Evaluation of the 1999 Updating Test for the Master Address File

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I. Introduction

After the 1990 Census, the Census Bureau created a Master Address File (MAF) . A couple years before Census 2000, the Census Bureau conducted field activities to update the MAF (see [1]). Shortly after Census 2000, a process to continually update the Census Bureau's MAF is needed as an input to the American Community Survey (ACS) (see [2] and [3]). An important part of the ACS program is the field work to keep the MAF complete, accurate, and up–to–date. This involves periodic work by field representatives (FRs) to obtain information about newly constructed housing units and about older existing units missing from the MAF. This work includes governmental office visits followed by field listing operations to verify and correctly locate addresses obtained from these governments.

The Census Bureau will incorporate the field activities for updating the MAF into the Community Address Updating System (CAUS) which is currently under development. The CAUS relates to a variety of activities such as support of the 2010 Census planning , evaluation studies of Census 2000 to set a benchmark for evaluating the CAUS, regular updates of MAF/TIGER, TIGER modernization to obtain more accurate global positioning for map features, work on integrating current household surveys, integration of count question resolution with the targeting of MAF/TIGER updates, and research on the administrative records systems to identify new addresses.

The long term focus of the CAUS is to improve overall coverage of the MAF. To accomplish this, the CAUS will use the following methods to identify growth across the country:

- obtaining address lists from county / local/ tribal governments
- a targeting operation focused on identifying areas of growth where address lists may or may not be available
- canvassing blocks with potential MAF deficiencies

One or all of these methods may be used to collect MAF updates. Regardless of the methodology, the FRs use the **A**utomated **L**isting and **M**apping **I**nstrument (ALMI) as the data capture tool to collect information about new growth, verify addresses, or update existing MAF or TIGER information. The ALMI is a laptop computer containing address and mapping information.

The initial focus of CAUS is to improve the coverage of the MAF in non-city-style address areas for the ACS. The 1999 updating test addressed this focus.

II. Overview of the Field Test Evaluation

The goals of the evaluation were to establish a prototype for future evaluations and to analyze the procedures from the field test in order to make recommendations for future tests. In accomplishing that, a group of people from various areas in the Census Bureau (we) carried out the evaluation in four phases. First, we selected a stratified sample of blocks based on the findings from the test. Next, using the same initial input as the field test, we conducted a dependent listing operation with the blocks, then compared the two listings to quantify the results. We performed a computer match followed by a clerical matching operation. Finally, we identified blocks with differing housing unit counts as troubled blocks and suggested causes for the differences in these blocks.

III. Recommendations from Evaluation

We recommend the following:

- Use FRs with knowledge about
  - the county
  - Windows software
  - listing

[1] This paper reports the results of research and analysis undertaken by the Census Bureau staff. It has undergone a Census Bureau review more limited in scope than that given to official Census Bureau publications. This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress.

- Allow enough time for FRs to do their assignment
- Evaluate more sample from the updated blocks
- Test the software loading multiple times

We present the data to support our conclusions in the remainder of the paper. We also want to provide a procedural history of this evaluation since it would be the prototype for future evaluations.

IV. 1999 Updating Test

Presently, the Census Bureau is developing a program for the field procedures to update the MAF. Several areas within the Census Bureau are collaborating to test and evaluate methods for this field work.

A field test was conducted in six counties from August to September, 1999 (see [4]). The test focused on rural counties that had a majority of mailing addresses as rural route or post office box numbers.

The six counties were:

- Starr, TX
- Calvert, MD
- Miami, IN
- Washington, MO
- Vilas, WI
- Schuylkill, PA

The field test included the following operations:

- Contacting Government Offices
- Contacting Other Sources
- Targeting New Growth Areas
- Canvassing and Listing Blocks for New Growth

During the contacting portion of the field test, the FRs gathered lists of new growth in the county. Afterwards, the FRs used the lists to target blocks with new growth. Then they prioritized the blocks for canvassing and listing. See [4] for more details.

During the canvassing and listing portion of the field test, the FRs used the ALMI to record address and household information. The FRs could add, delete, or modify address information within the block using the ALMI. We initially loaded the ALMI with the most recent address information from the MAF.

When the FRs completed their work, we downloaded the addresses from the ALMI and used them in the analysis.

