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MEMORANDUM FOR   ACS Research and Evaluation Advisory Group

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Subject: Understanding Differences in ACS and 2010 Census Information on
        Occupancy Status – Sampling Frame

Attached is the American Community Survey Research and Evaluation report on the differences between the 2010 Census housing unit universe and the 2010 ACS sampling frames.

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Understanding Differences in ACS and 2010 Census Information on Occupancy Status – Sampling Frame

FINAL REPORT

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Introduction

The 2010 American Community Survey (ACS) estimates of vacant housing units (HUs) differ markedly from the counts of vacant housing units from the 2010 Census. Differences between the ACS housing unit sampling frame and the 2010 Census address list is one potential factor that may have contributed to the difference in the occupied and vacant housing unit classifications between ACS and the 2010 Census (Griffin, 2011).

The goal of this report is to examine and document the differences between the 2010 Census universe of housing units and the 2010 ACS housing unit sampling frame. The results of this project will not necessarily uncover the cause of the difference in the vacancy rates but will lead to a better understanding of the differences between the universes of housing units in the 2010 Census and 2010 ACS that might have contributed to differences in the vacancy rates.

Background

The MAF/TIGER Database (MTdb)

The Master Address File (MAF) is the Census Bureau's official inventory of known living quarters (housing units and group quarters [GQs]) and some nonresidential addresses in the United States and Puerto Rico. It serves as the sole source of housing unit addresses for the ACS sampling frame and is also the source of addresses for other demographic surveys and the Decennial Census. The MAF contains source and status information, geocodes, and other attributes of each address. Each MAF record has a unique identifier, called a MAFID, which allows users of MAF data to track an individual MAF record over time.

The Topologically Integrated Geographic Encoding and Referencing (TIGER) system is a spatial database containing a digital representation of map features such as geographic boundaries, roads, water features, and more. The MAF and TIGER are combined to form the MAF/TIGER database (MTdb). The Geography division is responsible for maintaining the MTdb.

The MAF contains both city-style addresses and non city-style addresses. A city-style address is an address with a house number and street name (e.g., 101 MAIN ST). Non city-style addresses are addresses such as rural routes (RR 2 BOX 10), highway contract routes (HC 65 BOX 18), and post office boxes (PO BOX 1234).

Twice a year, the Geography division updates the MAF with city-style addresses from the United States Postal Service (USPS) Delivery Sequence File (DSF), a national file of mail delivery points serviced by the post office. City-style addresses from the DSF can be matched to existing city-style address records on the MAF to minimize the risk of introducing duplicates. The Geography division attempts to geocode city-style addresses by matching their house number and street name to a street and address range in the MTdb. Geocoding and matching non city-style addresses is troublesome and could lead to duplication of existing MAF records, so non city-style addresses from the DSF are not used to update the MAF. The

MAF should have better coverage of housing units in areas where mail is delivered to a city-style address than in areas of the country without city-style mail delivery. MAF coverage of housing units in areas without city-style delivery suffers without field operations to update those addresses on the MAF.

In general, results from field operations are used to update both addresses and map features in the MTdb. Updates from targeted field operations used to support various Census Bureau programs are incorporated into the MTdb on an ongoing basis. Some examples of these field operations include the Demographic Area Address Listing, which updates the frame for current surveys; Special Censuses; and Census tests. Results from national field operations used to conduct the 2010 Census were also updated in the MTdb. We expect that updates from the 2010 Census greatly improved housing unit coverage in areas where coverage of housing units on the MAF was deficient.

2010 Census Updates in the MAF

The first major 2010 Census operation implemented to improve coverage of living quarters on the MAF was the Local Update of Census Addresses operation (LUCA). LUCA was a partnership program enabling local governments to provide updates to the MAF in order to ensure a more complete count for their community. Addresses provided by LUCA participants were verified in the national Address Canvassing field operation in the spring and summer of 2009. Address Canvassing was a dependent listing using lists of addresses from the MAF. Address Canvassing listers could add, delete, or update the MAF address list. Those results were then used to update the MAF.

The Group Quarters Validation (GQV) operation followed Address Canvassing and attempted to make a final determination of the GQ/HU status for all addresses where this could not be determined in Address Canvassing. Records that were valid for the 2010 Census enumeration after GQV make up the 2010 Census enumeration universe.

Questionnaire delivery operations, such as Update/Leave, Update/Enumerate, and Remote Alaska provided further updates to the Census address list. Follow up operations (for example, Nonresponse Follow up, Vacant/Delete Check, and Field Verification) also updated the Census address list. Enumerators could correct existing addresses or they could have affected the inventory of addresses by adding or deleting addresses during those field operations. See Census Bureau (2011) for more detailed information on 2010 Census operations.

Address updates from 2010 Census operations were incorporated into the MAF so that internal Census Bureau MAF customers, such as the ACS, could use those results. Once all 2010 Census operations were complete, a final Census status was assigned to every record that was part of any 2010 Census operation. This status was determined outside of the MAF and later sent to the Geography division to include on the MAF. Occupied and vacant housing unit records tabulated in the 2010 Census make up the final Census housing unit universe.

How ACS Uses the MAF

The Geography division creates files, called MAF extracts, containing MAF data and provides those files to the ACS twice a year to support ACS sampling, data collection, and tabulation. The ACS uses the files delivered in July to create the main phase sampling frame for the following year and the January MAF extracts to create the supplemental phase sampling frame creation for that same year.

There are more than 50 million records on the MAF extracts that represent addresses that should not be included on any housing unit sampling frame. Examples include nonresidential addresses, duplicate address records, and records flagged as nonexistent by field operations. The MAF extracts also contain records for other types of living quarters such as group quarters (for example, college dorms, military barracks, prisons, group homes, etc.) and transitory locations (RV parks, marinas, campgrounds, etc.) that are excluded from the ACS housing unit sampling frame. The only records on the MAF excluded from MAF extracts are records for domestic violence shelters. Those are excluded because of a Census Bureau policy mandating that domestic violence shelters be excluded from MAF extracts.

The ACS classifies each record on the MAF extract as a valid housing unit record or an invalid record based on a set of criteria, called the "ACS filter," that takes into account source and status information of the record. Valid records are housing unit records that meet the criteria or "pass the filter." Subject matter experts in the Decennial Statistical Studies Division (DSSD) update the filter rules every six months to account for new and ongoing MAF update operations. The set of valid housing unit records, as defined by the ACS filter, is the ACS sampling frame.

The 2010 ACS Sampling Frames

The ACS used two frames to select the 2010 ACS housing unit sample. The ACS 2010 main phase (M10) sample was selected using the frame created using MAF extracts that the Geography delivered in July 2009 (the M10 MAF extracts)[1]. About 95.5 percent of the 2010 ACS sample was selected from the M10 frame. Updates from Address Canvassing were not on the MAF at that time and, therefore, were not available for ACS to include on the M10 sampling frame. The filter used to create the M10 frame included housing unit records tabulated in Census 2000 plus records added or validated by post-Census sources. Post-Census sources include the DSF, Demographic Area Address Listing, Special Censuses, and Census Tests. Another category of records included on the M10 frame was housing unit addresses deleted during Census 2000 that remain on the most recent DSF as a residential delivery point. The ACS includes these records because they may represent housing units that were under construction (or were planned to be constructed) during Census 2000 but were not built in time to be included in the final Census 2000 housing unit universe. ACS refers to this category as Census deletes that persist on the DSF. See Bates (2010a) for a description of the process used to create the M10 sampling frame.

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[1] We refer to the sampling frame and the MAF extract used to create the sampling frame by its year and phase. The 2010 ACS main phase sampling frame is the M10 frame and the July 2009 MAF extract used to create that frame is the M10 MAF extract. Similarly, the 2010 ACS supplemental sampling frame and the January 2010 MAF extract used to create that frame are referred to as the S10 frame and the S10 MAF extract, respectively.

The Geography division applied Address Canvassing and GQV results to the MAF after creating the M10 MAF extracts. Those results were included in the January 2010 ACS MAF extracts used to create the 2010 ACS supplemental (S10) sampling frame; however, only 4.5 percent of the 2010 ACS sample was selected from the S10 frame.

Prior to Address Canvassing and GQV, the base for the ACS sampling frame was essentially the Census 2000 housing unit universe. Once the national Address Canvassing and GQV updates were available, the ACS filter rules disregarded the Census 2000 status and relied on the more recent 2010 Census enumeration universe status of each record. This allowed us to include new housing units from Address Canvassing on the ACS sampling frame as well as exclude records that were invalidated by Address Canvassing from the frame. The ACS S10 frame consisted of the 2010 Census enumeration universe plus addresses that were not sent to Address Canvasing but met the criteria for post-Census DSF adds. See Bates (2010b) for a description of the process used to create the S10 sampling frame.

Differences Between ACS and Census Use of the MAF

The ACS errs on the side of overcoverage in an attempt to pick up new housing units that would otherwise be missed. The data that the ACS uses for filtering is not as current as the data the Census uses because of various processing lags. One example of the processing lag is the time that it took for the final 2010 Census status to appear in the ACS MAF extracts. The final Census status, which took into account results from all Census operations, was determined in late 2010 but was not available to ACS until July 2011 for use in creating the ACS 2012 main phase (M12) sampling frame. While the Census was able to produce their final Census housing unit counts in late 2010, ACS could not incorporate those results into the frame until ACS data year 2012.

There are also lags between each step from the time a record is added to the DSF to the time that the new DSF record could be included in the ACS sample. Those steps include:

- the USPS adds a new record to the DSF
- the USPS sends the DSF to the Geography division
- the Geography division updates the MAF with the DSF
- the Geography division creates MAF extracts for ACS
- ACS creates the sampling frame
- ACS selects the sample

It also takes several months after sample selection before the ACS mails a questionnaire to a new address and then a couple more months until the ACS attempts a personal visit. The total lag between the time an address is added to the DSF and the time when an ACS interviewer might visit that address is at least 11 months and could be as many as 29 months.

The ACS is more liberal in using the new DSF records than the Census, in part, because of this processing lag. One category of DSF addresses included on the ACS sampling frame but excluded from Census operations is ungeocoded DSF records. The Geography division can assign every ungeocoded record to a

county, but not to a block within the county. ACS field representatives are able to look for an address in the entire county. Census operations, on the other hand, require a block geocode because assignment areas for Census operations are blocks or groups of blocks. Records without a block geocode are excluded from Census operations because they cannot be included in any block assignments.

A second major category of DSF records that the ACS filter and the Census filters treat differently are DSF records that the USPS excludes from delivery statistics (EDS records). EDS records represent addresses that the USPS does not consider to be mail delivery points at the time the DSF is created. If/when the USPS begins delivering mail to that address it should then become included in the delivery statistics and it's status reflected as such on the DSF.

Some EDS records represent new construction addresses or planned new construction addresses. Other EDS records represent other types of situations such as old versions of addresses from an address conversion or some other type of situation that should be excluded from the ACS sampling frame. Unfortunately, there is no clear indication of which EDS records on the DSF represent potential new construction and which records are excluded from delivery statistics for other reasons. The ACS includes new EDS addresses on its sampling frame because the USPS may be delivering mail to that address by the time the ACS attempts to mail a questionnaire to it.

The Census, however, only included EDS records on the address lists used in Address Canvassing. Address Canvassing was a dependent listing operation so listers were able to determine which EDS records should be included in the 2010 Census enumeration universe and which should be excluded. New EDS records added to the MAF by the DSF after Address Canvassing were excluded from all post-Address Canvassing filters.

There is also a category of DSF addresses that the ACS excludes but the Census includes. For the ACS, each new DSF record must be in a geographic area where including these records is less likely to result in duplication of an address without a city-style address. We define a "duplication zone" where there is an increased risk that new city-style DSF addresses may duplicate existing non city-style addresses already on the frame. The ACS filter excludes DSF records inside of that duplication zone. The Census does not consider the ACS duplication zone when filtering DSF addresses.

Research Questions and Methodology

Q1: How many housing units were on the ACS sampling frames for ACS data year 2010? What changes were made to the ACS frame between M10 and S10?

We used the M10 and S10 MAF extracts to get state-level counts of housing units on the ACS M10 and S10 sampling frames. Each record on the MAF extract contains a flag indicating whether or not the record passed the ACS filter and is included on the sampling frame for that phase. The flag also classifies each record on the frame into one of four general categories: Census housing units, post-Census DSF adds, Census deletes that persist on the DSF, and field validations. We compared the M10 and S10 frame counts for these four general filter categories. National counts of housing units on the M10 and S10

frame are included in Table 1 in the Results section. Table A-1 in Appendix A provides state-level counts of housing units by filter category for each state.

