for both new and higher costs, which include:

- Ballot layout and programming
- Printing paper ballots
- Pre-election testing
- Mandatory 3% manual audit
- Transporting and securing equipment and ballots
- Replacing consumed accessories

5.a Ballot layout.

Ballot layout means setting up the ballots for printing. Contest names, candidate names, party names, other text, and graphic elements are entered and positioned as they will appear on the printed ballot. Ballot layout for the DS200 may have to be done separately from ballot layout for the AutoMark ballot marking device and separately from ballot layout for New York City's Sequoia central scanners.

It is expected that the Board will do its own ballot layout. This may require additional staff time and/or consultants before each election.

However, if ES&S ballot layout services are needed, the prices are based on the number of ballot faces (also called ballot styles) *per language*. English and Spanish are billed as one language, and each additional language is extra. In addition to English and Spanish, some New York City ballots contain Chinese, some contain Korean, and some contain both.

According to the Board of Elections,[23] a typical New York City general election involves 934 different ballot faces. We estimated approximately 280 extra language fees for Chinese and 61 for Korean.[24] The following table shows the cost for ES&S to do ballot layout for 934 ballot faces with extra fees for these languages. Note that the ballot layout cost is less when ES&S also does the ballot programming (see Section 5.b.)

Language	Ballot Faces / Lang. Fees	w/ Ballot Programming Cost Each	Cost Total	Ballot Layout Only Cost Each	Cost Total
English, Spanish	934	$25	$23,350	$45	$42,030
Chinese	280	$50	$14,000	$90	$25,200
Korean	61	$50	$3,050	$90	$5490
Approximate ES&S Layout Cost / Election			**$40,400**		**$72,720**

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[22] "New York elections board selects Burson for voter education campaign." PRWeek. July 29, 2008. by Frank Washkuch. http://www.prweekus.com/New-York-elections-board-selects-Burson-for-voter-education-campaign/article/113011/ Archived at: http://www.votersunite.org/article.asp?id=8383

[23] Details for a typical NYC election are from "New York City Board of Elections Request For Information III." App B

[24] Appendix E shows how we estimated the extra language fees.

Currently, the city lays out the ballot strips for the front of the lever machines. If these strips were no longer needed, the savings would somewhat offset the cost of ballot layout for the scanners.

5.b Ballot programming.

Ballot programming means creating the election-specific ballot definition files that determine which marks on a ballot are credited to which candidates in the electronic vote database. Different software programs are used for programming ballots for the DS200, the AutoMark ballot marking device, and New York City's Sequoia central scanners, so ballot programming will have to be done separately for each of the three types of machines.

It is expected that the city will do its own ballot programming. This is likely to require additional staff time and/or consultants before each election.

However, if ES&S ballot programming services are needed, the prices are calculated per election district, per ballot face, per contest, and per candidate. New York City has 6,111 election districts.[25] According to the Board of Elections, in a typical New York City general election,[26] there may be as many as 934 different ballot faces, 2,000 contests, and 17,000 candidates. The following table shows the cost for ES&S to do the ballot programming for these numbers.

Item in ES&S Price List	Quantity	Cost Each	Cost Total
Base charge for DS200			$437.50
Base charge for Unity setup			$437.50
Election district	6,111	$6.00	$36,666.00
Ballot face	934	$13.00	$12,142.00
Contest	2,000	$15.00	$30,000.00
Candidate	17,000	$6.00	$102,000.00
ES&S Ballot Programming Costs / Election			**$181,683.00**

Currently the city performs the mechanical programming for the lever machines. If this mechanical programming were no longer needed, the saving would somewhat offset the cost of software ballot programming for the scanners.

5.c Printing paper ballots.

ES&S has quoted a base charge not to exceed $1.00 per ballot for printing ballots through an ES&S partner printer. Additional services including stub and/or numbering, folding, scoring, packaging, color, other designs, and shipping would cost as much as $0.16 more per ballot. Additional but unspecified costs would apply to special requests such as watermarking or unique packaging requirements.

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[25] "New York City Board of Elections Request For Information III." App B

[26] Details for a typical NYC election are from "New York City Board of Elections Request For Information III." App B

Costs for general election and citywide primary election. Given voters' unfamiliarity with using paper ballots, voters may spoil some ballots. New York law allows each voter to receive a maximum of three ballots—one blank ballot upon signing in, and up to two blank replacement ballots for spoiled ballots.[27] For a general election it may be necessary to print more ballots than active registered voters, as many as 110% or higher. Fewer ballots are likely to be needed for citywide primary elections.

The following table shows the printing costs for different per-ballot prices and for different percentages of active registered voters for which ballots are printed. As of April 1, 2009, New York City had 4,219,471 active registered voters.[28]

% of Voters	# of Ballots	ES&S Price per Ballot			
		$0.75	$0.90	$1.00	$1.16
50%	2,109,736	$1,371,328	$1,687,789	$1,898,762	$2,236,320
70%	2,953,630	$2,004,249	$2,447,293	$2,742,656	$3,215,237
90%	3,797,524	$2,637,169	$3,206,798	$3,586,550	$4,194,154
110%	4,641,419	$3,270,091	$3,966,304	$4,430,445	$5,173,072
130%	5,485,313	$3,903,011	$4,725,808	$5,274,339	$6,151,990
150%	6,329,207	$4,535,932	$5,485,313	$6,118,233	$7,130,907

New York City provides emergency ballots to each Election District for use by voters in case of lever machine malfunction. These ballots cost $0.47 to $0.50 each.[29] If the lever machines were replaced with DS200 scanners, these emergency ballots would no longer be needed. Assuming that 300 emergency ballots are prepared for each of 6,111 Election Districts in a general election, eliminating the need for these ballots would save $916,650. This would partially offset the cost of printing DS200 ballots. Assuming only 100 emergency ballots are printed for each Election District in a primary election, the savings would be $305,550.

Costs for special elections. In New York City, 25 special elections were held (or planned) in the years 2001 through 2009, for an average of two or three per year.

The following tables show the cost of printing ballots for each of three types of special election. Appendix C shows the calculations for the average number of voters for each type of district.

State Senate District (with 160,000 active registered voters)

% of Voters	# of Ballots	Ballot Costs for Each ES&S Ballot Price			
		$0.75	$0.90	$1.00	$1.16
10%	16,000	$12,000	$14,400	$16,000	$18,560
20%	32,000	$24,000	$28,800	$32,000	$37,120
30%	48,000	$36,000	$43,200	$48,000	$55,680

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[27] "State of New York 2008 Election Law." Section 8-312.1, page 261

[28] "NYS Voter Enrollment by County, Party Affiliation and Status."

[29] Emergency ballot prices received from the Board of Elections in the City of New York by telephone, April 21, 2009.

