



# AMERICAN HOUSING SURVEY

**Housing Adequacy and Quality As Measured by the AHS**



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# AMERICAN HOUSING SURVEY

## Housing Adequacy and Quality As Measured by the AHS

Prepared for  
**U.S. Department of Housing and Urban Development**  
**Office of Policy Development and Research**

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The contents of this report are the views of the contractor and do not necessarily reflect the views or policies of the U.S. Department of Housing and Urban Development or the U.S. government.

## Preface

The U.S. Department of Housing and Urban Development's (HUD's) mission statement is "Create strong, sustainable, inclusive communities and quality, affordable homes for all" and part of the Department's strategic plan is "Preserve the affordability and improve the quality of federally assisted and private unassisted affordable rental homes." To monitor progress toward these goals, the quality of the housing stock must be measured. HUD's American Housing Survey (AHS) provides key data for measuring housing quality. Housing quality data in the AHS are summarized into a measure of the most basic level of quality: housing adequacy.

As part of its ongoing program of research based on the AHS, the Office of Policy Development and Research (PD&R) commissioned Econometrica, Inc., to conduct a three-part evaluation of housing quality data and the housing adequacy measure in the AHS. First, Econometrica conducted research to determine which components of housing quality were

key in determining whether housing units were adequate, as embodied by the variable ZADEQ, which summarizes housing quality. Second, Econometrica used the longitudinal features of the AHS to explain the persistency of inadequacy in particular housing units. Third, Econometrica summarized other housing quality information collected in the AHS that could be used to strengthen our understanding of housing adequacy in the American housing stock.

A key finding was that inadequate housing is very rare and that most inadequate units do not remain in that condition for very long. Another salient finding was that the most important component of inadequate classification is sharing one's bathroom with members of another household. The second most important common deficiency was heating failures. This report documented more than 100 quality-related variables in the AHS data that could be analyzed to gain a better understanding of housing quality issues.

## Table of Contents

Executive Summary.....v	3. Indicators of Quality Problems in AHS .....6
1. Background.....1	4. Recent Interest in the AHS Measure of Housing Adequacy .....12
2. Extent and Nature of Severe Physical Problems in Housing Units .....2	References .....13
2.1. AHS Definition of Physical Adequacy.....2	Appendix. Analysis of Severe Plumbing Problems Over AHS Surveys.....14
2.2. Physical Inadequacy: 2005 Through 2009 .....2	
2.3. Persistence of Severe Physical Problems .....3	

## List of Tables

Table 1. Units With Severe Physical Problems in 2005, 2007, and 2009 and the Specific Physical Problems Experienced by These Units .....3	Table 11. AHS Variables Related to Rodents and Toilet Breakdowns .....8
Table 2. Percentage of Units by the Number of Specific Physical Problems Experienced.....3	Table 12. AHS Variables Related to Kitchens .....9
Table 3. Changes in Physical Condition Between Surveys....4	Table 13. AHS Variables Related to External Structural Problems.....10
Table 4. Persistence of Particular Physical Problems .....4	Table 14. AHS Variables Related to Stair Climbing .....10
Table 5. AHS Variables Related to Bathrooms .....6	Table 15. AHS Variables Related to Problems Outside Unit ...10
Table 6. AHS Variables Related to Heating.....7	Table 16. AHS Variables Related to Overall Unit Quality .....10
Table 7. AHS Variables Related to Electricity and Wiring.....7	Table 17. AHS Variables Related to Housing Deficiencies Not Available for All Surveys.....11
Table 8. AHS Variables Related to Outside Water Leaks.....8	Table A-1. Published AHS Data on Severe Plumbing Problems, 1985 Through 2011 .....15
Table 9. AHS Variables Related to Inside Water Leaks .....8	
Table 10. AHS Variables Related to Walls, Floors, and Ceilings.....8	

## Executive Summary

The American Housing Survey (AHS) measures physical adequacy, a concept related to, but different from, housing quality. The U.S. Department of Housing and Urban Development developed this measure to assess the extent to which the housing stock met the standard of “a decent home and a suitable living environment,” established by the Housing Act of 1949. The AHS definition of physical adequacy is complex; any 1 of 14 different situations can result in the classification of a unit as having severe physical problems. According to this measure, very few American housing units have serious physical problems. In each of the 3 years studied (2005, 2007, and 2009), the percentage of occupied housing units that were severely inadequate was less than 2 percent.