We also compared the inventory of housing units on the M10 and S10 ACS MAF extracts to determine the sources of any differences between the M10 and S10 frames. This involved a MAFID match for all M10 and S10 valid housing unit records to determine the source of any ACS frame status changes between M10 and S10. Each record where the ACS frame status changed from valid to invalid (or vice versa) between M10 and S10 was categorized as an add, validation, or invalidation.

"Adds" are cases where the MAFID represented a valid housing unit on the S10 frame but was missing altogether from the M10 MAF extract. We examined source information and DSF status information from the S10 MAF extract to determine whether Address Canvassing, GQV, or the DSF added the record to the MAF.

Address Canvassing and GQV adds were determined by examining the Address Canvassing and GQV action codes on the S10 MAF extract for each record added to the MAF between M10 and S10.

If neither Address Canvassing nor GQV added a given record then we looked at the DSF status information to determine if it was a DSF record added to the MAF after M10. The new DSF records that were included in the Census enumeration universe were counted as Census adds since the Census filter included those records. All other new DSF records were classified as ACS DSF adds. ACS DSF adds are records that were added to the MAF by the fall 2009 DSF and passed the ACS filter for S10 but were not included in the 2010 Census enumeration universe. These are likely to be new DSF records that are ungeocoded and/or excluded from delivery statistics.

"Validations" are cases where the MAFID represented a valid housing unit on the S10 frame but was an invalid record on the M10 MAF extract. Validations occurred when a housing unit address that was not on the ACS M10 frame was sent out to a field operation and the lister found the unit. Addresses not sent out to a field operation were validated if an added record from a field operation matched to it.

We examined the Address Canvassing and GQV action codes on the S10 MAF extract to determine if a lister found the record in one of those operations. If a lister found the record then we classified that record as a Census validation.

Validations also resulted from changes in the DSF status of a record. Validations that did not have an action from Address Canvassing or GQV were counted as DSF validations if there was a change in the DSF status of that record.

"Invalidations" are cases where the MAFID represented a valid housing unit on the M10 frame but was an invalid record on the S10 MAF extract. Invalidations typically result from negative field actions, where a lister cannot find an address or determines that the address represents something other than a residential housing unit. Invalidations may also result from DSF status changes. We used the source and

DSF status information from the S10 MAF extract to classify each invalidation as a Census delete, Census duplicate, or DSF delete.

Census deletes include any valid M10 housing unit record flagged as nonexistent or nonresidential by Address Canvassing or GQV. Valid M10 housing unit records that were converted to a GQ or transitory locations are also classified as Census deletes. Records that did not meet the criteria to be included on the Address Canvassing lists and were not re-added by Address Canvassing were also classified as Census deletes because they were not included in the Census enumeration universe.

Census duplicates include any M10 housing unit record identified as a duplicate by either Address Canvassing or GQV. This includes records where an address correction from Address Canvassing or GQV resulted in the record being flagged as a duplicate during MAF updating.

DSF deletes are invalidations that did not have a negative action from Address Canvassing or GQV but did have a DSF status change. These could be records that were deleted from the DSF or were converted to business records on the DSF. They could also be records that geocoded to an area inside the "duplication zone" where ACS does not use the DSF because of an increased chance that the DSF record duplicates an existing record. The DSF delete category also includes DSF records that were identified as duplicates via the USPS Locatable Address Conversion System (LACS) file.[2]

A small number of housing units on the M10 frame were excluded from the S10 MAF extracts because they were classified as domestic violence shelters. DSSD confirms with the Geography division that each missing MAFID record is a domestic violence shelter before we approve the frame for sampling. Records excluded from the MAF extracts as domestic violence shelters are grouped together with invalidations in the various tables in this report.

Adds and validations are measures of gross undercoverage on the M10 frame. Invalidations represent gross overcoverage on the M10 frame. Table 2 in the Results section provides national counts of the various sources of adds, validations, and invalidations mentioned above. Table A-2 in Appendix A contains state-level counts of those sources of overcoverage and undercoverage on the M10 frame.

Q2: How does the count of housing units on the 2010 ACS sampling frame compare to the 2010 Census housing unit count?

The July 2011 ACS MAF extracts used to create the ACS M12 sampling frame included a variable showing the final 2010 Census status information for every MAFID. The 2010 Census status indicated whether a record was excluded from the final 2010 Census tabulations or if it was counted in the 2010 Census as a housing unit or a group quarters. The M12 extracts also contain source and status information for each record from each Census operation.

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[2] The LACS file provides information on address conversions that result in two DSF addresses representing the same mail delivery point. This is common in areas undergoing E-911 address conversions as well as areas where streets are renamed.

We compiled MAF extract counts of 2010 housing units at the state and national level using the 2010 Census status variable and compared those counts to the official 2010 Census housing unit counts from American FactFinder to verify that the counts were the same. We then computed coverage rates for the M10 and S10 frames relative to the official Census housing unit count for each state and the United States. Those results are provided in Table A-3 in Appendix A.

There are three types of potential M10 frame errors if you consider the 2010 Census housing unit universe to be "truth." Housing units in the 2010 Census universe could have been missing from the M10 frame because they were either missing from the M10 MAF extract (omissions) or because they were on the MAF but invalidated by the M10 filter (erroneous exclusions by the M10 filter). Housing units on the M10 frame that were not counted in the 2010 Census would be considered erroneous inclusions by the M10 filter. We obtained counts of records that fall into each of those three error categories by comparing the M10 frame status and the 2010 Census status for each individual MAFID record on the M10 and M12 MAF extracts. We did not do this same comparison for the S10 frame since the S10 frame only accounted for 4.5 percent of the 2010 ACS sample.

For each record where the Census status was different than the M10 frame status, we examined source and status information from the M12 MAF extract to identify the reason for the status change. We grouped the various sources into the following six broad categories to facilitate presentation of the results.

1. Pre-Census operations are Address Canvassing and GQV.

2. Census field operations are Update/Leave, Update/Enumerate, Remote Update/Enumerate, Remote Alaska, Group Quarters Enumeration, Enumeration of Transitory Locations, Nonresponse Follow up, Vacant/Delete Check, and Field Verification. (Census Bureau, 2011)

3. Census exclusions are records that were valid for M10 but were excluded from the final 2010 Census housing unit universe without being invalidated by any Census operation. These records did not meet the criteria for inclusion on the Address Canvassing address list and were not added by any Census operation.

4. Administrative sources are HU Count Review, GQ Count Review, the New Construction operation, and LUCA Appeals.

5. Conversions are records that represent housing units on one MAF extract but either a group quarters or a transitory location on the other.

6. "Other" records are records that could not be categorized into one of the five classifications above.

Table 3 in the Results section provides national counts of omissions, erroneous exclusions, and erroneous inclusions for each of the six categories above.

Table A-4 in Appendix A contains counts of omissions, erroneous exclusions, and erroneous inclusions at the state-level. This table also includes error rates for each of the three types of errors.

Since we suspect that there would be more M10 frame errors in areas of the country that do not contain city-style addresses covered by the DSF, we calculated the percentage of city-style addresses on the M10 frame for each state. This is the number of records with a house number, street name, and ZIP code on the M10 frame divided by the total number of housing units on the M10 frame. We also calculated an M10 DSF coverage rate for each state. The DSF coverage rate is the number of records on the M10 frame that were on the latest DSF at the time the M10 MAF extracts were created divided by the total number of M10 housing units.

Table A-5 in Appendix A includes the omission rate, erroneous exclusion rate, and the erroneous inclusion rates that are included in Table A-4 but also has three additional error rates. The total exclusion rate is the sum of the omission rate and the erroneous exclusion rate. This is the percentage of all 2010 Census housing units excluded from the M10 frame. The net error rate is the erroneous inclusion rate minus the total exclusion rate. This provides a measure of the change between the M10 frame and the Census housing unit universe. The gross error rate is the sum of the omission rate, erroneous exclusion rate, and the erroneous inclusion rate. The gross error rate provides a measure of the total error on the M10 frame. This table also includes the percentage of city-style addresses in the state and the DSF coverage rate.

The final three research questions focus more on each of these three categories of errors on the M10 frame. Research question 3 looks at omissions from the M10 frame. Research questions 4 and 5 examine the erroneous exclusions and erroneous inclusions, respectively. Omissions and erroneous exclusions represent undercoverage on the M10 frame. Erroneous inclusions represent overcoverage on the M10 frame.

Q3: What were the sources of housing units that were counted in the 2010 Census but were not on the M10 MAF extract?

As explained above in research question 2, there are three types of differences between the M10 frame and the 2010 Census housing unit universe. Research question 3 examines the omissions from the MAF that were added to the MAF after M10 frame creation. To identify these omissions, we matched the MAFIDs in the 2010 Census housing universe to all MAFIDs on the M10 MAF extract. Omissions are cases where the MAFID record for a 2010 Census housing unit was completely missing from the M10 MAF extract. These are troublesome for ACS because records missing from the MAF cannot be included on the ACS frame.

Each MAFID representing an omission was added to the MAF after the M10 MAF extract was created. We identified the source of the operation that added the record to the MAF using the source and status information from the M12 MAF extract. We then categorized that added record as an add from a pre-Census operation, another Census field operation, or an administrative source as explained in research

question 2. If we could not determine the operation that added the record then we counted the record in a general "other" category.

We calculated an omission rate for each state and for the nation. The omission rate is calculated as the number of omissions divided by the total 2010 Census housing universe so we can make statements like "x percent of 2010 Census housing units were missing from the M10 MAF extract."

We also examine the DSF status of each omission to determine if/when the DSF included the unit. If the DSF included the unit then the we could include the unit on the ACS frame after it appears on the DSF; however, omissions that do not appear on the DSF would never be included on the ACS frame without a field operation adding it. Those records are included on the frame only due to the large-scale 2010 Census operations.

Q4: Why did the ACS M10 filter exclude housing units that were on the M10 MAF extract and counted in the 2010 Census?

The second type of difference between the M10 frame and the 2010 census housing unit universe are 2010 Census housing unit records that existed on the MAF at the time we created the M10 frame, but were excluded by the M10 filter. These are potential M10 filter errors of exclusion. To identify these erroneous exclusions, we matched all MAFIDs in the 2010 Census housing universe to all MAFIDs on the M10 MAF extract. Erroneous exclusions are records where the 2010 Census MAFID was on the M10 MAF extract but was not included on the M10 frame.

After M10 frame creation, some operation must have validated each MAFID representing an erroneous exclusion in order for that MAFID to be included in the 2010 Census housing unit universe. We identified the source of the operation that validated the record using the source and status information from the M12 MAF extract. We then categorized the source of the validation as being from a pre-Census operation, another Census field operation, an administrative source, or as being a conversion to a housing unit from some other type of living quarter, such as a GQ or a transitory location. If we could not determine the operation that validated the record then we counted the record in a general "other" category.

We calculated an erroneous exclusion rate for each state and for the nation. The erroneous exclusion rate is the number of erroneous exclusions divided by the total 2010 Census housing universe so we can make statements like "x percent of 2010 Census housing units were erroneously excluded by the M10 filter."

As part of this analysis, we also reapply the M10 filter to determine why the M10 filter excluded these records. The ACS filter excludes records that are nonresidential, duplicates, and/or non-housing units (GQs and transitory locations). The filter also excludes certain categories of post-Census 2000 DSF add records. There are 11 different criteria that a post-Census 2000 DSF add must meet in order to be included on the ACS frame. We identify each of the M10 filter criteria that each record on the DSF failed. Each erroneous exclusion record that was not included in the Census 2000 housing unit universe,

was not validated by a field operation prior to M10, and was not on the DSF was classified as being excluded because it was not on the DSF.

We examine the various categories of filter rule failures and identify filter rules that could benefit from further research to determine if enhancements to the filter could reduce the number of erroneous exclusions in the future. Table 5 in the Results section provides counts of erroneous exclusions for the nation for various groups of filter rule failures. Table A-6 in Appendix A provides the same information for each state.

Q5: What were the sources of housing units included on the M10 frame that were excluded from the 2010 Census? What was the cause of these invalidations?

The third and final type of difference between the M10 frame and the 2010 census housing unit universe are housing unit records that were included on the M10 frame but excluded from the 2010 Census housing unit universe. These are potential M10 filter errors of inclusion, a source of overcoverage on the M10 frame. To identify these erroneous inclusions, we matched all MAFIDs on the M10 frame to all records on the M12 MAF extract. Erroneous inclusions are records where the M10 MAFID was on the M12 MAF extract but was excluded from the 2010 Census housing unit universe.

A housing unit on the M10 frame could have been excluded from the 2010 Census housing unit universe if it received a negative action from a Census operation or it could have been excluded from the 2010 Census for other reasons. Where possible, we identified the source of the operation that invalidated the record using the source and status information from the M12 MAF extract. We then categorized the source of the invalidation as being from a pre-Census operation, another Census field operation, or as being a conversion from a housing unit to some other type of living quarter, such as a GQ or a transitory location.