City Council District (with 81,000 active registered voters)

% of Voters	# of Ballots	----------Ballot Costs for Each ES&S Ballot Price----------			
		$0.75	$0.90	$1.00	$1.16
10%	8,100	$6,075	$7,290	$8,100	$9,396
20%	16,200	$12,150	$14,580	$16,200	$18,792
30%	24,300	$18,225	$21,870	$24,300	$28,188

Assembly District (with 65,000 active registered voters)

% of Voters	# of Ballots	----------Ballot Costs for Each ES&S Ballot Price----------			
		$0.75	$0.90	$1.00	$1.16
10%	6,500	$4,875	$5,850	$6,500	$7,540
20%	13,000	$9,750	$11,700	$13,000	$15,080
30%	19,500	$14,625	$17,550	$19,500	$22,620

The cost for printing ballots for special elections, as shown above, would be somewhat offset by the savings of not printing emergency ballots for each Election District.

Assuming three special elections per year, the following table estimates the range in annual cost for printing special election ballots.

Special Election Type	Low	High
State Senate District	$12,000	$55,680
City Council District	$6,075	$28,188
Assembly District	$4,875	$22,620
Total for Three Elections	**$22,950**	**$106,488**

5.d Pre-election testing.

Section 6210.8 of New York State Regulations[30] requires a "pre-qualification test" to be conducted on each voting system prior to its use in an election. For each ballot face, a set of ballots, called a "test deck" is marked with a predetermined set of votes. The test deck is fed into each scanner, and the scanner's results are compared to the expected results to ensure that the scanner counts all voting positions correctly. Any discrepancies require the error or errors to be corrected and the scanner to be retested.

Guidelines for creating a test deck of ballots,[31] prepared by a certified software quality engineer, describe how to create the minimum number of ballots that provide thorough testing for an optical scanner. The number of ballots in the test deck varies according to the number of contests and number of candidates on the ballot. For example, the sample ballot described in the guidelines has 12 contests and 40 candidates; testing requires 155 ballots.

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[30] "6210 Regulations," page 17

[31] "Guidelines for Creating a Deck of Test Ballots." By John Washburn
http://www.washburnresearch.org/archive/TestingGuidelines/GuidelinesForCreatingTestBallots.pdf

A typical New York City general election involves 934 different ballot faces, and some elections involve as many as 6,111 faces.[32] The following table shows the cost of printing blank ballots at a cost of $1.00 per ballot for the test decks needed for both numbers of faces (assuming all ballots had the same number of contests and candidates). A special election has only one ballot face and few candidates, so few test ballots would be needed.

# of Ballots in Test Deck	Cost for 934 ballot faces	Cost for 6,111 ballot faces
50	$46,700	$305,550
100	$93,400	$611,100
150	$140,100	$916,650
200	$186,800	$1,222,200

See section 6.e for more information about the testing process and time required for testing the machines.

5.e Mandatory 3% manual audit.

Section 9-211 of state law requires 3% of machines to be randomly selected after each election, and the votes cast on those machines to be hand counted.[33]

Average cost of counting a vote-for-one contest on large numbers of ballots. The cost of hand counting varies significantly, so we have calculated an average cost per vote based on the **approximate** costs obtained from six sources. The table that follows shows the source, approximate number of ballots counted, number of vote-for-one races counted, and cost per vote.

Source	Ballots	Contests	Cost per Vote
WA 2004 gubernatorial recount[34]	2,466,454	1	$0.37
MN 2008 general election audit[35]	100,000	5	$0.09
CT 2008 general election audit[36]	116,469	5	$0.11
CT 2007 general election audit[37]	105,580	3	$0.10
AZ 2006 RTA initiative recount[38]	120,821	2	$0.05
NH averages from many manual counts[39]			$0.07
Average			**$0.13**

General and Citywide Primary Elections. In the table below, we have simplified the determination of how many ballots would have to be hand counted by using 3% of the number of ballots cast.

New York City had 4,219,471 active registered voters as of April 2009. Using that number, the following table shows five different turnout percentages, the number of ballots to hand count for each turnout (calculated by taking 3% of turnout), and the cost of hand-counting at $0.13 per vote-for-one contest for five different numbers of contests per ballot.

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[32] Details for a typical NYC election are from "New York City Board of Elections Request For Information III." App B

[33] "State of New York 2008 Election Law." Page 306

[34] http://www.votersunite.org/info/2004GovManualRecount.pdf

[35] Citizens for Election Integrity MN report at http://www.ceimn.org/files/ceimn.report.5.26.pdf.

[36] http://www.ctvoterscount.org/CTVCdata/09/04/CostStatsNov08.pdf [correction 5/6/09; from 3 at 19¢ each to 5 at 11¢ each]

[37] http://www.ctvoterscount.org/CTVCdata/09/04/CostStatsNov08.pdf

[38] Attorney General's press conference at http://blip.tv/file/2022123. Time: 8:20 for ballots counted; 13:30 for total cost.

[39] Information received by the authors in an email from Thomas Manning, Assistant Secretary of State, New Hampshire.

Turnout	30%	40%	50%	60%	80%
3% Ballots to Hand Count	37,975	50,634	63,292	75,950	101,267
1 Contest	$4,937	$6,582	$8,228	$9,874	$13,165
5 Contests	$24,684	$32,912	$41,140	$49,368	$65,824
10 Contests	$49,368	$65,824	$82,280	$98,736	$131,647
15 Contests	$74,052	$98,736	$123,420	$148,103	$197,471
20 Contests	$98,736	$131,647	$164,559	$197,471	$263,295

Special Elections. In New York City, 25 special elections were held (or planned) in the years 2001 through 2009, for an average of two or three per year.

For special elections in State Senate, City Council, and Assembly districts, for five different turnout percentages, the following table estimates the number of ballots to be hand counted. Appendix C shows the calculations to determine the average number of active registered voters per district.

District Type	# Voters	------------------------Turnout------------------------				
		5%	10%	15%	20%	25%
		Ballots to Hand Count (# Voters x Turnout x 3%)				
State Senate	160,000	240	480	720	960	1,200
City Council	81,000	122	243	365	486	608
Assembly	65,000	98	195	293	390	488

Cost of counting a vote-for-one contest on small numbers of ballots. In a hand count of small numbers of ballots, the cost of administrative management to oversee procedures would be spread over a much smaller number of ballots, and it is likely that the cost per ballot would be higher than $0.13. Due to lack of information about management costs, we have not estimated the cost of counting the small number of ballots required to be hand counted after special elections for State Senate, City Council, or Assembly.

5.f Transporting and securing equipment and ballots.
The costs of transporting and securing the DS200, accessories, and ballots before and after an election are unknown. These costs include:

- **Equipment transportation.** A DS200 scanner and its ballot box are not as heavy as a lever machine, and the city would be transporting approximately one-fourth as many scanners as lever machines. However, transporting fragile electronic equipment requires additional care, so it is unclear whether the transportation costs will increase or decrease.

  Most accessories are likely to be transported in the ballot box of the DS200. This may include marking pens, privacy sleeves, uninterruptible power supply, and the second lithium battery. The ballots needed for the election districts to be served by each scanner may also be transported in the ballot box.

- **Equipment security.** It is necessary to provide security for DS200 scanners, ballots, accessories, and jump drives while they are in transit and at the poll sites.

  Jump drives hold the ballot programming. They must be programmed and inserted into their ports in each DS200 scanner for transportation with the scanner. The door over these ports in each scanner must be secured with tamper evident seals. It is unknown whether the seals will have individual numbers that must be logged upon installation.