The two most frequently observed problems are having to share the bathroom (55 percent) and heating failure (29 percent). More than one-half of the severely inadequate units reported one household sharing its bathroom with another household. Between 5 and 11 percent of all severely inadequate units reported one or more deficiencies in bathroom facilities, namely, not having hot and cold running water, not having a shower or tub, or not having a flush toilet. More than 90 percent of the units were classified as severely inadequate because of only one condition. In the 3 years studied, only 1 sample unit of the approximately 40,000 units surveyed was found to have five severe physical problems in any year.

Severe physical problems do not persist in American housing units. Of the relatively few units with severe physical problems in 2005 or 2007 and that remained occupied in the next

survey, more than 80 percent were adequate in the next survey and less than 12 percent were still severely inadequate in the next survey.

The two most frequently observed problems—having to share the bathroom and heating failures—are not persistent. The highest observed survey-to-survey persistence for these two problems was 6.9 percent, which is lower than the 11.9-percent persistence of severe inadequacy. On the other hand, the four problems that would require structural changes to the units—no hot and cold running water, no tub or shower, no flush toilet, or no electricity—are persistent from survey to survey. The percentage of units with one of these problems in one survey and the same problem in the next survey ranges from 39.8 percent (no hot and cold running water) to 88.4 percent (no electricity).

The fact that less than 6 percent of units that share the bathroom in one survey share them in the next survey is puzzling, given the way “exclusive use” is determined. This report found this characteristic of the AHS measure of severe inadequacy to be troubling, because the absence of exclusive use is by far the most important determinant of severe inadequacy. We explore this determinant in greater detail.

The report also compiles a list of 102 quality-related variables that were available in one or more national public use files (PUFs) during the 1985-through-2009 period. Of the variables, 68 can be used to track housing quality from 1985 to 2011; the remaining 34 variables are not available in all PUFs for the surveys from 1985 through 2011.

## 1. Background

In October 2009, Econometrica, Inc., entered into a contract with the U.S. Department of Housing and Urban Development (HUD) to support the American Housing Survey (AHS). As part of that contract, HUD asked Econometrica to examine the AHS measure of housing adequacy and determine which physical problems most frequently result in a unit being labeled as severely inadequate.

In the early 1970s, HUD fostered the development of a measure of housing inadequacy because of its concern about the housing conditions of the poor. In particular, HUD wanted to assess the extent to which the housing stock met the standard of “a decent home and a suitable living environment,” established by the Housing Act of 1949. A great deal of thought went into the creation of the AHS measure. Simonson documents the research and consultation undertaken by HUD and cites seven previous

indicators of inadequacy from both government (HUD, the Office of Management and Budget, and the Congressional Budget Office) and private sources.<sup>1</sup>

Section 2 of this report describes the AHS measure of housing adequacy and then analyzes the factors that determine whether the AHS labels a unit as severely inadequate. In particular, the section examines whether inadequacy in general and the conditions associated with inadequacy are persistent from one survey to the next. In the course of this research, Econometrica developed a list of all the variables collected by the AHS since 1985 relating to housing deficiencies. Section 3 discusses this fuller list of housing deficiencies. Section 4 addresses the current status of research into physical adequacy. An appendix examines how the variables related to the bathroom component of the severely inadequate determination have changed over time.

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<sup>1</sup> Simonson (unpublished).



## 2. Extent and Nature of Severe Physical Problems in Housing Units

This section describes the AHS definition of physical adequacy, reports recent data on physical adequacy, and examines the extent to which physical inadequacy and the conditions that cause physical inadequacy persist.

### 2.1. AHS Definition of Physical Adequacy

The AHS publishes information in the statistical reports on the physical adequacy of occupied housing units. Occupied units are classified as adequate, having moderate physical problems, or having severe physical problems. A unit is considered severely inadequate if any of the following criteria apply.<sup>2</sup>

1. Unit does not have hot and cold running water.
2. Unit does not have a bathtub or shower.
3. Unit does not have a flush toilet.
4. Unit shares plumbing facilities.
5. Unit was cold for 24 hours or more and more than two breakdowns of the heating equipment have occurred that lasted longer than 6 hours.
6. Electricity is not used.
7. Unit has exposed wiring, not every room has working electrical plugs, and the fuses have blown more than twice.
8. Unit has five or six of the following structural conditions:
  - a. Unit has had outside water leaks in the past 12 months.
  - b. Unit has had inside water leaks in the past 12 months.
  - c. Unit has holes in the floor.
  - d. Unit has open cracks wider than a dime.
  - e. Unit has an area of peeling paint larger than 8 by 11 inches.
  - f. Rats have been seen recently in the unit.