If we could not find an operation that invalidated the record then we examined other status information to determine if the record was included in any 2010 Census operation. If a record was included in a 2010 Census operation but was not included in the final 2010 Census housing unit universe then we classified it as an "other invalidation" since we could not determine the operation that invalidated it. If the record was not included in any Census operation then it was classified as a "Census exclusion." Census exclusions are records that did not qualify to be included in any Census operation. An example of a category of Census exclusions is ungeocoded records. Another example is Census 2000 records that did not pass the filter to be included on the Address Canvassing address list.

Table 6 in the Results section provides counts of erroneous inclusions by M10 filter category. State-level counts of erroneous inclusions by M10 filter category are provided in Table A-7 of Appendix A.

We calculated an erroneous inclusion rate for each state and for the nation. The erroneous inclusion rate is calculated as the number of erroneous inclusions divided by the total number of housing units on the M10 frame so we can make statements like "x percent of the M10 housing unit frame was excluded from the 2010 Census."

Limitations

The data used to compare the various frames came from multiple MAF extracts created over 3 years and are subject to minor inconsistencies caused by ongoing MAF updates. Where possible, the data were grouped into broad categories to minimize the impact of these inconsistencies.

Counts of validations and invalidations may be overstated. Validations and invalidations rely on a match of individual MAF records using the MAFID, not the address represented by that MAF record. In the cases where multiple MAFIDs represent the same housing unit, the address may be counted as both a validation and an invalidation. For example, if MAFID A and MAFID B both represent the same housing unit and one is valid on the M10 frame while the other is a Census housing unit, then record A would be counted as an invalidation because it was not included in the Census and record B would be counted as a validation because it was a Census record excluded from M10. Both records represent the same housing unit but this cannot be determined with any confidence without an address match. We know this happened with some records flagged as duplicates on the M10 frame. We suspect this happened more often in cases where a lister corrected an address by deleting it and re-adding it. Some Census operations corrected geocodes by requiring listers or enumerators to delete records and then re-add them in the correct block. When the deleted record and the added record cannot be linked together then this would also result in a situation where the same housing unit is counted as both an erroneous inclusion and an erroneous exclusion.

Results

Q1: How many housing units were on the ACS sampling frames for ACS data year 2010? What changes were made to the ACS frame between M10 and S10?

Table 1 shows the breakdown of valid ACS records by ACS filter category for the two 2010 ACS sampling frames. The M10 frame was created using MAF extracts in July 2009, before Address Canvassing updates were incorporated into the MAF. More than 95 percent of the ACS sample was selected from the M10 frame. The S10 frame, which contained updates from Address Canvassing and GQV, was created in January 2010.

Table 1 M10 and S10 Housing Unit Frame Counts by Filter Category

General Filter Category	M10	S10	Difference (S10-M10)
Census HUs	115,497,055	132,436,687	16,939,632
Post Census 2000 DSF Adds	19,820,783	2,980,559	-16,840,224
Census Deletes on DSF	1,525,365	0	-1,525,365
Other Field Validations	669,851	0	-669,851
US Total	**137,513,054**	**135,417,246**	**-2,095,808**

Source: American Community Survey Master Address File Extracts (July 2009 and January 2010)

Nearly 17 million more records were classified as Census housing units in S10 than in M10 because of a change in how the ACS defined a Census record for the S10 sampling frame. A Census record for M10 was defined as a housing unit record included in Census 2000, while a Census record for S10 was defined as a housing unit record in the 2010 Census enumeration universe after Address Canvassing and GQV. Many of the post-Census 2000 DSF adds in M10 were reclassified as Census records for S10. This explains the large shift in the counts of valid housing unit records in the Census housing unit and post-Census 2000 DSF add categories in Table 1.

We no longer included the "Census deletes that persist on the DSF" category for S10 because records in that category should have been added or validated during Address Canvassing. We also excluded the other field validations category due to the end of the Special Census program and a moratorium on updating the MAF from the Demographic Area Address Listing during the 2010 Census. The counts for those two categories are shown in Table 1 as 0 for S10. Many of the records in those two categories in M10 were reclassified as Census HUs on the S10 frame.

Table A-1 in Appendix A provides a state-level breakdown of the M10 and S10 housing unit frame counts by ACS filter category.

The 2.1 million net decrease in the number of housing units on the ACS S10 frame shown in Table 1 can be broken down into three categories: 6.6 million newly added housing unit records (adds), 5.2 million housing unit records that failed the M10 filter but passed the S10 filter (validations), and 13.9 million invalidated housing unit records. The adds and validations represent undercoverage of the M10 frame while the invalidations represent overcoverage. Table 2 below provides a national breakdown of the sources of the adds, validations, and invalidations.

Table 2 Sources of Differences Between the M10 and S10 Frames

Source	Count
Census Adds	6,386,947
ACS DSF Adds	261,859
Census Validations	5,138,417
DSF Validations	47,580
Total Adds and Validations	**11,834,803**
Census Deletes	10,401,899
Census Duplicates	3,334,358
DSF Deletes	194,354
Total Invalidations	**13,930,611**
Net Difference	**-2,095,808**

Source: American Community Survey Master Address File Extracts (July 2009 and January 2010)

Adds and Validations

Adds between M10 and S10 could have come from one of three sources: Address Canvassing, GQV, or the DSF. Address Canvassing and GQV adds are included in the count of Census adds in Table 2. A

total of 5,964,065 (93.4 percent) of all Census adds in Table 2 came from Address Canvassing. GQV added another 369,868 housing units (5.8 percent) to the S10 frame. The new (post-M10) DSF records that were included in the Census enumeration universe were counted as Census adds in Table 2 since the 2010 Census enumeration universe filter included those records. There were 53,014 Census DSF adds which accounted for just 0.8 percent of all Census adds included on the S10 frame.

All new DSF records that were not in included in the 2010 Census enumeration universe were classified as ACS DSF adds. These DSF records were mainly ungeocoded DSF records and/or EDS records. There were 261,859 new DSF records on the S10 frame in the ACS DSF adds category in Table 2.

The "Census Validations" category consists of records that failed the M10 filter and became valid for ACS in S10 because a Census field operation validated the existing record. Address Canvassing accounted for 5,082,677 (98.9 percent) of all Census validations in Table 2.

There were 47,580 records counted in Table 2 as DSF validations. These are records where a DSF status change caused a previously invalid M10 housing unit record to convert to a valid housing unit record for S10. None of the DSF validations were included in the Census enumeration universe.

Invalidations

Invalidations are records that were on the ACS M10 sampling frame but were classified as invalid records for S10. The main source of invalidations was Address Canvassing, which deleted

A total of 9,837,247 (94.6 percent) of the 10.4 million Census deletes in Table 2 resulted from Address Canvassing. An additional 451,267 records (4.3 percent) did not meet the filter criteria to be included on the Address Canvassing address lists and were not re-added by Address Canvassing. Those records are also classified as Census deletes because they were excluded from the Census enumeration universe by the Address Canvassing filter.

Table 2 also shows that there were more than 3.3 million records classified as duplicates by a Census operation. A total of 3,051,010 (91.5 percent) of the Census duplicates were identified by Address Canvassing. The remaining 283,348 (8.5 percent) were identified by GQV.

Another 194,354 records in Table 2 are classified as DSF deletes. These records did not have a negative action from Address Canvassing or GQV but were excluded from the S10 frame because of a DSF status change. These could be records that were deleted from the DSF or were converted to business records on the DSF. They could also be records with a geocoding status change from a block outside the duplication zone to a block inside the duplication zone. This category of invalidations also includes DSF records that were identified as duplicates by the LACS file.

Table 2 shows that the total number of adds and validations for S10 was 11,834,803 and the number of invalidations was 13,930,611. This represents a net loss of 2,095,808 housing units on the S10 frame.

Most of this change to the S10 frame was due to Address Canvassing. Address Canvassing accounted for 11,046,742 (93.3 percent) of all adds/validations and 12,888,257 (92.5 percent) of all invalidations.

Table A-2 in Appendix A provides the counts of adds, validations, and invalidations for each state.

Q2: How does the count of housing units on the 2010 ACS sampling frame compare to the 2010 Census housing unit count?

The ACS M10 sampling frame contained 137,513,054 housing units. The count dropped to 135,417,246 for S10, mainly as a result of the national Address Canvassing operation as discussed in the previous section. The stateside count of Census 2010 housing units from the M12 MAF extracts was 131,704,730. This is consistent with the official 2010 Census housing unit count for the United States; however, there are minor differences at the state level due to changes for individual MAF records that occurred between the time that the final Census status was determined in late 2010 and the time ACS first received the Census status in mid-2011. Table A-3 in Appendix A shows the number of 2010 Census housing units from the M12 MAF extract and the official 2010 Census count for each state.

The final 2010 Census count of housing units was much lower than both the ACS M10 and S10 frame counts. Taking the 2010 Census housing unit count as "truth" there was 4.4 percent overcoverage in the ACS M10 frame and 2.8 percent overcoverage on the S10 frame. This is not surprising given that the National Estimates of Coverage reports show that net overcoverage in the ACS frame has steadily increased from 1.9 percent in 2002 to 5.2 percent in 2009 (Kephart, 2010).

Table 3 provides a breakdown of the differences between the 2010 Census housing unit count and the number of housing units on the ACS M10 frame. The net difference of 5,808,324 housing units is made up of 17,310,789 housing units that were valid for M10 but excluded from the 2010 Census (erroneous inclusions) and 11,502,465 housing units that were excluded from the M10 frame but were included in the final Census housing unit universe. Those 11,502,465 records include 6,412,480 housing units that were missing from the MAF altogether in M10 (omissions) and 5,089,985 records that were on the MAF but were invalidated by the M10 ACS filter (erroneous exclusions).

Table 3 Sources of Differences Between the M10 Frame and the Census Universe of HUs

Type of Operation	Omissions	Erroneous Exclusions	Erroneous Inclusions	Net Change
Pre-Census Operations	5,278,307	4,652,901	12,041,952	-2,110,744
Census Field Operations	965,082	185,889	2,229,058	-1,078,087
Census Exclusions	0	0	2,899,121	-2,899,121
Administrative Sources	132,867	230,904	0	363,771
Conversions	0	20,196	39,341	-19,145
Other	36,224	95	101,317	-64,998
Total	**6,412,480**	**5,089,985**	**17,310,789**	**-5,808,324**

Source: American Community Survey Master Address File Extracts (July 2009 and July 2011)

At the national level, the 6.4 million omissions from the MAF represents 4.9 percent of the 131.7 million 2010 Census housing units. Another 3.9 percent of the 2010 Census housing units were erroneously excluded from the M10 frame by the M10 filter. In addition, 12.6 percent of the 137.5 million housing units on the M10 frame were erroneously included on the M10 frame.

The 17.3 million erroneous inclusions and the 5.1 million erroneous exclusions in Table 3 are records on the M10 MAF extract where the M10 filter provided a different result than the 2010 Census. Pre-Census and Census field operations corrected more than 85 percent of these 22.4 million M10 filter errors. ACS should consider research to determine if filter rules could be modified to reduce the number of those errors.

Similarly, pre-Census and Census field operations added 97.4 percent of the 6.4 million housing units that were missing from the M10 MAF extract.

The pre-Census operations in Table 3 are Address Canvassing and GQV. These operations added, validated, and invalidated more records than any other group of operations between M10 and the 2010 Census and account for most of the difference between the M10 frame and the final Census housing unit universe.

Census field operations resulted in a net decrease of 1,078,087 housing units from M10 to the Census. These operations added or validated 1,159,071 housing units and invalidated another 2,229,058 housing unit records. Census Field operations include Update/Leave, Update/Enumerate, Remote Update/Enumerate, Remote Alaska, Group Quarters Enumeration, Enumeration of Transitory Locations, Nonresponse Follow up, Vacant/Delete Check, and Field Verification.

The 2,899,121 Census exclusions are records that were valid for M10 but were excluded from the final 2010 Census housing unit universe without being invalidated by any Census operation. These records did not meet the criteria for inclusion on the Address Canvassing address list and were not added by any Census operation. A total of 2,243,103 of those exclusions were ungeocoded addresses, almost all of which were from the DSF. The remaining 656,018 Census exclusion records were geocoded records that were neither included in nor found by any 2010 Census operation.

Administrative sources added or validated another 363,711 records that were not on the M10 frame. HU Count Review, GQ Count Review, the New Construction operation, and LUCA Appeals are considered Administrative sources for purposes of Table 3.

There were 39,341 records that converted from a housing unit in M10 to a non-HU (GQ or transitory location) for the 2010 Census and 20,196 records that changed from a GQ in M10 to a housing unit in the Census.