5.g Replacing consumed accessories.
For most consumables the lifespan and cost of replacement in future years is unknown. It will depend on:

> The longevity of the 2,227 uninterruptible power supplies.
> The longevity of the 2,227 mother board batteries.
> The quantity of the 6,681 DS200 keys lost or not returned to the BOE.
> The longevity of the 4,454 lithium ion batteries.
> The life of a jump drive, and whether they must be saved for up to 22 months.
> The quantity of privacy sleeves that are taken by voters or otherwise lost or damaged.

A fresh roll of thermal paper must be used in each DS200 for each election,[40] and an extra should be on hand for general elections in case the paper roll needs to be replaced due to high voter turnout.[41] The cost of a paper roll is $1.95. The following table shows the estimated annual cost of paper rolls for elections.

Election Type	DS200s	Paper Rolls	Cost Each	Cost Total
General (2 rolls per scanner)	1,794	3,588	$1.95	$6,996.60
Citywide Primary	1,794	1,794	$1.95	$3,498.30
State Senate Special [42]	67	67	$1.95	$130.65
City Council Special	38	38	$1.95	$74.10
Assembly Special	30	30	$1.95	$58.50
Total				**$10,758.15**

6. Storage, tracking, maintenance, disposal

The cost of storage, inventory control and tracking, maintaining and replacing DS200 equipment, and disposing of lever machines is unknown. It is unlikely that HAVA funds will cover these costs, which include:

- Storage for the DS200 between elections.
- Recharging batteries before elections.
- Storing ballots after elections.
- Tracking and replacing equipment and accessories.
- Quarterly testing of the DS200 scanners.
- Disposal and recycling of scanner-related consumables and ballots, a continuing cost
- Storage of lever machines until disposed of.
- Disposal of lever machines, a one-time cost.

6.a Storage for the DS200 between elections.
Storage facilities for the DS200 scanners must be environmentally controlled and physically secure, and must provide electricity for recharging the 4,454 batteries before each election (2,227 scanners with two batteries each).

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[40] "5.0 Requirements & Requirements Response from ES&S." Page 74.

[41] "5.0 Requirements & Requirements Response from ES&S." Page 59.

[42] The number of DS200 scanners for each special election assumes one scanner per poll site and is based on the average number of poll sites in each type of district in Bronx and New York Counties. Appendix D shows how those averages were calculated.

6.b Recharging batteries before elections.

Batteries for each of the 2,227 DS200 scanners should be charged no more than 4 weeks prior to an election. Charging time can take up to 8 hours to ensure a fully charged battery.[43] It is unknown how much electricity and how much staff time will be required.

6.c Storing ballots after elections.

Federal law requires that ballots voted in a federal general election be securely stored for 22 months. Section 3-222 of state election law requires that all ballots, voted and unvoted, be stored.[44] Such storage requires storage boxes or other appropriate containers, storage facilities, and personnel to manage and secure the facilities.

The following calculations show the minimum size of a secured area required to store boxes of ballots, assuming a 17-inch ballot and depending on the percentage of active registered voters for which ballots were printed.

Number of ballots in box	1000
Height of box (inches)	9
Length of box (inches)	18
Width of box (inches)	9
Citywide active registered voters	4,219,471

Ballots printed (% active reg. voters)	40%	60%	80%	100%
Number of ballots to store	1,687,788	2,531,683	3,375,577	4,219,471
Number of boxes	1,688	2,532	3,376	4,220
Area needed to store boxes of ballots:				
Height, in feet, for ten 9" boxes	7.5	7.5	7.5	7.5
Length, in feet, for ten 18" boxes	15	15	15	15
Width, in feet, for number of 9" boxes	13	20	26	33
[Number of 9" boxes in the width]	[17]	[26]	[34]	[43]

Thus, for example, for a general election in which ballots are printed for 100% of active registered voters, 4,220 boxes of ballots would need to be stored. If these boxes were stored 10 high and 10 deep, the number of boxes wide would be 42.2, which has been rounded up to 43 boxes wide. The volume in feet of the storage space needed would be 7.5 feet high, 15 feet deep, and 33 feet wide.

6.d Tracking and replacing equipment and accessories.

Procedures for tracking the DS200 scanners and accessories must be developed. Personnel must be allocated to:

- Track the location and maintenance status of each DS200;
- Test, schedule maintenance for, and supervise repairs to and replacements for DS200s;
- Track the location and status of accessories;
- Order, receive, store, install, and track replacements for consumables.

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[43] "5.0 Requirements & Requirements Response from ES&S." Page 48.

[44] State of New York 2008 Election Law." Page 46

6.e. Quarterly testing of the DS200 scanners.

New York State Regulation 6210.2 requires quarterly testing of each piece of equipment[45] according to prescribed procedures. The quarterly testing procedures for ballot marking devices[46] is currently available in draft form. Since these procedures are similar for the Sequoia ImageCast BMD and the AutoMark BMD, it is likely that similar procedures will be used for testing the DS200 scanners each quarter.

Quarterly maintenance is a ten-step process. Pre-election testing, which can replace the quarterly maintenance for the quarter in which it occurs, includes these same steps, along with a test of the tabulation accuracy on all the test decks. For each unit, the process includes:

- Verifying serial numbers, security seals, and inventory of accessories; and inspecting the unit for damage.

- Verifying the functionality. In pre-election testing, this step includes scanning the test deck and verifying results. *The county election commissioners themselves must perform this step for all units.* Quarterly testing instructions from the State Board of Elections say:

  "If security seals must be removed during this step, the bipartisan team must reseal the BMD and record the security seal information on the Interim Quarterly Maintenance Log once all maintenance is completed."

- Preparing the unit for re-storage or transport to the poll sites.

- Updating the maintenance log with all test information and new security seal numbers, and notifying the State Board of the test results.

The following table shows the total time required for a bipartisan pair of staff and/or technician to test 2,227 units, at several different lengths of time per unit. This time would be in addition to the time required to test the AutoMark ballot marking devices New York City purchased.

	-------Time per Unit per Technician------		
Quarterly Testing Required	**20 minutes**	**30 minutes**	**40 minutes**
Time for 2,227 DS200 scanners	742 hours	1,114 hours	1,484

Using these estimates, at 8 hours per day, forty technicians (20 pairs of 2 technicians) would require one to two weeks of dedicated time to complete this process each quarter.

6.f Disposal and recycling.

If the city replaces lever machines with DS200 scanners, the following costs must be considered:

- Storing lever machines for an appropriate length of time before disposal.
- Disposing of, selling, or recycling lever machines.
- Disposing of toxic lithium ion batteries when they are no longer rechargeable.
- Disposing of toxic UPS batteries when they are no longer rechargeable.

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[45] "6210 Regulations." page 4.

[46] "Lot 2 BMD Interim Quarterly Maintenance Procedure." Version 7.4. New York State Board of Elections. February 25, 2009. http://www.votersunite.org/info/Lot2BMDInterimQuarterlyMaintenanceProcedurev7.4.pdf

- Recycling ballots when storage periods expire.