The eighth criterion uses the term *structural* because the problems are related to structural weaknesses. Water leaks, cracks in the walls, and holes in the floor are obvious structural issues. Signs

of rats suggest holes in the exterior walls, and peeling paint is often a sign of water leakage. Seven different combinations of these structural problems can satisfy the requirements of the final criterion (all six structural conditions, all but a, all but b, and so on); therefore, 14 different situations can lead to classifying a unit as severely inadequate.

The four questions related to bathroom facilities have the following internal logic. The questions related to hot and cold running water, the presence of a bathtub or shower, and having a flush toilet determine whether the unit has a complete bathroom. The “shared plumbing facilities” question presumes a complete bathroom. This question is not asked if a unit lacks hot and cold running water *and* lacks a tub or shower *and* lacks a flush toilet *and* lacks a bathroom sink. The wording of the question focuses not on the household’s use of a bathroom outside the unit but on whether members of another household use the bathroom in the unit. The wording in the *AHS Codebook* (page 589) follows.

Some people live in neighborhoods where some of the houses don’t have complete plumbing facilities so they must use other people’s bathrooms. Does anyone not living in your home, not counting guests or workers, regularly use your bathroom?

As a group, these four questions determine whether the unit has a full bathroom and, if so, whether the household has to share that bathroom with members of another household.

The AHS reports on the physical adequacy of occupied units only, although information on some of these conditions is collected for vacant units and units whose occupants usually reside elsewhere, so-called usual residence elsewhere, or URE, units.

### 2.2. Physical Inadequacy: 2005 Through 2009

Using data from the AHS, table 1 tallies the number of units considered severely inadequate in at least one of the years 2005, 2007, and 2009 and identifies the serious problems these units

<sup>2</sup> The relevant AHS variable is ZADEQ, the definition of which can be found in HUD (2011: 281).

**Table 1. Units With Severe Physical Problems in 2005, 2007, and 2009 and the Specific Physical Problems Experienced by These Units**

	2005	2007	2009	Average
Occupied housing units	108,871,000	110,692,000	111,806,000	110,456,333
Severely inadequate units	2,021,050	1,805,960	1,863,660	1,896,890
Percent severely inadequate	1.9	1.6	1.7	1.7
Number of sample units severely inadequate	798	627	764	730
<b>Percentage distribution of severely inadequate units by situation<sup>a</sup></b>				
No hot and cold running water	11.0	9.4	6.1	8.9
No bathtub or shower	7.9	10.0	6.0	8.0
No flush toilet	7.0	7.3	5.5	6.6
Shared plumbing facilities	51.2	57.2	57.1	55.0
Unacceptable cold periods because of heat failures	31.7	25.6	29.2	29.0
No electricity	3.1	2.5	3.2	2.9
Inadequate electricity wiring	0.4	0.2	0.6	0.4
Structural problems (five or six of the listed conditions)	2.6	4.2	4.0	3.6

<sup>a</sup> The percentages add to more than 100 percent because some units suffer from multiple problems.

experienced. The counts confirm the well-known fact that very few American housing units have serious physical problems. In each of the 3 years, the percentage of occupied housing units that were severely inadequate was less than 2 percent.

Having inadequate bathroom facilities proved by far to be the most common reason units were classified as having severe physical problems. More than one-half of the severely inadequate units reported sharing their bathroom with another household. Between 5 and 11 percent of all severely inadequate units also reported one or more deficiencies in bathroom facilities, namely, not having hot and cold running water, not having a shower or tub, or not having a flush toilet.

Between one-fourth and one-third of severely inadequate units reported heating failures. Less than 4 percent of the severely inadequate units were without electricity. Having five or six of the structural problems occurred in 2 to 4 percent of the severely inadequate units.