V. Stratify Results from 1999 Updating Test

A goal in the evaluation was to quantify new growth missed by the procedures used during the test.
So, we stratified all the blocks within a county to create four primary sampling strata:

❶ Targeted, completely canvassed & updated blocks
❷ Targeted, partially canvassed & updated blocks
❸ Targeted, but not updated blocks
❹ Not targeted and not updated blocks

The unmatched records in the evaluation from the ❹ stratum, not updated and not targeted blocks, would show the missed new growth. The unmatched records from the ❶ and the ❷ strata also show missed new growth.

The unmatched records from the ❸ stratum, targeted but not updated blocks, would show missed new growth due to a lack of time to complete the updating.

We define the updated blocks as blocks where something changed in the address information resulting from adding new addresses or modifying address information in a block during the test. The FRs in the test were successful in finding new growth in every block they updated.

Only one FR completely verified and updated addresses within their assignment during the test. The other five thought they best utilized their time by not covering the entire block. In the analysis, we ended up with three post strata by collapsing the ❶ and the ❷ strata.

For blocks that were not targeted, we wanted to determine if the lists gathered by the FRs lacked any information about growth. We would need to think about other avenues to capture this growth.

Within the strata, we used five substrata based on the initial housing unit (HU) count within the block. The five substrata included 0 HUs, 1 HU, 2 HUs, 3 - 20 HUs, and 21 - 100 HUs.

We wanted to see if the number of housing units in the block had a relationship to the amount of new growth.

We designated blocks with more than 100 HUs as a separate stratum for field purposes. Time did not allow us to update blocks with more than 100 HUs in each primary strata.

Within each substratum, we sorted the blocks by geographic information (census tract and block). Then we selected the blocks for the evaluation systematically with equal probability. We selected five blocks from the substrata with 0 HUs, 1 HU, and 2HUs. In the substrata with 3 - 20 HUs and 21 - 100 HUs, we allocated the sample blocks to strata in an attempt to minimize the expected variance of the total number of HUs in the six counties. We used Neyman's allocation. We show the sample blocks allocated to each county in table 1.

VI. Field Work for the Evaluation

To have independence from the field test, we used different FRs in the six counties to perform the dependent listing. Due to the lack of personnel, we needed to send a FR from over a hundred miles away to Starr County. The other five FRs in the evaluation had knowledge about their county though the person in Calvert county had very limited knowledge.

In four counties (bolded in table 1) , many blocks designated for the evaluation were not visited. The FRs cited three reasons for not completing their assignment: a lack of knowledge about the county, limited listing experience, and difficulty with the ALMI. During the analysis, we adjusted the weights in all the counties to account for the missed blocks.

Table 1

	Blocks Assigned	Blocks Completed	%
Calvert, MD	**40**	**9**	**23**
Miami, IN	87	85	98
Schuylkill, PA	**102**	**56**	**55**
Starr, TX	**42**	**20**	**48**
Vilas, WI	104	98	94
Washington, MO	**55**	**23**	**42**
Total	430	291	68

The FRs in the evaluation had the same ALMI training session and the same trainer as the FRs in the field test. All FRs started with the same address data from the MAF in the ALMI for their county.

One difference between the evaluation and the test was the time lag between training and the use of the ALMI for listing. The FRs in the evaluation were able to use the ALMI immediately after the training, while the FRs in the test had to perform other procedures before using the ALMI. Those procedures took at least two weeks. All FRs in the test and the evaluation needed some assistance with the ALMI while in the field.

In the evaluation, we gave the FRs their block assignments. Then they performed a dependent listing by doing the following:

- Canvassing the assigned census blocks
- Verifying all addresses on the MAF in the block
- Identifying addresses in the block not on the MAF and adding the information into the ALMI
- Identifying addresses on the MAF not in the block and deleting unnecessary information
- Modifying address information

In the field test, the FRs used their judgment (see [4]) to create their own block assignments and concentrated on adding new growth, rather than deleting extraneous information from the MAF. They were not required to update the entire block.

In the evaluation and the field test, we required the FRs to add any new streets in the block. The FRs in the evaluation identified new streets by canvassing the entire block.

In the test, they most likely identified the new streets from their lists before canvassing the block. A FR could miss a new street in the test if the new street was not on a list and they only partially canvassed the block.