7. Vendor On-site Support

In addition to the training discussed in Section 4, ES&S recommends that it provide the following first year support services to the City:[47]

- Project management.
- Acceptance testing support.
- Voting machine facility assessment.
- Pre-election equipment setup.
- Election management system acceptance testing support.
- Election management system pre-election support.
- Election day support for voting machine technicians, poll workers, and a call center.

ES&S charges $1,800 per day for each onsite support person. It is unknown how many person-days this support would involve.

8. Additional Staff and Consultants

Additional staff and/or consultants may be needed for these tasks and possibly others:

- Quarterly testing of the DS200 scanners (see section 6.e)
- Charging batteries before each election (see section 6.b)
- Pre-election testing of the DS200 scanners (see section 5.d)
- Training poll workers (see sections 4.a and 4.b)
- Educating voters (see section 4.g)
- Purchasing and tracking ballots (see sections 5.c and 6.d)
- Ballot layout and/or ballot programming (see section 5.a and 5.b)
- Transporting and securing ballots, scanners, and accessories (see section 5.f)
- Tracking/repairing scanners (see section 6.d)
- Tracking/purchasing consumable accessories (see section 6.d)

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[47] "5.0 Requirements & Requirements Response from ES&S." Page 94

9. Summary of Costs

9.a First year costs we were able to estimate.

The range of first year lever replacement costs we estimated in previous sections is shown below. Both the "Low" and "High" are lower than the full costs New York City will face because they do not include costs for which our information was limited (see Section 1.b).

		First Year Estimated Cost Range	
Costs that can be Estimated		**Low**	**High**
Initial equipment costs		$20,242,363	$25,997,730
Software license fees		$1,635,600	$1,802,640
Total Hardware and Software		**$21,877,963**	**$27,800,370**
Poll worker training by ES&S[48]		$1,350,000	$1,575,000
Increase in poll worker training pay		$0.00	$2,625,000
ES&S "train the trainers" classes[49]		$5,400	$16,200
Technician certification classes[50]		$72,000	$99,000
General Election:	Ballot printing[51]	$3,270,091	$7,130,907
	Test decks[52]	$46,700	$1,222,200
	3% manual audit[53]	$65,824	$98,736
	<Emergency ballots[54]>	-$916,650	-$916,650
Citywide Primary Election:	Ballot printing[55]	$1,371,328	$3,215,237
	Test decks[56]	$46,700	$1,222,200
	3% manual audit[57]	$49,368	$49,368
	<Emergency ballots>[58]	-$305,550	-$305,550
Three Special Elections:	Ballot printing[59]	$22,950	$106,488
Total 'Other' Costs		**$5,078,161**	**$16,138,136**
Total Hardware, Software, and 'Other'		**$26,956,124**	**$43,938,506**

9.b First year costs for which our information is too limited to estimate.

We expect the first year costs to be larger than summarized in the section above. This is because the shortfall does not include the additional costs we have been unable to estimate.

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[48] Assumes the city uses ES&S training in the first year, training for 30,000 to 35,000 poll workers.

[49] Assumes ES&S training for 20 to 60 trainers.

[50] Assumes only 20 certified hardware technicians and 10 certified software technicians would be needed.

[51] General election, low is for printing ballots for 110% of voters at $0.75 per ballot; high is for 150% at $1.16 per ballot.

[52] Low is for decks of 50 ballots for 934 ballot faces; high is for decks of 200 ballots for 6,111 ballot faces, both at $1 per ballot.

[53] Assumes a turnout of 40% to 60% for the general election, with 10 vote-for-one contests on the ballot.

[54] Assumes savings from not needing 300 emergency ballots printed for each of 6,111 election districts.

[55] Citywide primary, low is for printing ballots for 50% of voters at $0.75 per ballot; high is for 70% at $1.16 per ballot. The offset for not printing emergency ballots varies too much to estimate for primary elections.

[56] Low is for decks of 50 ballots for 934 ballot faces; high is for decks of 200 ballots for 6,111 ballot faces, both at $1 per ballot.

[57] Assumes a turnout of 30% for the primary election, with 10 vote-for-one contests on the ballot.

[58] Assumes savings from not needing 100 emergency ballots printed for each of 6,111 election districts.

[59] Special elections for one State Senate seat, one City Council seat, and one Assembly seat., low is for printing ballots for 10% of voters at $0.75 per ballot; high is for 30% at $1.16 per ballot. The cost of printing a test deck is negligible; the cost of conducting an audit on so few ballots is unknown; and the number of emergency ballots is unknown; so those costs aren't included.

Unestimated costs, first year:

Voter education	?.??
Storage for new electronic equipment and accessories between elections	?.??
Electricity for charging batteries before each election	?.??
Securing ballots on election day	?.??
Storage for ballots after elections	?.??
Inventory control and tracking for equipment and accessories	?.??
Replacement of consumable accessories	?.??
Security for equipment while out of the warehouse for election use	?.??
Compensation for additional staff and consultants	?.??
Manually counting 3% of ballots cast in special elections	?.??

Unestimated costs, first year, may also include:

Additional poll worker training facilities	?.??
Additional costs for escalating manual audit of ballots if discrepancies are found	?.??
Additional cost of transporting equipment to training facilities	?.??
Additional costs of transporting equipment on election day	?.??

Savings from not using lever machines. Replacing lever machines would result in savings from costs not expended on lever machine usage. Such savings would somewhat offset the costs of using a paper ballot and optical scanner system, but are likely to be insignificant compared to the estimated and unestimated costs of the new system. Annual savings include:

Citywide primary election emergency ballots	-?.??
Three special elections emergency ballots	-?.??
Ballot layout for lever machine strips for general, primary, and 3 special elections	-?.??
Setting up lever machines for general, primary, and 3 special elections	-?.??
Lever machine maintenance and repair	-?.??

9.c Recurring annual costs, years 2-5.

Recurring annual costs for which ranges can be reasonably estimated include:

		Estimated Ongoing Cost Range	
Costs that can be Estimated		**Low**	**High**
Software license fees		$1,635,600	$1,802,640
Increase in poll worker training pay		$0.00	$2,625,000
General Election:	Ballot printing[60]	$3,270,091	$7,130,907
	Test decks[61]	$46,700	$1,222,200
	3% manual audit[62]	$65,824	$98,736
	<Emergency ballots[63]>	-$916,650	-$916,650

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[60] General election, low is for printing ballots for 110% of voters at $0.75 per ballot; high is for 150% at $1.16 per ballot.

[61] Low is for decks of 50 ballots for 934 ballot faces; high is for decks of 200 ballots for 6,111 ballot faces, both at $1 per ballot.

[62] Assumes a turnout of 40% to 60% for the general election, with 10 vote-for-one contests on the ballot.

[63] Assumes savings from not needing 300 emergency ballots printed for each of 6,111 election districts.