Table 2 indicates how frequently severely inadequate units suffered from more than one problem. More than 90 percent of the units were classified as severely inadequate because of only one condition. In the 3 years studied, only 1 sample unit of the approximately 40,000 units surveyed was found to have five severe physical problems in any year.

## 2.3. Persistence of Severe Physical Problems

One would not expect problems of the type that lead to the designation of severely inadequate to persist from survey to survey. Instead one would expect that owners or landlords would fix the problem or that the unit would leave the stock or at least become vacant. Approximately 20 percent of all units with either moderate or severe physical problems in either 2005 or 2007 did not have information on adequacy in the next survey because they were unoccupied or because they could not be interviewed. The vacant or out-of-the-stock alternative is not as prevalent as it may at first appear, however, because approximately 15 percent of adequate units were either vacant or could not be interviewed in the next survey.

Table 3 shows the extent to which physical problems persist from AHS survey to AHS survey. The table considers only those units that were occupied in both 2005 and 2007 or in both 2007 and 2009 because the Census Bureau determines physical adequacy only for occupied units.

Table 3 confirms the well-known fact that severe physical problems do not persist in American housing units. Of those units with severe physical problems in 2005 or 2007 and that remained occupied in the next survey, more than 80 percent

**Table 2. Percentage of Units by the Number of Specific Physical Problems Experienced**

	2005 (%)	2007 (%)	2009 (%)	Average (%)
<b>Percentage distribution by number of qualifying conditions</b>				
Only one condition	91.6	90.3	92.7	91.5
Two conditions	2.7	3.9	3.9	3.5
Three conditions	4.9	5.0	2.6	4.2
Four or more conditions	0.9	0.8	0.9	0.9

**Table 3. Changes in Physical Condition Between Surveys**

		Physical Condition	2007		
			Adequate	Moderately Inadequate	Severely Inadequate
2005	No.	Adequate	86,550,000	2,031,000	1,195,000
		Moderately inadequate	2,114,000	1,158,000	159,000
		Severely inadequate	1,345,000	114,000	198,000
	%	Adequate	96.4	2.3	1.3
		Moderately inadequate	61.6	33.8	4.6
		Severely inadequate	81.2	6.9	11.9
		Physical Condition	2009		
			Adequate	Moderately Inadequate	Severely Inadequate
2007	No.	Adequate	86,510,000	2,077,000	1,348,000
		Moderately inadequate	1,951,000	1,163,000	111,000
		Severely inadequate	1,199,000	89,000	174,000
	%	Adequate	96.2	2.3	1.5
		Moderately inadequate	60.5	36.1	3.4
		Severely inadequate	82.0	6.1	11.9

were adequate in the next survey, and less than 12 percent were still severely inadequate in the next survey. Of those units that were adequate in 2005 or in 2007, 96 percent of units remained adequate in the next survey, approximately 2.5 percent had moderate physical problems, and approximately 1.5 percent had severe physical problems.

An interesting question is whether certain physical problems account for what limited persistence exists among severely inadequate housing units. Table 4 looks at the persistence of particular physical problems, focusing on the six most common problems identified in table 1. The available sample sizes are small for some of the problems because of the infrequency of the problem.

The two most frequently observed problems—having to share the bathroom and heating failures—are not persistent. The highest observed survey-to-survey persistence for these two

problems was 6.9 percent, which is lower than the 11.9-percent persistence of severe inadequacy. On the other hand, the four problems that would require structural changes to the units—no hot or cold running water, no tub or shower, no flush toilet, or no electricity—are persistent from survey to survey. The percentages of units with one of these problems in one survey and the same problem in the next survey run from 39.8 percent (no hot and cold running water) to 88.4 percent (no electricity).

The conditions that involve bathroom facilities affect adequacy differently. Having to share a bathroom with another household is relatively common but not persistent. Having incomplete bathroom facilities is not common but is persistent.

The lack of persistence in “no exclusive use” is puzzling. The appendix looks at the history of the bathroom questions and examines the questions’ internal consistency. Here we use two examples to explain why we find the lack of persistence puzzling.