Table A-4 in Appendix A provides state-level counts of omissions, erroneous exclusions, and erroneous inclusions for M10 as well as omission rates, erroneous exclusion rates, and erroneous inclusion rates.

Since the ACS relies mainly on the DSF to update the ACS frame between censuses, we would expect there to be more errors in areas of the country where there is lower DSF coverage of city-style addresses. In those areas, matching new addresses to the MAF is difficult due to the lack of city-style addresses. For example, 101 MAIN ST can be matched to 101 N MAIN ST but it cannot be matched to RR 6 BOX 22. In areas without city-style addresses used for mailing, field operations are necessary to update the frame.

Table A-5 in Appendix A includes a net error rate, gross error rate, percentage of city-style addresses, and the DSF coverage rate for each state. Table 4 below is an excerpt of Table A-5 showing the 5 states with the highest gross error rates.

Table 5 M10 Error Rates, City Style Address Percentage, and DSF Coverage Rates for M10

		Error Rates						Percent City-Style Addresses	DSF Coverage
State	State Name	Omissions (A)	Erroneous Exclusions (B)	Erroneous Inclusions (C)	All Exclusions (A+B)	Net (C-B-A)	Gross (A+B+C)		
54	West Virginia	21.1%	6.1%	31.3%	27.2%	4.1%	**58.5%**	**64.2% (51)**	**54.2% (51)**
50	Vermont	7.0%	20.6%	29.1%	27.7%	1.5%	**56.8%**	**86.7% (48)**	**63.6% (49)**
23	Maine	13.7%	7.3%	24.2%	21.0%	3.2%	**45.2%**	**81.7% (49)**	**65.4% (48)**
02	Alaska	14.4%	8.0%	21.1%	22.4%	-1.2%	**43.5%**	**78.4% (50)**	**61.9% (50)**
35	New Mexico	12.3%	6.9%	22.2%	19.1%	3.1%	**41.3%**	**89.5% (47)**	**75.4% (45)**

Source: American Community Survey Master Address File Extracts (July 2009 and July 2011)

The state-level rankings are provided in parentheses in the "Percent City-Style Address" and "DSF Coverage" columns. Table 5 shows that the 5 states with the highest gross error rates are the same 5 states with the lowest percentage of city-style addresses. In addition, those five states include the 4 states with the lowest DSF coverage rate. New Mexico has the 7th lowest DSF coverage rate. It seems clear that in order to reduce errors on the ACS frame, we need to do a better job updating the MAF between censuses in areas that do not have city-style mailing addresses.

The three categories of M10 errors – omissions, erroneous exclusions, and erroneous inclusions – are further discussed below in the sections for research questions 3, 4, and 5, respectively.

Q3: What were the sources of housing units that were counted in the 2010 Census but were not on the M10 MAFextract?

The 6.4 million adds in Table 3 are records that ACS could not have included on the 2010 ACS sampling frame because they were not on the MAF at the time of M10 frame creation. This means that 4.9% of the total 2010 Census housing unit universe was omitted from the MAF at the time of M10 sampling frame creation.

Pre-Census and Census field operations added about 6.2 million, or 97.4 percent, of the records that were not on the MAF at the time of M10 frame creation. Pre-Census field operations accounted for 82.3 percent of all adds. Other Census field operations made up another 15.1 percent of the adds. Nearly 5.6

million of the 6.2 million field adds (89.7 percent) did not appear on any vintage of the DSF through the spring of 2011 and, therefore, would not have been on the MAF without those field operations.

Only 702,035 of all 6.4 million adds (10.9 percent) appeared on the spring 2011 DSF and would have been eligible for inclusion on the ACS sampling frame for 2012, two years after the 2010 Census. This illustrates the need for field operations to keep the inventory of housing units on the MAF current for ACS.

Table A-4 provides a count of omissions and an omission error rate for every state. As mentioned in the previous section, Table A-5 includes error rates as well as the percentage of city-style addresses and the DSF coverage rates for each state.

Seven states (Alaska, Hawaii, Maine, Montana, New Mexico, West Virginia, and Wyoming) had an omission rate of 10 percent or more, meaning that at least 10 percent of the 2010 Census housing units in those states were not included on the MAF until after ACS created the M10 sampling frame. Six of the seven states with the highest omission rates also have the lowest DSF coverage rates. This is not surprising since ACS relies on the DSF to add new housing units to the ACS frame. Areas not covered by the DSF – or more accurately, areas without city-style addresses on the DSF – are likely to have more coverage issues on the ACS frame.

West Virginia had the highest omission rate (21.1 percent) and the lowest DSF coverage rate (54.2 percent). It is the only state with a DSF coverage rate below 60 percent. The percentage of city-style addresses on the M10 frame in West Virginia was also lower than any other state. Only 64.2 percent of addresses on the M10 frame in West Virginia were city-style addresses. The state with the next lowest percentage of city-style addresses was Alaska where 78.4 percent of the M10 addresses were city-style addresses.

Q4: Why did the ACS M10 filter exclude housing units that were on the M10 MAF extract and counted in the 2010 Census?

There were 5,089,985 records on the M10 extract that were excluded from the ACS sampling frame by the M10 filter but were determined to be good housing unit records in the 2010 Census. That represents 3.9% of the Census housing unit universe that was erroneously excluded from the M10 frame and later validated by the 2010 Census. We reapplied the M10 filter criteria to these records to determine why the filter excluded those records. Table 5 shows the national results.

Table 5 M10 Erroneous Exclusions

Filter Rule Failure	Count
Duplicates	738,451
Nonresidential	199,558
LUCA Adds	2,127,346
Not on DSF	203,907
DSF - Duplication Zone	510,984
DSF - Date Test	649,891
DSF – Other	592,968
Other	66,880
Total	**5,089,985**

Source: American Community Survey Master Address File Extract (July 2009 and July 2011)

Records on the MAF flagged as duplicates are excluded from the ACS frame regardless of source. The 738,451 records included in the Census that were on the M10 MAF extract as duplicates could be MAF errors or they could be situations where ACS included one record from a duplicate pair while the Census included the other.

There were 464,627 duplicate records (62.9 percent) where the record it duplicated was on the M10 frame. These are cases where MAFID A and MAFID B represent the same housing unit, MAFID A was excluded from the M10 frame because it was a duplicate but MAFID B was included on the M10 frame. In these cases, ACS had coverage of the housing unit in M10. MAFID A was then counted as a good housing unit in the 2010 Census. For 334,939 (72.1 percent) of these cases, MAFID B was excluded from the 2010 Census so the housing unit that was represented by MAFID B for M10 is now represented by MAFID A.

In the above example, MAFID A is an erroneous exclusion from the M10 frame and MAFID B is an erroneous inclusion. This results in both an error of inclusion and an error of exclusion for that housing unit even though the housing unit represented by both MAFID A and MAFID B is included on the M10 frame and in the 2010 Census. This is one example of why the counts of gross errors on the M10 frame are overstated to some unknown extent.

However, there were 129,688 M10 duplicate pairs where MAFID A and MAFID B were both counted in the Census. These cases are either MAF errors in M10 where MAFID A should not have been identified as a duplicate of MAFID B or they are Census errors where MAFID A and B represent the same housing unit but the Census failed to identify one of them as a duplicates. It is not possible to determine which error applies for each of these cases given the data available on the MAF extracts.

The 199,558 Census 2010 housing unit records that were erroneously excluded from the M10 frame as nonresidential addresses are likely to be MAF errors that were corrected during the 2010 Census.

The largest category of erroneous exclusions was records that were added by LUCA. The ACS excludes LUCA adds from the frame until they have been field verified. LUCA adds accounted for 41.8% of all erroneous exclusions. Since LUCA addresses were such a large component of gross undercoverage on

the M10 frame, DSSD should investigate whether or not including those records before they have been field verified would negatively affect the ACS frame. Note: the LUCA adds category of erroneous exclusions only includes those LUCA adds that were not on the DSF. If a LUCA add matched to a DSF record then that record was treated as a DSF record for filtering purposes.

There were another 203,907 records that were not on the DSF, not included in the Census 2000 housing unit universe, and were not validated by any field operation between Census 2000 and Address Canvassing. Many of these records were records that were on older versions of the DSF but not on the most recent DSF.

Post-Census DSF adds must meet several criteria in order to be valid for the ACS. There are three counts in Table 5 for DSF filter rule failures accounting for a total of 1,753,843 erroneous exclusions.

- There were 649,891 records that failed only the "DSF date test" criterion. The DSF date test invalidates "old" DSF records that have never been validated by a field operation. For M10, any residential DSF record that appeared on the DSF for the first time prior to November 1999 was excluded from consideration as a post-2000 Census DSF add because we would have expected the 2000 Census to validate that address if it existed. DSSD should examine the DSF date test criterion given the large number of these older DSF records that were validated by the 2010 Census operations.
- There were 510,984 records that failed only the duplication zone criteria. The duplication zone is an area where ACS does not use post-Census DSF adds because of the increased risk that those records duplicate existing non city-style addresses. If these records are duplicates, then it's possible that the ACS included the non city-style address while the 2010 Census invalidated that record and validated the city-style DSF record. However, there are undoubtedly some post-Census DSF records in the duplication zone that represent new construction. This merits further investigation that is outside the scope of this report.
- There were 592,968 records that failed more than just the DSF date test or duplication zone criteria. Most of those records failed multiple criteria; however, there were 156,922 records in this "Other DSF" category that were excluded from the M10 frame because they were unmatched LACS records and were likely to be duplicates of other addresses on the frame.

Given that the DSF is the largest source of intercensal updates to the MAF, DSSD should investigate the 1.8 million erroneous exclusions from the DSF to determine if filter rules can be modified to reduce the number of these errors.

The remaining 66,880 erroneous exclusions were excluded from ACS because they were deleted by field operations or because they were incorrectly flagged as GQs on the MAF.

Table A-6 provides state-level counts for each of the above filter rule failure categories.

Table A-4 provides a count of erroneous exclusions and the erroneous exclusion error rate for every state. (Note that the national counts of erroneous exclusions in Table 5 above and Table A-6 in Appendix A are 1,824 lower that the count of erroneous exclusions in Table A-4 in Appendix A. The national count in

Table A-4 is a sum of the state-level counts which include records that moved from one state to another between M10 and the 2010 Census. There are 1,824 such state corrections. Those records are counted in Table A-4 as erroneous inclusions in the state where they were located for M10 and as erroneous exclusions from the state where they were counted in the 2010 Census. However, those 1,824 records are geocoding corrections, not filter rule failures.)

There was only one state where more than 10 percent of the 2010 Census housing unit records were excluded by the M10 filter. Vermont had a 20.6 percent erroneous exclusion rate. More than half of the 66,494 erroneous exclusions in Vermont were LUCA adds that ACS excluded because they had not been validated by a field operation prior to M10. There were other states where LUCA adds made up a higher percentage of the erroneous exclusions than Vermont; however, the LUCA adds in Vermont that were excluded by the M10 filter made up more than 11 percent of the total 2010 Census housing unit count in that state. In addition, erroneously excluded DSF records also made up a large percentage (7.5 percent) of the 2010 Census housing units in Vermont.

Q5: What were the sources of housing units included on the M10 frame that were excluded from the 2010 Census? What was the cause of these invalidations?

There were 17,310,789 valid M10 housing unit records that were not included in the final 2010 Census universe of housing units. These records are considered to be erroneous inclusions on the M10 frame that were invalidated by the 2010 Census. This category of records represents 12.6 percent of all valid records on the ACS M10 frame. Table 6 shows the number of records erroneously included in each of the major M10 filter categories.

Table 6 M10 Erroneous Inclusions by Filter Category

M10 Filter Category	M10 Count	Invalidations	Percent of M10 Count
Census 2000 HUs	115,497,055	12,461,395	10.8%
Post Census DSF Adds	19,820,783	4,350,008	21.9%
Census Deletes on DSF	1,525,365	292,781	19.2%
Other Field Validations	669,851	206,605	30.8%
US Total	**137,513,054**	**17,310,789**	**12.6%**

Source: American Community Survey Master Address File Extracts (July 2009 and July 2011)

Almost 11 percent of the Census 2000 housing unit records that were valid for ACS in M10 were invalidated during the 2010 Census. Census 2000 housing unit records account for 72.0 percent of all erroneous inclusions on the M10 frame.

Post-Census 2000 DSF adds made up another 25.1 percent of the erroneous inclusions. The fact that nearly 22 percent of the post Census DSF adds on the M10 frame were excluded from the 2010 Census is troubling because the DSF is the largest source of intercensal updates to the MAF. There is not a way to determine using MAF data how many were excluded from the 2010 Census because they were planned new construction that had not been built in time to be included in the 2010 Census.