Costs that can be Estimated		Estimated Ongoing Cost Range	
		Low	High
Citywide Primary Election: Ballot printing[64]		$1,371,328	$3,215,237
	Test decks[65]	$46,700	$1,222,200
	3% manual audit[66]	$49,368	$49,368
	<Emergency ballots>[67]	-$305,550	-$305,550
Three Special Elections:	Ballot printing[68]	$22,950	$106,488
Total recurring annual cost		**$5,286,361**	**$16,250,576**

Unknown recurring annual costs include:

Software license fee increase	?.??
Voter education	?.??
Storage for DS200 and accessories between elections	?.??
Electricity for charging batteries before each election	?.??
Securing ballots on election day	?.??
Storing ballots after elections	?.??
Tracking, repairing, and replacing DS200 scanners	?.??
Replacing consumable accessories	?.??
Securing equipment on election day	?.??
Increased compensation for voting machine technicians (years 1-5)	?.??
Compensation for additional staff and consultants	?.??
Manually counting 3% of ballots cast in special elections	?.??

Possible additional unknown annual costs:

Additional poll worker training facilities	?.??
Additional costs for escalating manual audit of ballots if discrepancies are found	?.??
Additional cost of transporting equipment to training facilities	?.??
Additional costs of transporting equipment on election day	?.??

Savings from not using lever machines. Replacing lever machines would result in savings from costs not expended on lever machine usage. Such savings would somewhat offset the costs of using a paper ballot and optical scanner system, but are likely to be insignificant compared to the estimated and unestimated costs of the new system. Annual savings include:

Citywide primary election emergency ballots	-?.??
Three special elections emergency ballots	-?.??
Ballot layout for lever machine strips for general, primary, and 3 special elections	-?.??
Setting up lever machines for general, primary, and 3 special elections	-?.??
Lever machine maintenance and repair	-?.??

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[64] Citywide primary, low is for printing ballots for 50% of voters at $0.75 per ballot; high is for 70% at $1.16 per ballot. The offset for not printing emergency ballots varies too much to estimate for primary elections.

[65] Low is for decks of 50 ballots for 934 ballot faces; high is for decks of 200 ballots for 6,111 ballot faces, both at $1 per ballot.

[66] Assumes a turnout of 30% for the primary election, with 10 vote-for-one contests on the ballot.

[67] Assumes savings from not needing 100 emergency ballots printed for each of 6,111 election districts.

[68] Special elections for one State Senate seat, one City Council seat, and one Assembly seat., low is for printing ballots for 10% of voters at $0.75 per ballot; high is for 30% at $1.16 per ballot. The cost of printing a test deck is negligible; the cost of conducting an audit on so few ballots is unknown; and the number of emergency ballots is unknown; so those costs aren't included.

9.d Maintenance and support contracts after expiration of the 5-year warranty.

After the 5-year warranty expires on the scanners, additional voting machine technicians may be needed. Such technicians may require increased compensation due to their computer expertise, compared to current technicians who work with the mechanical lever machines.

Alternatively the city may sign a maintenance and support contract with ES&S. The following table shows the **currently quoted** costs of three maintenance and support contracts ES&S offers for 2,227 DS200 units:[69]

	Per Unit	Total Cost
1 Year Hardware Preventative Maintenance and Support:	$213	$474,351
1 Year Firmware Maintenance and Support:	$91	$202,657
Total Cost for 1 Year under One-year Contract		**$677,008**
Cost per Year		**$677,008**
3 Year Hardware Preventative Maintenance and Support:	$672	$1,496,544
3 Year Firmware Maintenance and Support:	$288	$641,376
Total Cost for 3 Years under Three-year Contract		**$2,137,920**
Cost per Year		**$712,640**
5 Year Hardware Preventative Maintenance and Support:	$1,178	$2,623,406
5 Year Firmware Maintenance and Support:	$505	$1,124,635
Total Cost for 5 Years under Five-year Contract		**$3,748,041**
Cost per Year		**$749,608**

*   ES&S includes the following caveat with these price quotes:
"The pricing of these programs will be ES&S' then-current fees at the time a program is put in place."

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[69] Costs were quoted in ES&S' response to New York City's RFI. "5.0 Requirements & Requirements Response from ES&S." Page 107.

10. The Use of HAVA Funds

10.a New York State and New York City, as of 2007.

As of December 2007, New York State had $230,513,327 in funds that were appropriated under three sections of HAVA. New York City's share of the State's HAVA money is 36.9088%.[70] The City's share shown in the chart below is likely too high, because State expenditures may reduce the funds available to apportion to the counties.

Source of Funds	New York State[71]	City of New York
2007 Title I, Section 101	$2,657,504	$980,853
2007 Title I, Section 102	$57,521,022	$21,230,319
2007 Title II, Section 251	$170,334,801	$62,868,531
Total Funds as of December 2007	**$230,513,327**	**$85,079,703**

As a condition for receiving Section 251 funds, HAVA requires each state to appropriate funds equal to 5% of the total amount of its Section 251 program. As of June 23, 2006, the City's portion was $2,766,476. We did not include these funds in the chart because, although they are intended for Section 251 expenditures, they appear to be a City expense rather than a HAVA grant.

Title I, Section 101 City has $980,853	Intended for: 1. Improving the administration of elections for Federal office. 2. Educating voters about voting procedures, voting rights, and voting technology. 3. Training election officials, poll workers and election volunteers. 4. Developing a plan for managing Section 251 funds. 5. Improving, acquiring, leasing, modifying, or replacing voting systems. 6. Improving the accessibility and quantity of polling places. 7. Providing assistance to voters with limited English proficiency. 8. Establishing toll-free telephone hotlines for voters.
Title I Section 102 City has $21,230,319	Intended for: - Replacing punch cards or lever machines.
Title II, Section 251 City has $43,207,574	Intended for: 1. Procuring voting systems that comply with the requirements of Title III, Section 301, such as accessibility. 2. Implementing provisional voting. 3. Providing required information to voters in the polling place. 4. Developing and implementing a statewide voter registration list. 5. Implementing ID requirements for first-time voters who register to vote by mail. 6. Improving the administration of elections for federal office.

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[70] Memo from State Board of Elections to County Boards of Elections. June 23, 2006.

[71] "State Governments' Use of Help America Vote Act Funds." Pages 14, 20, 23, and 28.

10.b New York City, as of 2009.

In 2008 New York City purchased accessible Ballot Marking Devices (BMDs) with money received under HAVA Title II, Section 251.

2007 Title II, Section 251	$62,868,531
<2008 NYC costs for AutoMark BMDs>[72]	-$19,660,957
2009 remaining Section 251 Funds	**$43,207,574**

As of 2009, the City's remaining HAVA funds are approximately:

Source of Funds	City of New York
2007 Title I, Section 101	$980,853
2007 Title I, Section 102	$21,230,319
2009 Title II, Section 251	$43,207,574
Total Funds as of 2009	**$65,418,746**

New York City's Section 102 funds – $21,230,319 – might not cover the first-year cost of replacing the lever machines by purchasing scanners, privacy booths, accessories and software licenses, for which our estimate ranges from $21,877,963 to $27,800,370. However, it appears that Section 101 and Section 251 funds may be able to be used to cover the shortfall.