VII. Matching Operations

We performed two matching operations, a computer match followed by a clerical match.

We did not use blocks not visited during the evaluation during the matching. We created our matching universe by using all the records from the blocks designated for the evaluation. We then matched the records from the test files to the evaluation files.

We were primarily interested in the records added to the MAF since these records represent new growth. We also included the records from the initial input files since the FRs could delete these records or modify their address information.

During the computer match, we matched by MAF identification number (MAFID), followed by the non-city-style address information, and ended with the city-style address information. We show the results in Table 2.

Table 2

	Computer Matched Records		
	MCI	MCC	
	ID	ADDS	ID
Calvert, MD	772	3	0
Miami, IN	1605	42	0
Schuylkill, PA	1113	4	387
Starr, TX	319	17	0
Vilas, WI	1901	48	1
Washington, MO	404	28	1

MCI - matched by MAFID
MCC - matched by city-style address
ID - Records that had MAFIDs
ADDS - Records that did not have MAFIDs

When we matched by MAFID, we also used the action code from the FR. If the FR modified any part of the record, we passed that record into the non-city-style or city-style part of the matching process. The 389 units matched by the city-style address had some data modified during the field work.

All added units did not have a MAFID. Geography division assigns a MAFID during their processing after they receive the data.

We did not match any records on the non-city-style address. This was not surprising since a respondent having a non-city-style address would need to be contacted as part of the test and the evaluation. The FRs were not required to call back in cases when the respondent was not present.

After the computer matching operation, we used the remaining unmatched records for the universe in the clerical matching operation.

During the clerical matching operation, we matched eight additional records (five records from Calvert and three records from Miami) based on their location description or a misspelling in the street name.

We noticed during the computer matching that we matched records in strata ❸ and ❹. During the test, the FRs did not visit blocks in these strata. All housing units added during the evaluation in blocks in these strata should not match to any housing units from the test. We believe that the ALMI was not completely loaded for the evaluation.

We also identified the reasons for the unmatched records during the clerical matching process. We explain in section VIII.

VIII. Trouble Blocks

We suggested two reasons for the majority of the unmatched records in the matching operations.

Unmatched records belonged in stratum ❸, targeted but not updated stratum. If the FR had enough time in the test to visit these blocks, then we believed that they would have found these units.

There was a problem identifying blocks within the ALMI. Units could be located in one block in the address list but mapped to another block. These units were designated as ∅ in the map. We used the same ALMIs for the test and the evaluation. When we reloaded the ALMIs for the evaluation with the initial input from the test, the ALMIs did not load the data in the same manner for the records designated as ∅. During the clerical match, we identified these records and dropped them from the analysis when appropriate. This loading problem was apparent in the ❸ and ❹ strata. We were able to match added HUs from the evaluation to blocks not visited by the FRs during the test.

Table 3 Unmatched Records from the Sampling Strata

	❶ & ❷	❸	❹
Calvert, MD	0	6	35
Miami, IN	7	22	4
Schuylkill, PA	0	4	0
Starr, TX	0	23	3
Vilas, WI	74	129	31
Washington, MO	5	17	0

Ultimately, we decided not to revisit the trouble blocks. There were two reasons that we did not perform field visits to rectify the trouble blocks:

① We could not identify enough trouble blocks in a county to make a field visit cost efficient.
② We wanted to avoid any confusion between our test and Census 2000.

IX. Analysis and Results

The final weight comprised of the inverse probability of selection from the stratification and a block adjustment factor (BAF). We used the BAF to account for the blocks not visited by the FRs.

Table 4 shows the housing units (HUs) added to the MAF from the test and the evaluation. The HUs added during the evaluation were the HUs not found during the test. This would note a coverage problem.

Table 4 Added Units

	Test	Evaluation	
		Not Weighted	Weighted
Calvert	573	41	1874
Miami	82	33	608
Schuylkill	32	4	173
Starr	67	26	557
Vilas	43	234	2579
Washington	52	22	520

The universe contained all units from the test and the evaluation. This universe measured the effects of the field procedures on the MAF. In other words, the under coverage shows the units missed from the entire housing inventory during the test, while the over coverage shows erroneous units added to the entire housing inventory.

We computed over coverage and under coverage estimates using the final weights.

To conceptualize where a unit existed, we provide Table 5 to place the components of each estimate.