**Table 4. Persistence of Particular Physical Problems**

Physical Problem	Year	Sample Units	Number of Units	In Next Survey	Percent
Sharing bathroom	2005	302	888,000	15,000	1.7
	2007	298	880,000	52,000	5.9
Heating failures	2005	177	534,000	37,000	6.9
	2007	120	370,000	12,000	3.2
No hot or cold running water	2005	48	148,000	59,000	39.8
	2007	31	98,000	41,000	41.8
No tub or shower	2005	32	109,000	83,000	76.5
	2007	37	113,000	58,000	51.5
No flush toilet	2005	26	91,000	81,000	88.4
	2007	28	90,000	54,000	60.5
No electricity	2005	16	50,000	24,000	48.5
	2007	12	36,000	31,000	85.5

The first example involves two units in a duplex that share a common bathroom that has full plumbing; that is, hot and cold running water, a bathroom sink, a flush toilet, and a tub or shower. If the AHS surveyed both of these units, it would indicate that both units had complete plumbing and that both units shared the bathroom. In the AHS, the sink, toilet, and tub need not be in the same individual unit; a unit has a complete bathroom as long as the sink, toilet, and tub are in the same structure.<sup>3</sup> The second example involves two units in different structures, one unit without a bathroom and one unit with a complete bathroom that it shares with the household of the unit without a bathroom. If the AHS surveyed both of these units, it would indicate that the first unit did not have a complete bathroom and that the second unit has a complete bathroom that it shares.<sup>4</sup>

Our expectation would be that the first example represents a situation that would persist from survey to survey, but the second example represents a situation that would not persist from survey to survey. The observed lack of persistence in “no exclusive use” implies that the second example is more common than the first example. But the second example requires that one unit lack complete plumbing. The number of units without hot piped water, a tub or shower, or a flush toilet is substantially smaller than the number of units without exclusive use in nearly all surveys. Therefore, the second example can account, at most, for a fraction of the “no exclusive use” units.

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<sup>3</sup> In the American Community Survey and its predecessors, the long forms in various decennial censuses, the Census Bureau requires that the relevant bathroom fixtures be in the same unit rather than the same structure for a unit to be credited with a complete bathroom.

<sup>4</sup> If the first unit lacked all the elements of a full bathroom (hot and cold running water, a bathroom sink, a flush toilet, and a tub or shower), then the AHS would not even ask this household whether it shared its bathroom because it has no bathroom to share.

### 3. Indicators of Quality Problems in AHS

This report focuses on the AHS measure of housing adequacy. Adequacy is a broader concept than quality; a unit can have quality problems but still be considered adequate. Because of the emphasis on adequacy, the AHS measure does not use all of the extensive information collected in the AHS on quality problems.

This section provides a list of AHS variables related to quality problems that were collected in the period between 1985 and 2011. We constructed this list by identifying all the variables in the national survey that appear in the Unit Quality section of the most recent *AHS Codebook*<sup>5</sup> or that were used to assign ZADEQ values. We then examined the codebook for the 1973-through-1993 period<sup>6</sup> to determine whether those variables or closely related variables were available before 1997.<sup>7</sup> Our approach will miss quality related variables that were in the AHS before 1995 but do not have counterparts in the 1997 or later surveys. We chose the 1985-through-2011 period because the most recent AHS sample was drawn in 1985 and augmented in subsequent survey years to account for new construction and other additions to the housing stock. During this time, a shift from onsite interviewing to telephone interviewing occurred, and a new data collection instrument was introduced in 1997.

The first five variables involve whether a unit has complete plumbing (table 5). Before 1997, the definition of variables 1 through 4 presumed “exclusive use”; that is, TUB = 1 meant that a unit had either a tub or shower *and* that the household did not share that tub or shower with another household.

Beginning in 1997, exclusive use was indicated by a new variable, SHARPF, so that in 1997 or later surveys, TUB = 1 means simply that a household had access to a tub or shower in the same structure. In combination with TUB = 1, SHARPF = 2 means that the household had exclusive use to that tub or shower.

Although having complete plumbing has been a core constituent of ZADEQ throughout the 1985-through-2009 period, the AHS definition of complete plumbing shifted slightly in 1997. The shift was subtle. In every survey, complete plumbing requires hot and cold running water, a tub or shower, and a toilet, all for the exclusive use of the household. The 1985-through-1993 codebook explains exclusive use in the following excerpt.