Of the 4.4 million erroneous inclusions in the Post-Census DSF add category, 2.4 million (55.8 percent) were EDS records on the DSF. Approximately 1.3 million of those EDS records were ungeocoded. Overall, 2.3 million of the 4.4 million erroneously included post-Census DSF adds were ungeocoded.

Table A-7 in Appendix A provides state-level counts of M10 erroneous inclusions by M10 filter category.

Table A-4 provides a count of erroneous inclusions and the erroneous inclusion error rate for every state. (Note that the national count of erroneous inclusions in Table 6 above and Table A-7 in Appendix A are 1,824 lower that the count of erroneous inclusions in Table A-4 in Appendix A. The national count in Table A-4 is a sum of the state-level counts which include records that moved from one state to another between M10 and the 2010 Census. There are 1,824 such state corrections. Those records are counted in Table A-4 as erroneous inclusions in the state where they were located for M10 and as erroneous exclusions from the state where they were counted in the 2010 Census; however those 1,824 records are geocoding corrections, not erroneous inclusions.)

The erroneous inclusion rate was higher than the erroneous exclusion rate for all states. There were 7 states (Alabama, Alaska, Maine, Mississippi, New Mexico, Vermont, and West Virginia) where more than 20 percent of the housing units on the M10 sampling frame were excluded from the Census universe of housing units. As previously mentioned, the largest contributor of erroneous inclusions on the M10 frame was Census 2000. West Virginia had a 31.3 percent erroneous inclusion rate. More than 87.3 percent of those erroneous inclusions were Census 2000 addresses. Vermont also had a high erroneous inclusion rate (29.1 percent), of which 88.5 percent were Census 2000 addresses.

Census 2000 contributed a larger percentage of invalid addresses to the M10 frame than any other source for every state; however, there were some states where the DSF also contributed greatly to these errors. The DSF contributed more than 30% of the erroneous inclusions in 10 states (Arizona, Colorado, Delaware, Florida, Georgia, Iowa, Nebraska, Nevada, Texas, and Utah). While it may be difficult to identify categories of Census records that should be excluded from the ACS frame, ACS should conduct research to determine if filter rules could be improved to filter out more of the questionable DSF records.

Summary and Conclusions

Summary

The ACS M10 sampling frame was created in July 2009 and contained no updates from 2010 Census field operations. Although new addresses from the LUCA program were reflected on the M10 ACS MAF extract, the ACS excluded those records from the sampling frame until after they were field verified. There were 137.5 million housing units on the stateside M10 sampling frame from which 95.5 percent of the 2010 ACS sample was selected.

The ACS S10 sampling frame was created in January 2010 and included updates from both Address Canvassing and GQV. Address Canvassing had a major impact on the S10 frame. It added or validated

nearly 11 million housing unit records that were missing from the M10 frame. It also deleted or invalidated almost 13 million housing unit records that were on the M10 frame. There were 135.4 million housing units on the stateside S10 sampling frame.

The 2010 Census address list was compiled during Address Canvassing and was updated with results from the various Census enumeration and follow up operations. The final Census universe of housing units was determined in late 2010 and was available to ACS beginning in July 2011. There were 131.7 million housing units included in the final 2010 Census universe of housing units.

The difference between the ACS M10 count of housing units and the 2010 Census count was 5.8 million housing units. This difference was made up of 6.4 million omissions (2010 Census housing unit records that were not on the M10 MAF extract), 5.1 million erroneous exclusions (2010 Census housing unit records that were on the M10 MAF extract but were invalid for ACS in M10), and 17.3 million erroneous inclusions (records that were on the ACS M10 frame but excluded from the 2010 Census).

The 6.4 million post-M10 adds translates to a 4.9 percent omission error rate for M10. Of the 6.4 million 2010 Census housing unit records that were missing from the M10 ACS MAF extract, 6.2 million were added by one of the various Census field operations, beginning with Address Canvassing. Address canvassing accounted for 5.0 million (77.5 percent) of all adds. Only 702,035 of all 6.4 million adds (10.9 percent) appeared on the spring 2011 DSF and would have been eligible for inclusion on the ACS sampling frame for 2012, two years after the Census.

Erroneous exclusions from M10 are housing unit records that were excluded from the M10 frame by the filter and later validated and included in the final 2010 Census universe of housing units. The 5.1 million records in this category results in a national erroneous exclusion rate of 3.9 percent. About 41.8 percent of the 5.1 million erroneous exclusions were added by the LUCA program. LUCA adds were intentionally excluded from the ACS frame until they were field verified. An additional 13.1 percent of the erroneous exclusions were DSF records that were excluded from the M10 frame because they were potential duplicates. Another 12.8 percent were older DSF records that first appeared on the DSF prior to Census 2000 but were not found in Census 2000.

Erroneous inclusions on the M10 frame are housing unit records that were included on the M10 frame but later invalidated and not included in the 2010 Census universe of housing units. There were 17.3 million erroneous inclusions, resulting in a national erroneous inclusion rate of 12.6%. Of the 17.3 million erroneous inclusions, 72.0 percent were housing unit records that were counted in Census 2000. About 25.1 percent of the erroneous inclusions were records categorized as post-Census 2000 DSF adds. More than half of the invalidated post-Census 2000 DSF adds were ungeocoded DSF records.

Conclusions

Differences between the ACS 2010 sampling frames and the 2010 Census housing unit universe may contribute to differences between the Census vacancy rate and the 2010 ACS estimate of the vacancy rate. The methodology used to compare the ACS frame to the Census housing unit universe in this report do

not lead to any conclusions about the cause of the vacancy rate differences. However, if records erroneously included on the M10 ACS frame are more likely to be identified as vacant housing units by the ACS, then ACS could overestimate the number of vacant housing units. Similarly, if records missing from the ACS M10 frame are more likely to be occupied housing units in the 2010 Census then that would result in the ACS underestimating the number of occupied housing units.

Research should be conducted to determine if improvements to the ACS filter can be made to reduce the number of erroneous inclusions and exclusions. Potential areas of research may include:

- the use of the DSF date test, which invalidates older DSF records that were not picked up by the Census;
- the duplication zone definition, which invalidates DSF records that may be more likely to duplicate existing non city-style addresses; and
- whether ACS should reconsider its policy of excluding LUCA adds from the ACS frame before they have been verified by a field operation

Areas of the country without city-style mail delivery require field operations to adequately update the frame. Large-scale national field operations typically occur every ten years in preparation for the Decennial Census. During intercensal years, coverage of housing units on the MAF, and therefore the ACS frame, suffers in those areas.

Table of Acronyms

The following table provides a list of acronyms used in this report.

Acronym	Translation
ACS	American Community Survey
ACSO	American Community Survey Office
DSF	Delivery Sequence File
DSSD	Decennial Statistical Studies Division
EDS	Exclude from Delivery Statistics
GQ	Group Quarters
GQV	Group Quarters Validation
HU	Housing Unit
LACS	Locatable Address Conversion System
LUCA	Local Update of Census Addresses
M10	2010 ACS Main Phase
M12	2012 ACS Main Phase
MAF	Master Address File
MTdb	MAF/TIGER Database
S10	2010 ACS Supplemental Phase
USPS	United States Postal Service
TIGER	Topologically Integrated Geographic Encoding and Referencing System

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Appendix A   State-Level Tables Referenced in Report

Table A-1 State-Level M10 and S10 Housing Unit Frame Counts by Filter Category

State	State Name	M10 Sampling Frame						S10 Sampling Frame				Change Between M10 and S10
		Total HUs	Valid HUs	Census HUs	DSF Adds	Census Deletes	Field Adds	Total HUs	Valid HUs	Census HUs	DSF Adds	
01	Alabama	3,224,847	2,383,873	1,956,165	386,334	28,023	13,351	3,409,262	2,262,273	2,175,879	86,394	-121,600
02	Alaska	450,100	302,108	259,156	32,340	2,626	7,986	488,198	312,572	308,365	4,207	10,464
04	Arizona	3,891,082	2,936,590	2,172,228	701,995	37,623	24,744	4,093,133	2,939,071	2,856,295	82,776	2,481
05	Arkansas	1,928,002	1,419,055	1,166,476	199,658	12,621	40,300	2,025,807	1,362,323	1,328,179	34,144	-56,732
06	California	17,734,031	13,854,334	12,178,846	1,513,832	124,977	36,679	18,211,275	13,846,450	13,701,076	145,374	-7,884
08	Colorado	3,037,743	2,274,894	1,805,044	440,918	23,382	5,550	3,133,504	2,274,283	2,224,271	50,012	-611
09	Connecticut	1,911,247	1,512,781	1,384,724	107,239	20,353	465	1,947,508	1,498,679	1,487,183	11,496	-14,102
10	Delaware	587,934	455,965	342,090	105,586	4,593	3,696	615,437	441,940	398,965	42,975	-14,025
11	District of Columbia	386,850	306,727	274,257	26,773	4,919	778	397,802	303,914	301,727	2,187	-2,813
12	Florida	12,505,307	9,377,080	7,278,415	1,965,381	112,551	20,733	12,898,531	9,144,643	8,929,123	215,520	-232,437
13	Georgia	6,161,621	4,392,689	3,272,361	1,051,824	51,122	17,382	6,430,192	4,285,356	4,085,730	199,626	-107,333
15	Hawaii	733,296	526,379	457,686	58,773	5,766	4,154	786,035	521,036	512,262	8,774	-5,343
16	Idaho	943,037	680,446	524,748	146,841	5,838	3,019	1,004,456	695,819	674,723	21,096	15,373
17	Illinois	7,348,689	5,626,321	4,875,669	516,194	80,531	153,927	7,495,664	5,433,292	5,345,302	87,990	-193,029
18	Indiana	3,757,452	2,965,138	2,527,481	372,823	39,808	25,026	3,851,084	2,878,165	2,812,945	65,220	-86,973
19	Iowa	1,790,479	1,427,669	1,229,192	170,521	10,857	17,099	1,825,110	1,384,845	1,351,282	33,563	-42,824
20	Kansas	1,667,188	1,303,860	1,126,935	162,492	11,991	2,442	1,709,452	1,279,131	1,247,806	31,325	-24,729
21	Kentucky	2,809,949	2,055,861	1,744,117	277,177	21,412	13,155	2,974,672	2,000,662	1,964,735	35,927	-55,199
22	Louisiana	2,796,723	2,158,516	1,842,351	281,679	31,066	3,420	2,932,398	2,044,467	2,003,300	41,167	-114,049
23	Maine	1,086,060	752,121	646,265	91,831	4,869	9,156	1,184,794	742,701	728,108	14,593	-9,420
24	Maryland	3,049,372	2,446,414	2,142,807	273,527	27,381	2,699	3,109,825	2,396,809	2,365,629	31,180	-49,605
25	Massachusetts	3,621,904	2,868,810	2,618,070	213,757	36,054	929	3,709,612	2,852,341	2,826,402	25,939	-16,469
26	Michigan	5,935,559	4,756,758	4,227,782	470,709	52,683	5,584	6,092,762	4,673,470	4,595,602	77,868	-83,288
27	Minnesota	3,137,707	2,433,585	2,058,671	348,697	21,155	5,062	3,226,666	2,400,537	2,352,162	48,375	-33,048
28	Mississippi	1,936,588	1,429,531	1,156,870	250,245	16,770	5,646	2,062,950	1,351,194	1,298,314	52,880	-78,337
29	Missouri	3,804,716	2,868,115	2,435,614	399,633	26,726	6,142	3,970,503	2,816,850	2,736,230	80,620	-51,265
30	Montana	700,695	486,157	409,805	70,292	2,742	3,318	753,531	496,121	487,293	8,828	9,964
31	Nebraska	1,075,694	842,073	720,916	112,747	5,685	2,725	1,106,998	825,304	806,216	19,088	-16,769
32	Nevada	1,575,468	1,188,068	821,699	352,727	8,628	5,014	1,636,636	1,177,809	1,136,576	41,233	-10,259
33	New Hampshire	830,121	625,874	544,208	71,506	5,300	4,860	883,484	625,935	614,816	11,119	61
34	New Jersey	4,630,505	3,693,108	3,305,802	330,964	53,110	3,232	4,747,538	3,625,552	3,563,908	61,644	-67,556
35	New Mexico	1,319,564	936,914	773,639	148,703	10,666	3,906	1,435,659	932,207	909,263	22,944	-4,707
36	New York	11,141,106	8,374,259	7,649,864	595,968	115,166	13,261	11,497,924	8,357,299	8,293,718	63,581	-16,960
37	North Carolina	6,472,897	4,537,099	3,471,933	955,608	42,291	67,267	6,739,229	4,456,061	4,348,842	107,219	-81,038
38	North Dakota	443,596	329,687	288,786	37,409	2,349	1,143	465,309	325,658	321,682	3,976	-4,029
39	Ohio	6,625,101	5,368,291	4,777,977	529,531	55,817	4,966	6,753,534	5,251,772	5,178,805	72,967	-116,519
40	Oklahoma	2,369,028	1,761,473	1,507,318	228,394	16,530	9,231	2,525,639	1,736,903	1,673,266	63,637	-24,570
41	Oregon	2,152,952	1,720,148	1,446,859	249,641	20,763	2,885	2,232,752	1,717,273	1,685,451	31,822	-2,875
42	Pennsylvania	7,586,716	5,834,073	5,234,591	522,797	68,554	8,131	7,897,635	5,714,141	5,600,418	113,723	-119,932
44	Rhode Island	588,070	479,339	439,310	32,508	7,272	249	605,441	472,990	469,316	3,674	-6,349
45	South Carolina	3,257,480	2,272,984	1,746,921	478,469	31,843	15,751	3,384,590	2,211,227	2,147,473	63,754	-61,757
46	South Dakota	491,679	378,898	321,289	52,655	2,219	2,735	518,217	376,129	367,437	8,692	-2,769
47	Tennessee	3,886,574	2,992,116	2,433,287	510,729	39,702	8,398	4,041,411	2,910,479	2,840,886	69,593	-81,637
48	Texas	14,217,446	10,585,473	8,122,211	2,300,938	114,398	47,926	14,896,555	10,455,896	10,020,077	435,819	-129,577
49	Utah	1,271,923	1,000,816	766,914	220,450	11,252	2,200	1,352,630	1,022,421	981,325	41,096	21,605
50	Vermont	547,935	329,281	290,246	32,042	2,693	4,300	569,872	330,944	327,399	3,545	1,663
51	Virginia	4,559,772	3,443,962	2,897,342	512,863	25,487	8,270	4,711,169	3,416,611	3,356,715	59,896	-27,351
53	Washington	3,671,713	2,946,955	2,443,276	465,113	33,042	5,524	3,850,296	2,975,843	2,909,129	66,714	28,888
54	West Virginia	1,280,802	934,483	840,161	78,705	5,079	10,538	1,462,916	911,240	883,949	27,291	-23,243
55	Wisconsin	3,326,044	2,673,095	2,316,463	327,728	26,180	2,724	3,425,746	2,679,145	2,638,476	40,669	6,050
56	Wyoming	360,407	262,808	222,218	35,517	2,900	2,173	385,536	269,463	262,656	6,807	6,655
US	Total	180,620,771	137,513,054	115,497,055	19,820,783	1,525,365	669,851	187,466,879	135,417,246	132,436,687	2,980,559	-2,095,808