It also appears the Section 101 and Section 251 funds could be used to pay for many of the first year's unestimated costs, such as voter education, poll worker training, and developing procedures to track and control the inventory of scanners and accessories.

It is less clear whether HAVA funds could be used to pay for continuing annual costs of lever replacement, such as the annual software license fees, replacement accessories, and post-warranty maintenance fees.

Costs directly associated with conducting elections are not covered by HAVA funding. Each year, New York City's election costs would increase for:

- Printing ballots and test decks
- Manually counting ballots from 3% or more of the scanners.
- Storing, securing, and transporting the equipment and post-election ballots.
- Additional staff and/or consultants to perform the tasks listed in Section 8.

Many of these costs cannot be estimated because information is limited. Costs that can be estimated vary from **$5,286,361 to $16,250,576 per year.**

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[72] Estimate provided by ES&S in the "Plan B BMD Implementation 2008 Cost Analysis Results V-1.0." Actual cost is unknown.

Appendix A. Reference Documents

1. "5.0 Requirements & Requirements Response from ES&S." The Board of Elections in the City of New York. December 17, 2008, http://www.vote.nyc.ny.us/pdf/documents/boe/rfi/2009/50_ESSresponse/ES&S%20Requirements%20 Response_01.09.09_FINAL%20for%20Web.pdf

2. "6210 Regulations." Officially entitled "Subtitle V of Title 9 of the Official Compilation of Codes, Rules and Regulations. Part 6210. Routine Maintenance and Testing of Voting Systems, Operational Procedures, and Standards for Determining Valid Votes." http://www.elections.state.ny.us/NYSBOE/law/6210Regulations09052008.pdf

3. "ES&S Response to New York State Office of General Services Pricing Forms." IFB #21231. Centralized Contracts for the Acquisition of Voting Systems and Ballot Marking Devices. http://www.ogs.state.ny.us/purchase/spg/pdfdocs/2230021231PL_ES&S.pdf

4. Memo from State Board of Elections to County Boards of Elections. June 23, 2006. Stanley Zalen and Peter Kosinski, Co-Executive Directors. Subject: Use of Funds Provided by Counties as Matching Funds Equal to 5% of the Total Available Requirements Payment. http://www.wheresthepaper.org/HAVA_AllocationToCountyBOEs.pdf

5. "New York City Board of Elections Request For Information III." App B Prices, Costs, Volumes & Subs v-5. Fall 2009. http://www.vote.nyc.ny.us/pdf/documents/boe/rfi/2009/20_AppendixB/App%20B%20NYC%20BOE%20RFI%20III%20Fall%202009%20App%20B%20Prices,%20Costs,%20Volumes%20&%20Subs%20v-5%20Final.pdf

6. "NYS Voter Enrollment by County, Party Affiliation and Status." New York State Board of Elections. April 1, 2009 http://www.elections.state.ny.us/NYSBOE/enrollment/county/county_apr09.pdf

7. "Plan B BMD Implementation 2008 Cost Analysis Results V-1.0." February 6, 2008. http://vote.nyc.ny.us/pdf/documents/boe/rfi/2008implementation/PlanBBMDImplementation2008CostAnalysisResultsv10Draft.pdf

8. "State Governments' Use of Help America Vote Act Funds." 2007. U.S. Election Assistance Commission. http://www.eac.gov/election/HAVA%20Funds/docs/2007-report-on-hava-spending-by-states/attachment_download/file

9. "State of New York 2008 Election Law." Amended Through October 31, 2007. http://www.elections.state.ny.us/NYSBOE/download/law/2008NYElectionLaw.pdf

10. "Testimony of Marcus Cederqvist, Executive Director, New York City Board of Elections, before the New York City Council Committee on Governmental Operations." March 12, 2009. http://www.wheresthepaper.org/NYC_BOE_BudgetTestimonyMarch12_09.pdf

Appendix B. Software License Fees in a Sampling of Other Jurisdictions

The Unity license fee varies widely among ES&S customers. This table shows a sampling of fees and indicates the jurisdiction, the year to which the fee applies, the number of registered voters in the jurisdiction when the contract was signed, and the software to which the license applies.

Jurisdiction	Year	Voters	Software Licensed	Cost
Pinellas County, FL DS200 scanner and AutoMark	2008	643,423[73]	Unity (all modules) and AutoMark Information Mgmt Software One license	$110,500[74]
Charlotte County, FL DS200 scanner and AutoMark	2008 2009	118,837[75]	Unity (all modules) and AutoMark Information Mgmt Software One license	$13,892[76] $14,586
Wyoming M100 scanner and AutoMark	2006	263,083[77]	Unity (all modules) and AutoMark Information Mgmt Software 12 licenses for most modules	$790,500[78]
North Dakota M100 scanner and iVotronic DRE	2005	316,049[79]	Unity Election Data Manager and Election Reporting Manager 54 licenses	$221,805[80]
Jefferson County, WA	2005	21,165[81]	Unity (all modules) One license	$38,500[82]
Bexar County, TX	2002 -2006	883,172[83]	Unity (all modules) One license for five years, includes warranty	$258,000[84]

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[73] http://www.voterfocus.com/hosting/pinellas/ew_pages/files/Miscellaneous%20Statistics/regstat.pdf

[74] http://www.votersunite.org/info/PinellasE&SSContract.pdf

[75] http://www.charlottevotes.com/index.php?id=64&spanish=N

[76] http://www.votersunite.org/info/CharlotteCountyLicenseFees.pdf

[77] http://soswy.state.wy.us/Elections/docs/VR-Stats_by_Party.pdf

[78] ES&S contract with Wyoming. Page 38 http://accurate-voting.org/contracts/WY/WY_ess_2005.pdf

[79] See: http://www.nd.gov/sos/electvote/voting/elec-stats.html for the ballots cast in the 2004 general election. North Dakota does not require voters to register.

[80] ES&S contract with North Dakota, page 13. http://accurate-voting.org/contracts/ND/ND_ess_2004.pdf

[81] http://test.co.jefferson.wa.us/weblinkext/PDF/fkua3555lc2jmguljmjpheyj/6/November%202%2c%202004%20 General%20Election.pdf

[82] ES&S contract with Jefferson County, page 11 http://accurate-voting.org/contracts/WA/Jefferson/WA_jefferson_2005.pdf

[83] http://www.bexar.org/ISDMS/EL/PE/G/Media%2020021105%20Joint.txt

[84] ES&S contract with Bexar County, pages 24 and 27. http://accurate-voting.org/contracts/TX/Bexar/TX_bexar_2002.pdf

Appendix C. Average Number of Voters in Special Election Districts

State Senate Districts[85]

District	Active Registered Voters	Counties (NYC voters in parenthesis)
10	164,500	Queens
11	161,520	Queens
12	139,951	Queens
13	109,677	Queens
14	166,798	Queens
15	141,172	Queens
16	151,914	Queens
17	168,586	Kings
18	195,474	Kings
19	165,714	Kings
20	169,843	Kings
21	145,671	Kings
22	142,456	Kings
23	140,978	Kings, Richmond
24	188,083	Richmond
25	200,263	Kings, New York
26	216,370	New York
27	145,757	Kings
28	160,660	Bronx, New York
29	225,847	New York
30	200,784	New York
31	181,928	Bronx, New York
32	164,499	Bronx
33	131,036	Bronx
34	151,238	Bronx (95,220) Westchester
36	166,354	Bronx (144,770) Westchester
159,150		**Average Number of Voters Per District**