Table 5	In test	Not in test
In evaluation	M_{et}	NM_e D_{to}
Not in evaluation	NM_t D_{eo}	

We computed the over coverage estimate as:

$$\frac{\sum_i NM_t + \sum_i D_{eo}}{\sum_i (M_{et} + NM_t) + \sum_i D_{eo}}$$

where NM_t = unmatched records in the test
M_{et} = matched records
D_{eo} = deleted units from only the evaluation
i = cell from the post strata table

A deleted HU could result from removing a duplicate HU on the address list or removing a HU from the address list that did not exist on the ground. For over coverage, the evaluation deleted a HU that the test failed to remove. When the same HU from the address list was deleted during the test and evaluation, the result is a match.

Our over coverage estimates were zero in each county. We believe there were two factors involved with this result. The FRs did not complete their entire assignment but more importantly we did not select enough updated blocks from the test for the evaluation to produce any results.

We computed the under coverage estimate as:

$$\frac{\sum_i NM_e + \sum_i D_{to}}{\sum_i (M_{et} + NM_e) + \sum_i D_{to}}$$

where NM_e = unmatched records in the evaluation
M_{et} = matched records
D_{to} = deleted units from only the test
i = cell from the post strata table

The FRs in the test deleted units from two counties. It was not the goal of the test to delete units from the address list. So, the component for deleted units from only the test did not play a significant role in the under coverage estimate.

We display the under coverage estimates in table 6. Overall, we found that the test missed 3.3% of the entire housing inventory in the six counties. The under coverage estimate of 3.3% represents an upper bound because it does not exclude any data.

The majority of the unmatched records belonged to the ❸ stratum. If we did not use the data from this stratum, we estimate that the test missed 1.5% of the entire housing inventory. The ❸ stratum represents the blocks targeted by the FRs but they were unable to visit them in the scheduled time. Given ample time, we believe that the FR could canvass and list the blocks that they wanted to visit. To support our assumption, we found very few unmatched records in the updated blocks, the ❶ and ❷ strata. The only exception was Vilas, WI.

Other considerations for the under coverage were the problems in Calvert, MD and Starr, TX. Both FRs were unfamiliar with the road system and both had difficulties with the ALMI. If we excluded the data from these two counties, the under coverage estimate for the remaining four counties is 2.6% If we also exclude the data from the ❸ stratum, the under coverage estimate is 1.1%. The under coverage estimate of 1.1% represents a lower bound because it considers ideally the goal of the test without any constraints.

A limitation to our results is the lack of standard errors. We have not developed a variance system. After creating an evaluation prototype, we will concentrate our efforts on incorporating a variance system into the process.

X. Conclusion

We will incorporate our findings from the evaluation in future field tests for updating the MAF. There are many areas for improvement and various systems need development. Please send any suggestions to the authors.

XI. Future Work

Our next field test takes place in September, 2000 and runs through November, 2000. We plan to have a dress rehearsal in June, 2001. Production for updating the MAF using data from the CAUS is scheduled for the latter half of 2002.

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Table 6

	Under coverage Sampling strata				Under coverage Substrata				
	All Units	❶& ❷	❸	❹	0 HUs	1 HU	2 HUs	3-20HUs	21-100 HUs
Calvert, MD	6.5%	0%	7.8%	4.6%	0%	0%	0%	10%	2.3%
Miami, IN	4.4%	2.2%	3.4%	15.4%	25%	17%	0.8%	1.7%	1.4%
Schuylkill, PA	0.1%	0%	0.6%	0%	0%	0%	0%	1%	0%
Starr, TX	5.5%	0%	7.1%	>0.1%	0%	0%	0%	11.7%	5.5%
Vilas, WI	10.9%	11.4%	9.5%	27.9%	0%	50%	4.1%	10.2%	10.6%
Washington, MO	6.9%	0.5%	7.3%	0%	0%	0%	0%	8.1%	5.6%
All Six Counties	3.3%	8.9%	5.6%	1.0%	0%	21%	1.3%	6%	4.9%
Four Counties[1]	2.6%	9.1%	4.8%	0.7%	0%	22%	1.4%	4.5%	5.5%

[1]The four counties include Vilas, WI, Miami, IN, Washington, MO, and Schuylkill, PA.