Source: American Community Survey Master Address File Extracts (July 2009 and January 2010)

Appendix A State-Level Tables Referenced in Report

Table A-2 State-Level Sources of Differences Between the M10 and S10 Frames

State	State Name	Adds and Validations			Invalidations			
		Census Adds	Census Validations	DSF Adds/ Validations	Census Deletes	Census Duplicates	DSF Deletes	Net Change
01	Alabama	173,539	112,229	7,780	-342,441	-68,176	-4,531	-121,600
02	Alaska	36,980	24,520	508	-33,261	-17,024	-1,259	10,464
04	Arizona	177,994	137,935	15,893	-249,445	-74,537	-5,359	2,481
05	Arkansas	93,918	75,874	2,190	-169,428	-56,383	-2,903	-56,732
06	California	449,346	265,039	14,168	-563,775	-164,754	-7,908	-7,884
08	Colorado	87,297	114,911	4,745	-142,655	-60,806	-4,103	-611
09	Connecticut	35,060	35,549	1,114	-61,370	-23,922	-533	-14,102
10	Delaware	24,403	12,542	2,791	-38,154	-14,935	-672	-14,025
11	District of Columbia	10,109	6,060	886	-14,903	-4,942	-23	-2,813
12	Florida	352,659	386,942	19,426	-797,706	-179,879	-13,879	-232,437
13	Georgia	244,467	278,069	14,518	-516,169	-118,336	-9,882	-107,333
15	Hawaii	50,425	9,614	877	-41,051	-24,415	-793	-5,343
16	Idaho	58,650	36,709	1,758	-60,900	-19,453	-1,391	15,373
17	Illinois	135,588	98,649	8,266	-338,727	-93,236	-3,569	-193,029
18	Indiana	87,379	69,029	5,854	-205,473	-39,441	-4,321	-86,973
19	Iowa	29,269	28,960	3,740	-84,498	-18,894	-1,401	-42,824
20	Kansas	36,299	42,726	4,397	-81,306	-25,654	-1,191	-24,729
21	Kentucky	155,667	110,238	3,097	-241,001	-78,910	-4,290	-55,199
22	Louisiana	128,482	64,656	4,641	-265,813	-44,398	-1,617	-114,049
23	Maine	95,540	53,321	2,304	-114,642	-44,347	-1,596	-9,420
24	Maryland	55,594	69,561	3,828	-141,021	-36,948	-619	-49,605
25	Massachusetts	83,603	70,227	2,605	-127,807	-44,173	-924	-16,469
26	Michigan	150,976	127,927	7,865	-274,776	-92,676	-2,604	-83,288
27	Minnesota	91,072	96,440	2,166	-144,236	-74,280	-4,210	-33,048
28	Mississippi	120,458	57,671	4,010	-209,095	-47,702	-3,679	-78,337
29	Missouri	157,925	116,348	4,795	-237,640	-83,995	-8,698	-51,265
30	Montana	50,330	36,324	982	-51,897	-24,693	-1,082	9,964
31	Nebraska	28,826	18,402	1,547	-49,917	-15,038	-589	-16,769
32	Nevada	52,754	54,043	4,380	-93,680	-27,365	-391	-10,259
33	New Hampshire	51,386	28,326	682	-56,962	-22,680	-691	61
34	New Jersey	108,970	66,046	5,197	-202,800	-43,207	-1,762	-67,556
35	New Mexico	110,978	58,021	2,152	-130,464	-44,093	-1,301	-4,707
36	New York	344,781	398,272	7,451	-483,987	-278,030	-5,447	-16,960
37	North Carolina	247,429	327,328	13,688	-488,207	-166,689	-14,587	-81,038
38	North Dakota	20,649	14,856	418	-28,541	-10,780	-631	-4,029
39	Ohio	120,212	97,131	6,154	-274,644	-63,049	-2,323	-116,519
40	Oklahoma	146,049	72,592	8,263	-180,743	-63,773	-6,958	-24,570
41	Oregon	74,649	42,113	4,243	-91,300	-31,550	-1,030	-2,875
42	Pennsylvania	294,470	218,188	12,593	-467,531	-167,250	-10,402	-119,932
44	Rhode Island	16,572	4,368	587	-23,440	-4,289	-147	-6,349
45	South Carolina	117,275	162,092	7,477	-276,374	-63,234	-8,993	-61,757
46	South Dakota	24,900	11,536	1,137	-27,708	-11,409	-1,225	-2,769
47	Tennessee	144,927	108,751	7,658	-271,597	-65,385	-5,991	-81,637
48	Texas	613,020	433,061	52,556	-883,491	-320,865	-23,858	-129,577
49	Utah	76,128	28,162	2,893	-62,854	-22,050	-674	21,605
50	Vermont	21,637	68,548	268	-44,321	-43,641	-828	1,663
51	Virginia	140,001	168,964	7,427	-237,400	-100,383	-5,960	-27,351
53	Washington	168,237	60,631	7,821	-158,466	-46,977	-2,358	28,888
54	West Virginia	174,167	51,716	2,880	-163,323	-85,782	-2,901	-23,243
55	Wisconsin	92,089	87,660	5,852	-126,835	-50,779	-1,937	6,050
56	Wyoming	23,812	19,540	911	-28,124	-9,151	-333	6,655
US	Total	6,386,947	5,138,417	309,439	-10,401,899	-3,334,358	-194,354	-2,095,808

Source: American Community Survey Master Address File Extracts (July 2009 and January 2010)

Appendix A   State-Level Tables Referenced in Report

Table A-3 State-Level Comparison of M10 and S10 HU Counts to the 2010 Census HU Count

State	State Name	M10	M10 Overcoverage[3]	S10	S10 Overcoverage	MAF Extract Census 2010	Official Census 2010
01	Alabama	2,383,873	9.8%	2,262,273	4.2%	2,171,852	2,171,853
02	Alaska	302,108	-1.6%	312,572	1.8%	306,967	306,967
04	Arizona	2,936,590	3.2%	2,939,071	3.3%	2,844,524	2,844,526
05	Arkansas	1,419,055	7.8%	1,362,323	3.5%	1,316,300	1,316,299
06	California	13,854,334	1.3%	13,846,450	1.2%	13,680,081	13,680,081
08	Colorado	2,274,894	2.8%	2,274,283	2.8%	2,212,897	2,212,898
09	Connecticut	1,512,781	1.7%	1,498,679	0.7%	1,487,891	1,487,891
10	Delaware	455,965	12.3%	441,940	8.9%	405,885	405,885
11	District of Columbia	306,727	3.4%	303,914	2.4%	296,719	296,719
12	Florida	9,377,080	4.3%	9,144,643	1.7%	8,989,582	8,989,580
13	Georgia	4,392,689	7.4%	4,285,356	4.8%	4,088,804	4,088,801
15	Hawaii	526,379	1.3%	521,036	0.3%	519,508	519,508
16	Idaho	680,446	1.9%	695,819	4.2%	667,794	667,796
17	Illinois	5,626,321	6.2%	5,433,292	2.6%	5,296,715	5,296,715
18	Indiana	2,965,138	6.1%	2,878,165	3.0%	2,795,540	2,795,541
19	Iowa	1,427,669	6.8%	1,384,845	3.6%	1,336,415	1,336,417
20	Kansas	1,303,860	5.7%	1,279,131	3.7%	1,233,215	1,233,215
21	Kentucky	2,055,861	6.7%	2,000,662	3.8%	1,927,163	1,927,164
22	Louisiana	2,158,516	9.8%	2,044,467	4.0%	1,964,980	1,964,981
23	Maine	752,121	4.2%	742,701	2.9%	721,829	721,830
24	Maryland	2,446,414	2.8%	2,396,809	0.8%	2,378,814	2,378,814
25	Massachusetts	2,868,810	2.2%	2,852,341	1.6%	2,808,254	2,808,254
26	Michigan	4,756,758	5.0%	4,673,470	3.1%	4,532,232	4,532,233
27	Minnesota	2,433,585	3.7%	2,400,537	2.3%	2,347,201	2,347,201
28	Mississippi	1,429,531	12.1%	1,351,194	6.0%	1,274,720	1,274,719
29	Missouri	2,868,115	5.7%	2,816,850	3.8%	2,712,729	2,712,729
30	Montana	486,157	0.7%	496,121	2.8%	482,825	482,825
31	Nebraska	842,073	5.7%	825,304	3.6%	796,793	796,793
32	Nevada	1,188,068	1.2%	1,177,809	0.3%	1,173,815	1,173,814
33	New Hampshire	625,874	1.8%	625,935	1.8%	614,756	614,754
34	New Jersey	3,693,108	3.9%	3,625,552	2.0%	3,553,562	3,553,562
35	New Mexico	936,914	3.9%	932,207	3.4%	901,388	901,388
36	New York	8,374,259	3.3%	8,357,299	3.1%	8,108,105	8,108,103
37	North Carolina	4,537,099	4.8%	4,456,061	3.0%	4,327,525	4,327,528
38	North Dakota	329,687	3.8%	325,658	2.6%	317,498	317,498
39	Ohio	5,368,291	4.7%	5,251,772	2.4%	5,127,507	5,127,508
40	Oklahoma	1,761,473	5.8%	1,736,903	4.4%	1,664,379	1,664,378
41	Oregon	1,720,148	2.7%	1,717,273	2.5%	1,675,562	1,675,562
42	Pennsylvania	5,834,073	4.8%	5,714,141	2.6%	5,567,315	5,567,315
44	Rhode Island	479,339	3.4%	472,990	2.1%	463,388	463,388
45	South Carolina	2,272,984	6.3%	2,211,227	3.4%	2,137,683	2,137,683
46	South Dakota	378,898	4.3%	376,129	3.5%	363,438	363,438
47	Tennessee	2,992,116	6.4%	2,910,479	3.5%	2,812,134	2,812,133
48	Texas	10,585,473	6.1%	10,455,896	4.8%	9,977,437	9,977,436
49	Utah	1,000,816	2.2%	1,022,421	4.4%	979,709	979,709
50	Vermont	329,281	2.1%	330,944	2.6%	322,538	322,539
51	Virginia	3,443,962	2.3%	3,416,611	1.5%	3,364,937	3,364,939
53	Washington	2,946,955	2.1%	2,975,843	3.1%	2,885,677	2,885,677
54	West Virginia	934,483	6.0%	911,240	3.3%	881,922	881,917
55	Wisconsin	2,673,095	1.9%	2,679,145	2.1%	2,624,358	2,624,358
56	Wyoming	262,808	0.4%	269,463	2.9%	261,868	261,868
US	**Total**	**137,513,054**	**4.4%**	**135,417,246**	**2.8%**	**131,704,730**	**131,704,730**

Source: American Community Survey Master Address File Extracts (July 2009, January 2010, July 2011)

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[3] Note: M10 and S10 overcoverage rates are calculated relative to the official Census 2010 HU count.