City Council Districts[86]

District	Active Registered Voters	Counties
1	91,129	New York
2	102,775	New York
3	113,758	New York
4	120,182	New York
5	99,889	New York
6	112,302	New York
7	93,773	New York
8	99,566	New York and Bronx
9	100,281	New York
10	72,419	New York

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[85] Source: http://www.elections.state.ny.us/NYSBOE/enrollment/senate/senate_apr09.pdf

[86] Source: http://www.vote.nyc.ny.us/pdf/documents/boe/EnrollmentTotals/2008/CouncilDistrictSummary.pdf

City Council Districts[86]

District	Active Registered Voters	Counties
11	79,596	Bronx
12	85,329	Bronx
13	77,642	Bronx
14	62,253	Bronx
15	66,986	Bronx
16	76,500	Bronx
17	85,706	Bronx
18	86,070	Bronx
19	81,667	Queens
20	61,998	Queens
21	49,428	Queens
22	67,342	Queens
23	81,591	Queens
24	77,601	Queens
25	63,259	Queens
26	68,200	Queens
27	88,368	Queens
28	69,977	Queens
29	72,837	Queens
30	68,294	Queens
31	79,773	Queens
32	74,881	Queens
33	96,246	Kings
34	84,088	Queens and Kings
35	91,329	Kings
36	86,255	Kings
37	69,401	Kings
38	58,230	Kings
39	82,139	Kings
40	72,922	Kings
41	82,120	Kings
42	87,225	Kings
43	76,407	Kings
44	62,667	Kings
45	75,346	Kings
46	84,091	Kings
47	71,876	Kings
48	70,149	Kings
49	84,123	Richmond
50	82,380	Kings and Richmond
51	90,271	Richmond
81,149		**Average Number of Voters Per District**

Assembly Districts[87]

District	Active Registered Voters	Counties
22	46,381	Queens
23	62,917	Queens
24	68,980	Queens
25	54,307	Queens
26	69,551	Queens
27	59,608	Queens
28	66,984	Queens
29	65,782	Queens
30	55,433	Queens
31	60,713	Queens
32	64,566	Queens
33	69,629	Queens
34	45,408	Queens
35	47,800	Queens
36	56,550	Queens
37	52,863	Queens
38	51,718	Queens
39	36,342	Queens
40	69,456	Kings
41	63,979	Kings
42	56,739	Kings
43	63,015	Kings
44	62,273	Kings
45	52,432	Kings
46	60,888	Kings
47	60,888	Kings
48	47,885	Kings
49	46,339	Kings
50	66,160	Kings
51	49,174	Kings
52	89,006	Kings
53	69,282	Kings
54	62,256	Kings
55	67,295	Kings
56	71,707	Kings
57	77,324	Kings
58	60,039	Kings
59	63,282	Kings
60	68,990	Kings, Richmond
61	67,917	Richmond
62	75,866	Richmond
63	68,460	Richmond
64	76,559	New York
65	85,996	New York

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[87] Source: http://www.elections.state.ny.us/NYSBOE/enrollment/assembly/assembly_apr09.pdf

Assembly Districts[87]

District	Active Registered Voters	Counties
66	91,497	New York
67	92,596	New York
68	80,022	New York
69	86,849	New York
70	80,017	New York
71	76,247	New York
72	63,410	New York
73	89,828	New York
74	88,689	New York
75	96,794	New York
76	64,312	Bronx
77	54,564	Bronx
78	47,090	Bronx
79	67,638	Bronx
80	54,910	Bronx
81	62,060	Bronx
82	69,384	Bronx
83	59,084	Bronx
84	62,622	Bronx
85	56,765	Bronx
86	47,469	Bronx
	64,099	**Average Number of Voters Per District**

Appendix D. Poll sites per State Senate, City Council and Assembly District

This appendix shows how we determined the average number of poll sites in the State Senate, City Council, and Assembly Districts in Bronx and New York Counties. These averages were used in Section 5.g to determine the number of paper rolls needed per special election.

The data for this appendix was copied from paper books of poll sites per district obtained from the New York State Elections Board.

State Senate Districts in Bronx and New York Counties

District Number	Number of Poll Sites	Boroughs
25	57	New York
26	59	New York
28	66	Bronx and New York
29	95	New York
30	91	New York
31	70	Bronx and New York
32	71	Bronx
33	43	Bronx
34	51	Bronx
36	64	Bronx
	67	**Average Number of Poll Sites per District**

City Council Districts in Bronx and New York Counties

District Number	Number of Poll Sites	Boroughs
1	49	New York
2	43	New York
3	43	New York
4	46	New York
5	27	New York
6	43	New York
7	40	New York
8	49	Bronx and New York
9	56	New York
10	28	New York
11	35	Bronx
12	36	Bronx
13	40	Bronx
14	21	Bronx
15	24	Bronx
16	36	Bronx
17	37	Bronx
18	32	Bronx
	38	**Average Number of Poll Sites per District**

Assembly Districts in Bronx and New York Counties

District Number	Number of Poll Sites	Boroughs
64	36	New York
65	19	New York
66	38	New York
67	37	New York
68	44	New York
69	37	New York
70	35	New York
71	33	New York
72	26	New York
73	32	New York
74	39	New York
75	36	New York
76	27	Bronx
77	21	Bronx
78	16	Bronx
79	35	Bronx
80	32	Bronx
81	23	Bronx
82	32	Bronx
83	25	Bronx
84	30	Bronx
85	20	Bronx
86	15	Bronx
	30	**Average Number of Poll Sites per District**

Appendix E. ES&S Additional Language Fees Charged for Typical Election

When ES&S does the ballot layout, it charges a fee per language per ballot face. In Section 5.a, "Ballot Layout," we estimated the number of additional language fees charged in an election with 934 ballot faces. To calculate that estimate, we did the following.

1. We contacted the Board of Elections in the City of New York and learned, for each county, the number of Election Districts that print Chinese on the ballot and the number that print Korean. The following table shows the number of Election Districts in which Chinese and Korean appear on the ballot.

County	EDs that offer Chinese	EDs that offer Korean
Bronx	0	0
Kings	717	0
New York	275	1
Queens	847	395
Richmond	0	0
Total EDs per Language	**1,839**	**396**

New York City has 6,111 election districts. In a typical general election there may be as many as 934 different ballot faces.[88]

2. We assumed that the ratio of EDs to ballot faces would remain consistent citywide. Given the number of EDs with Chinese printed on the ballot, we used the ratio to estimate how many ballot faces would be printed with Chinese.

$$\frac{934 \text{ ballot faces}}{6,111 \text{ EDs}} = \frac{280 \text{ ballot faces with Chinese}}{1,839 \text{ EDs with ballot faces with Chinese}}$$

3. We assumed that the ratio of EDs to ballot faces would remain consistent citywide. Given the number of EDs with Korean printed on the ballot, we used the ratio to estimate how many ballot faces would be printed with Korean.

$$\frac{934 \text{ ballot faces}}{6,111 \text{ EDs}} = \frac{61 \text{ ballot faces with Korean}}{396 \text{ EDs with ballot faces with Korean}}$$

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[88] "New York City Board of Elections Request For Information III." App B

Appendix F. Per County – Quantities of Scanners and Privacy Booths

This appendix describes how we calculated the number of scanners and privacy booths needed for poll site use in each county in New York City. Appendix G describes how we determined the citywide quantities. The Excel file used for the calculations is printed in full in Appendix H.