Appendix A   State-Level Tables Referenced in Report

Table A-4 State-Level Differences Between the M10 Frame and the Census Universe of HUs

State	State Name	M10	Census	Omissions	Erroneous Exclusions	Erroneous Inclusions	Net Change (Census-M10)	Error Rates		
								Omissions	Exclusions	Inclusions
01	Alabama	2,383,873	2,171,852	169,955	119,122	-501,098	-212,021	7.8%	5.5%	21.0%
02	Alaska	302,108	306,967	44,106	24,554	-63,801	4,859	14.4%	8.0%	21.1%
04	Arizona	2,936,590	2,844,524	170,300	142,682	-405,048	-92,066	6.0%	5.0%	13.8%
05	Arkansas	1,419,055	1,316,300	100,597	75,853	-279,205	-102,755	7.6%	5.8%	19.7%
06	California	13,854,334	13,680,081	448,455	244,068	-866,776	-174,253	3.3%	1.8%	6.3%
08	Colorado	2,274,894	2,212,897	93,093	111,052	-266,142	-61,997	4.2%	5.0%	11.7%
09	Connecticut	1,512,781	1,487,891	31,237	37,225	-93,352	-24,890	2.1%	2.5%	6.2%
10	Delaware	455,965	405,885	23,825	12,714	-86,619	-50,080	5.9%	3.1%	19.0%
11	District of Columbia	306,727	296,719	9,475	4,266	-23,749	-10,008	3.2%	1.4%	7.7%
12	Florida	9,377,080	8,989,582	347,242	379,678	-1,114,418	-387,498	3.9%	4.2%	11.9%
13	Georgia	4,392,689	4,088,804	229,024	285,008	-817,917	-303,885	5.6%	7.0%	18.6%
15	Hawaii	526,379	519,508	58,330	9,730	-74,931	-6,871	11.2%	1.9%	14.2%
16	Idaho	680,446	667,794	56,740	36,317	-105,709	-12,652	8.5%	5.4%	15.5%
17	Illinois	5,626,321	5,296,715	139,043	100,279	-568,928	-329,606	2.6%	1.9%	10.1%
18	Indiana	2,965,138	2,795,540	88,164	69,264	-327,026	-169,598	3.2%	2.5%	11.0%
19	Iowa	1,427,669	1,336,415	31,664	27,941	-150,859	-91,254	2.4%	2.1%	10.6%
20	Kansas	1,303,860	1,233,215	36,921	42,128	-149,694	-70,645	3.0%	3.4%	11.5%
21	Kentucky	2,055,861	1,927,163	146,994	108,498	-384,190	-128,698	7.6%	5.6%	18.7%
22	Louisiana	2,158,516	1,964,980	135,083	61,115	-389,734	-193,536	6.9%	3.1%	18.1%
23	Maine	752,121	721,829	98,826	52,916	-182,034	-30,292	13.7%	7.3%	24.2%
24	Maryland	2,446,414	2,378,814	61,280	64,028	-192,908	-67,600	2.6%	2.7%	7.9%
25	Massachusetts	2,868,810	2,808,254	86,946	64,751	-212,253	-60,556	3.1%	2.3%	7.4%
26	Michigan	4,756,758	4,532,232	146,621	123,460	-494,607	-224,526	3.2%	2.7%	10.4%
27	Minnesota	2,433,585	2,347,201	97,044	94,820	-278,248	-86,384	4.1%	4.0%	11.4%
28	Mississippi	1,429,531	1,274,720	119,518	58,624	-332,953	-154,811	9.4%	4.6%	23.3%
29	Missouri	2,868,115	2,712,729	162,149	117,921	-435,456	-155,386	6.0%	4.3%	15.2%
30	Montana	486,157	482,825	52,192	36,973	-92,497	-3,332	10.8%	7.7%	19.0%
31	Nebraska	842,073	796,793	28,504	18,422	-92,206	-45,280	3.6%	2.3%	10.9%
32	Nevada	1,188,068	1,173,815	64,998	67,149	-146,400	-14,253	5.5%	5.7%	12.3%
33	New Hampshire	625,874	614,756	53,331	28,736	-93,185	-11,118	8.7%	4.7%	14.9%
34	New Jersey	3,693,108	3,553,562	110,871	61,576	-311,993	-139,546	3.1%	1.7%	8.4%
35	New Mexico	936,914	901,388	110,475	61,765	-207,766	-35,526	12.3%	6.9%	22.2%
36	New York	8,374,259	8,108,105	325,229	379,952	-971,335	-266,154	4.0%	4.7%	11.6%
37	North Carolina	4,537,099	4,327,525	240,336	332,431	-782,341	-209,574	5.6%	7.7%	17.2%
38	North Dakota	329,687	317,498	20,898	14,360	-47,447	-12,189	6.6%	4.5%	14.4%
39	Ohio	5,368,291	5,127,507	118,315	91,581	-450,680	-240,784	2.3%	1.8%	8.4%
40	Oklahoma	1,761,473	1,664,379	158,066	74,944	-330,104	-97,094	9.5%	4.5%	18.7%
41	Oregon	1,720,148	1,675,562	72,462	42,613	-159,661	-44,586	4.3%	2.5%	9.3%
42	Pennsylvania	5,834,073	5,567,315	296,825	220,565	-784,148	-266,758	5.3%	4.0%	13.4%
44	Rhode Island	479,339	463,388	16,550	4,133	-36,634	-15,951	3.6%	0.9%	7.6%
45	South Carolina	2,272,984	2,137,683	115,645	159,021	-409,967	-135,301	5.4%	7.4%	18.0%
46	South Dakota	378,898	363,438	25,889	11,775	-53,124	-15,460	7.1%	3.2%	14.0%
47	Tennessee	2,992,116	2,812,134	136,766	111,933	-428,681	-179,982	4.9%	4.0%	14.3%
48	Texas	10,585,473	9,977,437	629,373	426,003	-1,663,412	-608,036	6.3%	4.3%	15.7%
49	Utah	1,000,816	979,709	76,958	27,959	-126,024	-21,107	7.9%	2.9%	12.6%
50	Vermont	329,281	322,538	22,692	66,494	-95,929	-6,743	7.0%	20.6%	29.1%
51	Virginia	3,443,962	3,364,937	138,477	170,132	-387,634	-79,025	4.1%	5.1%	11.3%
53	Washington	2,946,955	2,885,677	157,944	59,199	-278,421	-61,278	5.5%	2.1%	9.4%
54	West Virginia	934,483	881,922	186,078	53,939	-292,578	-52,561	21.1%	6.1%	31.3%
55	Wisconsin	2,673,095	2,624,358	94,871	83,208	-226,816	-48,737	3.6%	3.2%	8.5%
56	Wyoming	262,808	261,868	26,103	18,932	-45,975	-940	10.0%	7.2%	17.5%
US	Total	137,513,054	131,704,730	6,412,480	5,091,809	-17,312,613	-5,808,324	4.9%	3.9%	12.6%

Source: American Community Survey Master Address File Extracts (July 2009 and July 2011)

Appendix A State-Level Tables Referenced in Report

Table A-5 State-Level Error Rates, City-Style Address Percentage, and DSF Coverage Rates for M10

| State | State Name | Error Rates | | | | | | Percent City-Style Addresses | DSF Coverage |
		Omissions (A)	Erroneous Exclusions (B)	Erroneous Inclusions (C)	All Exclusions (A+B)	Net (C-B-A)	Gross (A+B+C)		
01	Alabama	7.8%	5.5%	21.0%	13.3%	7.7%	34.3%	94.4%	84.7%
02	Alaska	14.4%	8.0%	21.1%	22.4%	-1.2%	43.5%	78.4%	61.9%
04	Arizona	6.0%	5.0%	13.8%	11.0%	2.8%	24.8%	96.5%	87.4%
05	Arkansas	7.6%	5.8%	19.7%	13.4%	6.3%	33.1%	93.2%	80.0%
06	California	3.3%	1.8%	6.3%	5.1%	1.2%	11.3%	99.4%	94.1%
08	Colorado	4.2%	5.0%	11.7%	9.2%	2.5%	20.9%	98.5%	88.6%
09	Connecticut	2.1%	2.5%	6.2%	4.6%	1.6%	10.8%	99.8%	94.0%
10	Delaware	5.9%	3.1%	19.0%	9.0%	10.0%	28.0%	95.8%	87.2%
11	District of Columbia	3.2%	1.4%	7.7%	4.6%	3.1%	12.4%	99.8%	93.3%
12	Florida	3.9%	4.2%	11.9%	8.1%	3.8%	20.0%	99.1%	94.0%
13	Georgia	5.6%	7.0%	18.6%	12.6%	6.0%	31.2%	96.6%	89.3%
15	Hawaii	11.2%	1.9%	14.2%	13.1%	1.1%	27.3%	95.7%	81.0%
16	Idaho	8.5%	5.4%	15.5%	13.9%	1.6%	29.5%	94.7%	82.7%
17	Illinois	2.6%	1.9%	10.1%	4.5%	5.6%	14.6%	98.7%	90.3%
18	Indiana	3.2%	2.5%	11.0%	5.6%	5.4%	16.7%	98.6%	92.4%
19	Iowa	2.4%	2.1%	10.6%	4.5%	6.1%	15.0%	99.3%	91.6%
20	Kansas	3.0%	3.4%	11.5%	6.4%	5.1%	17.9%	97.5%	89.8%
21	Kentucky	7.6%	5.6%	18.7%	13.3%	5.4%	31.9%	92.8%	81.8%
22	Louisiana	6.9%	3.1%	18.1%	10.0%	8.1%	28.0%	96.8%	85.2%
23	Maine	13.7%	7.3%	24.2%	21.0%	3.2%	45.2%	81.7%	65.4%
24	Maryland	2.6%	2.7%	7.9%	5.3%	2.6%	13.2%	99.6%	94.4%
25	Massachusetts	3.1%	2.3%	7.4%	5.4%	2.0%	12.8%	99.4%	91.4%
26	Michigan	3.2%	2.7%	10.4%	6.0%	4.4%	16.4%	98.3%	91.2%
27	Minnesota	4.1%	4.0%	11.4%	8.2%	3.3%	19.6%	95.9%	89.4%
28	Mississippi	9.4%	4.6%	23.3%	14.0%	9.3%	37.3%	94.3%	82.3%
29	Missouri	6.0%	4.3%	15.2%	10.3%	4.9%	25.5%	93.4%	85.8%
30	Montana	10.8%	7.7%	19.0%	18.5%	0.6%	37.5%	89.6%	72.6%
31	Nebraska	3.6%	2.3%	10.9%	5.9%	5.1%	16.8%	96.1%	88.1%
32	Nevada	5.5%	5.7%	12.3%	11.3%	1.1%	23.6%	98.5%	91.6%
33	New Hampshire	8.7%	4.7%	14.9%	13.3%	1.5%	28.2%	92.8%	78.0%
34	New Jersey	3.1%	1.7%	8.4%	4.9%	3.6%	13.3%	99.8%	92.7%
35	New Mexico	12.3%	6.9%	22.2%	19.1%	3.1%	41.3%	89.5%	75.4%
36	New York	4.0%	4.7%	11.6%	8.7%	2.9%	20.3%	97.7%	83.2%
37	North Carolina	5.6%	7.7%	17.2%	13.2%	4.0%	30.5%	96.0%	85.4%
38	North Dakota	6.6%	4.5%	14.4%	11.1%	3.3%	25.5%	93.1%	76.8%
39	Ohio	2.3%	1.8%	8.4%	4.1%	4.3%	12.5%	99.4%	93.7%
40	Oklahoma	9.5%	4.5%	18.7%	14.0%	4.7%	32.7%	86.8%	78.0%
41	Oregon	4.3%	2.5%	9.3%	6.9%	2.4%	16.1%	98.9%	90.9%
42	Pennsylvania	5.3%	4.0%	13.4%	9.3%	4.1%	22.7%	94.5%	86.7%
44	Rhode Island	3.6%	0.9%	7.6%	4.5%	3.2%	12.1%	99.5%	92.2%
45	South Carolina	5.4%	7.4%	18.0%	12.8%	5.2%	30.9%	96.2%	86.8%
46	South Dakota	7.1%	3.2%	14.0%	10.4%	3.7%	24.4%	91.3%	78.3%
47	Tennessee	4.9%	4.0%	14.3%	8.8%	5.5%	23.2%	97.5%	90.6%
48	Texas	6.3%	4.3%	15.7%	10.6%	5.1%	26.3%	95.1%	88.6%
49	Utah	7.9%	2.9%	12.6%	10.7%	1.9%	23.3%	97.2%	89.2%
50	Vermont	7.0%	20.6%	29.1%	27.7%	1.5%	56.8%	86.7%	63.6%
51	Virginia	4.1%	5.1%	11.3%	9.2%	2.1%	20.4%	95.9%	89.2%
53	Washington	5.5%	2.1%	9.4%	7.5%	1.9%	17.0%	98.8%	92.0%
54	West Virginia	21.1%	6.1%	31.3%	27.2%	4.1%	58.5%	64.2%	54.2%
55	Wisconsin	3.6%	3.2%	8.5%	6.8%	1.7%	15.3%	99.3%	91.4%
56	Wyoming	10.0%	7.2%	17.5%	17.2%	0.3%	34.7%	94.0%	74.3%
US	**Total**	**4.9%**	**3.9%**	**12.6%**	**8.7%**	**3.9%**	**21.3%**	**96.8%**	**88.7%**

Source: American Community Survey Master Address File Extracts (July 2009 and July 2011)

Appendix A   State-Level Tables Referenced in Report

Table A-6 State-Level Counts of M10 Erroneous Exclusions

State	State Name	Duplicates	NonRes	LUCA Adds	Not on DSF	Duplication Zone	Date Test	Other DSF	Other	Total
01	Alabama	10,256	3,040	20,946	2,304	32,070	31,547	17,935	998	119,096
02	Alaska	1,096	519	18,682	581	1,881	535	964	294	24,552
04	Arizona	48,382	3,837	59,689	6,989	5,246	8,765	7,164	2,569	142,641
05	Arkansas	6,752	2,143	15,453	1,663	15,360	22,593	11,480	385	75,829
06	California	35,015	20,853	137,589	12,701	1,665	16,751	9,750	9,279	243,603
08	Colorado	15,640	3,498	62,527	3,935	4,240	17,016	3,631	547	111,034
09	Connecticut	3,040	2,044	24,066	1,946	130	4,038	1,602	341	37,207
10	Delaware	3,302	652	746	764	1,841	852	4,373	179	12,709
11	District of Columbia	261	872	1,939	362	0	264	325	242	4,265
12	Florida	72,643	12,282	199,426	10,069	23,830	30,105	28,383	2,873	379,611
13	Georgia	47,503	6,052	128,337	4,500	33,726	36,054	26,293	2,485	284,950
15	Hawaii	2,703	1,013	995	789	1,266	1,337	1,280	345	9,728
16	Idaho	3,974	986	19,093	4,411	2,380	1,616	3,644	201	36,305
17	Illinois	29,871	6,945	23,282	10,510	2,541	10,236	15,474	1,403	100,262
18	Indiana	10,596	4,337	22,912	7,917	2,415	8,287	12,064	649	69,177
19	Iowa	4,314	1,497	7,887	1,293	786	8,738	2,702	723	27,940
20	Kansas	8,980	1,790	11,540	1,195	2,251	9,452	6,441	458	42,107
21	Kentucky	11,629	2,968	23,061	3,840	29,774	17,935	17,898	1,263	108,368
22	Louisiana	5,973	4,306	14,457	5,652	9,349	15,600	5,101	671	61,109
23	Maine	5,121	1,509	8,905	1,066	12,608	5,455	17,919	314	52,897
24	Maryland	6,952	3,955	39,250	1,191	587	7,346	3,839	886	64,006
25	Massachusetts	9,902	4,373	36,456	4,361	505	5,348	2,665	1,056	64,666
26	Michigan	20,417	5,550	58,323	4,179	9,134	15,105	9,083	1,639	123,430
27	Minnesota	10,909	2,676	29,074	2,682	13,214	10,921	24,276	1,056	94,808
28	Mississippi	9,080	1,871	6,504	2,930	12,415	13,393	12,023	387	58,603
29	Missouri	17,933	4,229	27,159	3,088	18,407	23,777	22,519	793	117,905
30	Montana	5,008	1,005	17,806	521	4,262	5,615	2,489	256	36,962
31	Nebraska	2,934	1,128	4,616	837	1,877	2,916	3,900	208	18,416
32	Nevada	5,903	813	51,912	1,234	2,965	2,716	1,309	277	67,129
33	New Hampshire	3,545	862	6,196	1,260	4,483	5,046	7,124	211	28,727
34	New Jersey	13,106	4,122	25,493	6,669	479	6,720	3,738	1,225	61,552
35	New Mexico	5,964	1,560	35,066	1,212	5,793	7,581	4,214	354	61,744
36	New York	35,151	13,119	220,465	16,278	28,555	39,452	18,951	7,905	379,876
37	North Carolina	38,572	7,357	140,902	10,788	44,525	53,958	26,607	9,673	332,382
38	North Dakota	1,405	277	4,153	354	1,135	5,460	1,419	140	14,343
39	Ohio	17,276	6,554	30,078	6,972	1,694	21,145	6,884	955	91,558
40	Oklahoma	16,537	2,429	9,528	2,343	13,245	13,282	16,857	699	74,920
41	Oregon	9,460	3,043	18,450	3,851	1,051	2,863	3,315	572	42,605
42	Pennsylvania	34,030	11,259	63,228	16,757	18,636	16,440	57,998	2,193	220,541
44	Rhode Island	1,220	631	486	853	11	555	224	149	4,129
45	South Carolina	18,846	3,627	77,154	3,147	15,885	22,363	17,248	725	158,995
46	South Dakota	1,442	495	2,760	319	2,002	2,347	2,197	206	11,768
47	Tennessee	14,249	4,273	39,182	2,962	14,429	24,670	11,414	692	111,871
48	Texas	55,921	17,174	180,218	10,611	44,689	41,922	70,529	4,846	425,910
49	Utah	3,728	1,282	14,137	1,833	1,822	3,946	881	327	27,956
50	Vermont	5,075	682	35,772	580	7,455	3,475	13,311	125	66,475
51	Virginia	15,815	4,206	58,977	5,173	39,079	19,550	26,500	782	170,082
53	Washington	11,051	4,076	27,101	3,471	2,824	4,317	5,481	870	59,191
54	West Virginia	7,682	1,261	7,221	1,589	14,565	7,343	14,056	205	53,922
55	Wisconsin	11,099	3,863	45,681	3,053	1,236	10,680	6,518	1,068	83,198
56	Wyoming	1,188	663	12,466	322	666	2,463	976	181	18,925
US	Total	738,451	199,558	2,127,346	203,907	510,984	649,891	592,968	66,880	5,089,985

Source: American Community Survey Master Address File Extract (July 2009 and July 2011)

Appendix A   State-Level Tables Referenced in Report

Table A-7 State-Level Counts M10 Erroneous Inclusions by M10 Filter Category

State	State Name	Census 2000 HUs		Post-2000 DSF Adds		Census Deletes on DSF		Field Validations	
		Invalidations	Percent	Invalidations	Percent	Invalidations	Percent	Invalidations	Percent
01	Alabama	385,815	19.7%	103,550	26.8%	5,980	21.3%	5,697	42.7%
02	Alaska	51,908	20.0%	7,184	22.2%	547	20.8%	4,162	52.1%
04	Arizona	235,874	10.9%	158,219	22.5%	3,992	10.6%	6,941	28.2%
05	Arkansas	218,073	18.7%	51,327	25.7%	2,936	23.3%	6,797	16.9%
06	California	606,024	5.0%	228,727	15.1%	20,879	16.7%	11,131	30.3%
08	Colorado	159,709	8.8%	100,646	22.8%	3,599	15.4%	2,169	39.1%
09	Connecticut	66,315	4.8%	22,287	20.8%	4,479	22.0%	231	49.7%
10	Delaware	44,385	13.0%	39,909	37.8%	597	13.0%	1,720	46.5%
11	District of Columbia	19,776	7.2%	2,565	9.6%	938	19.1%	470	60.4%
12	Florida	698,702	9.6%	392,468	20.0%	15,764	14.0%	6,932	33.4%
13	Georgia	544,136	16.6%	256,529	24.4%	9,239	18.1%	7,937	45.7%
15	Hawaii	59,391	13.0%	11,949	20.3%	1,242	21.5%	2,345	56.5%
16	Idaho	72,827	13.9%	30,258	20.6%	1,109	19.0%	1,503	49.8%
17	Illinois	390,446	8.0%	142,783	27.7%	19,120	23.7%	16,565	10.8%
18	Indiana	236,786	9.4%	80,111	21.5%	6,716	16.9%	3,407	13.6%
19	Iowa	95,657	7.8%	51,473	30.2%	2,105	194%	1,619	9.5%
20	Kansas	106,824	9.5%	39,946	24.6%	1,932	16.1%	982	40.2%
21	Kentucky	311,866	17.9%	61,721	22.3%	4,100	19.1%	6,479	49.3%
22	Louisiana	318,414	17.3%	61,493	21.8%	7,971	25.7%	1,844	53.9%
23	Maine	152,426	23.6%	24,454	26.6%	1,104	22.7%	4,039	44.1%
24	Maryland	143,235	6.7%	44,494	16.3%	3,775	13.8%	1,377	51.0%
25	Massachusetts	162,039	6.2%	39,890	18.7%	9,895	27.4%	419	45.1%
26	Michigan	367,265	8.7%	116,087	24.7%	9,048	17.2%	2,191	39.2%
27	Minnesota	197,576	9.6%	74,697	21.4%	3,859	18.2%	2,098	41.4%
28	Mississippi	254,116	22.0%	71,742	28.7%	4,087	24.4%	2,984	52.9%
29	Missouri	315,622	13.0%	112,270	28.1%	4,592	17.2%	2,924	47.6%
30	Montana	71,001	17.3%	19,247	27.4%	600	21.9%	1,640	49.4%
31	Nebraska	60,664	8.4%	28,058	24.9%	1,236	21.7%	2,242	82.3%
32	Nevada	83,137	10.1%	60,364	17.1%	997	11.6%	1,899	37.9%
33	New Hampshire	74,622	13.7%	15,062	21.1%	1,411	26.6%	2,082	42.8%
34	New Jersey	229,515	6.9%	68,652	20.7%	12,798	24.1%	1,005	31.1%
35	New Mexico	158,650	20.5%	44,710	30.1%	2,320	21.8%	2,037	52.2%
36	New York	793,343	10.4%	144,005	24.2%	28,312	24.6%	5,620	42.4%
37	North Carolina	563,521	16.2%	188,066	19.7%	6,312	14.9%	24,399	36.3%
38	North Dakota	39,055	13.5%	7,379	19.7%	435	18.5%	571	50.0%
39	Ohio	336,212	7.0%	102,632	19.4%	9,994	17.9%	1,802	36.3%
40	Oklahoma	245,557	16.3%	76,302	33.4%	3,496	21.1%	4,724	51.2%
41	Oregon	108,200	7.5%	46,786	18.7%	3,284	15.8%	1,382	47.9%
42	Pennsylvania	617,232	11.8%	145,812	27.9%	17,103	24.9%	3,954	48.6%
44	Rhode Island	28,687	6.5%	5,997	18.4%	1,740	23.9%	133	53.4%
45	South Carolina	296,831	17.0%	103,413	21.6%	5,468	17.2%	4,238	26.9%
46	South Dakota	40,879	12.7%	10,381	19.7%	396	17.8%	1,457	53.3%
47	Tennessee	311,432	12.8%	107,365	21.0%	5,458	13.7%	4,271	50.9%
48	Texas	1,081,518	13.3%	538,390	23.4%	23,630	20.7%	19,828	41.4%
49	Utah	71,799	9.4%	50,866	23.1%	2,221	19.7%	1,134	51.6%
50	Vermont	84,913	29.3%	8,329	26.0%	608	22.6%	2,072	48.2%
51	Virginia	307,121	10.6%	73,053	14.2%	2,930	11.5%	4,493	54.3%
53	Washington	189,172	7.7%	82,313	17.7%	4,960	15.0%	1,966	35.6%
54	West Virginia	255,477	30.4%	28,828	36.6%	1,813	35.7%	6,441	61.1%
55	Wisconsin	164,601	7.1%	56,047	17.1%	4,979	19.0%	1,181	43.4%
56	Wyoming	33,049	14.9%	11,172	31.5%	675	23.3%	1,071	49.3%
US	Total	12,461,395	10.8%	4,350,008	21.9%	292,781	19.2%	206,605	30.8%

Source: American Community Survey Master Address File Extracts (July 2009 and July 2011)