Results per County: Site IDs is the count of **2006 Poll Site IDs** listed in the detail portion of the same column.

Details per County: 2006 Poll Site IDs. We used the list of poll sites per county as of November, 2006. This data was obtained from the Board of Elections in the City of New York[89].

Results per County: 2006 Voters is the sum of the numbers of **2006 Voters per Poll Site** listed in the detail portion of the same column.

Details per County: 2006 Voters per Poll Site. We used the number of active registered voters per poll site as of November, 2006. This data was obtained from the Board of Elections in the City of New York.

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[89] Poll site and voter data was used in reports at:
Bronx: http://www.wheresthepaper.org/BronxCost_061106.pdf
Kings: http://www.wheresthepaper.org/BrooklynCost_061106.pdf
New York: http://www.wheresthepaper.org/ManhattanCost_061106.pdf
Queens: http://www.wheresthepaper.org/QueensCost_061106.pdf
Richmond: http://www.wheresthepaper.org/SICost_061106.pdf

Results per County: 2009 Voters is the number of active registered voters per county as of April, 2009, obtained from the New York State Board of Elections.[90]

This number is the same as the sum of the numbers of **2009 Voters per Poll Site** listed in the detail portion of the same column.

Details per County: 2009 Voters per Poll Site. The number of active registered voters per poll site was estimated by calculation.

For simplicity, we assumed that the *percentage increase* in the number of active registered voters *per poll site* from 2006 to 2009 was the same as the *percentage increase per county*.

Results per County:

	Kings:
Site IDs	392
2006 Voters	1,140,731
2009 Voters	1,271,398
DS200s	527
Booths	4,956

Details per County:

2006 Poll Site IDs	2006 Voters per Poll Site	2009 Voters per Poll Site	DS200s Needed per Poll Site	Booths Needed per Poll Site
00038	3001	3345	1	14
00039	6147	6851	2	20
00041	1354	1509	1	7
00042	3859	4301	2	18
00043	2457	2738	1	11

$$\frac{\text{2009 voters per county}}{\text{2006 voters per county}} = \frac{\text{2009 voters per poll site}}{\text{2006 voters per poll site}}$$

To obtain the number of 2009 voters in each poll site, we used the ratio of 2009 voters per county to 2006 voters per county. We multiplied that ratio by the number of 2006 voters in that poll site.

For each county, we used this method:

1. First, we calculated the *percentage increase* in active registered voters by dividing the number of 2009 voters per county by the number of 2006 voters per county.

   For example, the *percentage increase* in Kings County was calculated by dividing 1,271,398 by 1,140,731. This yielded a ratio of 1.1145, which is a *percentage increase* of 111.45%.

   $$\frac{1,271,398}{1,140,731} = 1.1145 = 111.45\%$$

2. Then, for each poll site in the county, we multiplied the number of 2006 voters per poll site by the county's *percentage increase*.

   For example, in 2006 Kings County poll site 00038 had 3,001 active registered voters. We multiplied 3,001 by King County's *percentage increase* to estimate the number of 2009 voters.

   3,001 x 1.1145 = 3,345

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[90] "NYSVoter Enrollment by County, Party Affiliation and Status." Voters Registered as of April 1, 2009.
http://www.elections.state.ny.us/NYSBOE/enrollment/county/county_apr09.pdf

Results per County: DS200s is the sum of the numbers of **DS200s Needed per Poll Site** listed in the detail portion of the same column.

Details per County: DS200s Needed per Poll Site. New York State Regulations Section 6210.19 requires one scanner per 4000 active registered voters per poll site. In other words, each poll site needs one scanner for poll sites with up to 4000 voters, two scanners for poll sites with 4001 up to 8000 voters, and so on.

The number of scanners needed per poll site was calculated by dividing the number of 2009 voters by 4000 and rounding up to the nearest whole number.

Results per County: Booths is the sum of the numbers of **Booths Needed per Poll Site** listed in the detail portion of the same column.

Details per County: Booths Needed per Poll Site. New York State Regulations Section 6210.19 requires, for a presidential or gubernatorial election, one booth per 250 voters in poll sites with fewer than 6000 voters, or one booth per 350 voters in poll sites with 6000 voters or more.

The number of privacy booths needed per poll site was calculated by:

- Allowing one booth for each 250 voters with poll sites having fewer than 6000 2009 voters.

- Allowing one booth for each 350 voters with poll sites having 6000 or more 2009 voters.

Appendix G. Citywide – Quantities of Scanners and Privacy Booths

This appendix describes how we calculated the number of scanners and privacy booths needed for poll site use citywide in New York City. Appendix F describes how we determined the per county quantities. The Excel file used for the calculations is printed in full in Appendix H.

Columns:

Total 2006 Poll Sites.
This column lists the total number of 2006 poll sites in each of the counties.

Total 2006 Act Reg. Voters.
This column lists the total number of 2006 active registered voters in each county.

Total 2009 Act Reg. Voters.
This column lists the total number of 2009 active registered voters in each county.

Total DS200s Needed.
This column lists the total number of scanners needed for each county.

Total Privacy Booths Needed.
This column lists the total number of scanners needed for each county.

Citywide Results:	Total 2006 Poll Sites	Total 2006 Act. Reg. Voters	Total 2009 Act. Reg. Voters	Total DS200s Needed	Total Privacy Booths Needed
Kings	392	1,140,731	1271398	527	4,956
New York	359	896,586	1008504	451	3,963
Queens	311	926,037	1035532	424	4,031
Bronx	218	578,490	645898	277	2,546
Richmond	87	234,155	258139	115	1,028
Spares				358	3,305
Training				75	
Citywide				2,227	19,829

Rows:

[County Name]
For each of the five counties, these rows contain the "Results" values described in Section 1 of this appendix.

Spares.
In addition to the number of AutoMark ballot marking devices needed for each poll site, the city purchased an additional 20% of the devices for spares.[91] We estimated 20% of the total scanners needed to be 358 and added that to the number required to be purchased. We also added 20% to the number of booths needed for poll site use to determine the total number needed.

Training.
The city purchased an additional 75 AutoMark devices for training.[92] To determine the total number of scanners needed, we added 75 to the total number required for poll site use and for spares.

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[91] "Plan B BMD Implementation 2008 Cost Analysis Results V-1.0."

[92] "Plan B BMD Implementation 2008 Cost Analysis Results V-1.0."

Appendix H. Spreadsheet: Per Poll Site – Quantities of Scanners and Privacy Booths