Note that plumbing facilities are considered complete if they are located in the structure in which the unit is located, while in the Census, facilities are complete only if they are inside the specific housing unit. Plumbing facilities are shared if they are also for the use of the occupants of other housing units.<sup>8</sup>

The exact same language is found on pages 118 and 119 of the *AHS Codebook*, version 2.0. In 1997, the focus shifted to include use of bathroom facilities by households in other structures.<sup>9</sup> The long description of SHARPF is in the following paragraph.

Some people live in neighborhoods where some of the houses don't have complete plumbing facilities so they must use other people's bathrooms. Does anyone not living in your home, not counting guests or workers, regularly use your bathroom?<sup>10</sup>

**Table 5. AHS Variables Related to Bathrooms**

	Variable Name	Codebook Definition	Codebook Location*	First Year in New Sample	Final Year in New Sample	Number of Years in Survey
1	PLUMB	Complete plumbing facilities in unit	Unit Quality	1985	2011	14
2	HOTPIP	Unit has hot and cold running water	Unit	1985	2011	14
3	TUB	Unit has a bathtub or shower	Unit	1985	2011	14
4	TOILET	Unit has a flush toilet	Unit Quality	1985	2011	14
5	SHARPF	Unit shares plumbing facilities	Neighborhood	1997	2011	8

\* In tables 5 through 17, if a variable is found in the “1997 or later” codebook only or in both the 1985-through-1993 codebook and the “1997 or later” codebook, the location in the “1997 or later” codebook is given.

<sup>5</sup> HUD (2011).

<sup>6</sup> HUD (1995).

<sup>7</sup> We did not examine volume 2 of *The American Housing Survey Codebook*, which covers the 1995 national survey. Instead, we presume that any variable available from 1985 to 1993 and from 1997 to a later date would be available in the national surveys from 1985 to the later date.

<sup>8</sup> The quote is from the first page of the section on Equipment in HUD (1995). The AHS considered a unit as having complete plumbing even if the bathroom was located outside the unit as long as no other household used that bathroom.

<sup>9</sup> Note that the latest Codebook places SHARPF in the Neighborhood section.

<sup>10</sup> HUD (2011: 589).

In the appendix, we study whether this change in concept had any appreciable effect on the measurement of severe plumbing problems. This analysis leads us to conclude that lacking exclusive use was at least as important in determining whether a unit had severe plumbing problems before 1997 as after the change in concept. The same analysis suggests that lacking exclusive use is probably the predominant cause of severe plumbing problems over the period, however, if not in every survey. In addition, the published numbers suggests the possibility that other changes occurred in how severe plumbing problems were measured in different surveys.

The second group of variables deals with heating problems (table 6).

Although the variables have changed somewhat, the concepts have remained closely consistent throughout the 1985-through-2009 period. HEQUIP (6) describes the type of heating equipment, FREEZE (7) determines whether the household experienced uncomfortably cold conditions in the past 12 months, IFCOLD (8) indicates whether the equipment broke down, NUMCOLD (9) counts the number of breakdowns, and OTHCLD (10) indicates whether other reasons for being cold existed. If other reasons existed, WHYCLD (11) offered three specific options and an “other” option from 1985 through 1995. Beginning in 1997, WHYCD# (12 through 16) offered

four specific options and an “other” option. Note that the single WHYCLD allowed respondents to select only one of the four reasons, whereas WHYCD1 through WHYCD5 allow respondents to select more than one reason.

The third group of variables assesses the adequacy of the unit’s electrical system (table 7). BUYE (17) provides a consistent indicator over the period as to whether a unit has electricity.<sup>11</sup> Variables 18 through 21 indicate shortcomings in the electrical system.

Variables 22 through 26 in table 8 deal with water leaks originating outside the unit. LEAK (22) indicates whether any leaks have sprung from outside; RLEAK, WLEAK, and BLEAK (23 through 25) identify the source of the leak; and OTLEAK (26) is reserved for sources other than the roof, wall, windows, doors, or basement.

Variables 27 through 32 in table 9 deal with water leaks originating inside the unit. ILEAK (27) indicates whether any leaks have sprung from inside, and PILEAK and PLEAK (28 through 29) identify the source of the leak. In the 1985 through 1995 surveys, NLEAK (30) indicated that the source was unknown or other than a leaking pipe or plumbing fixture. Beginning with the 1997 survey, NLEAK1 and NLEAK2 separated the other source answers from the unknown answers.

**Table 6. AHS Variables Related to Heating**

Variable Name	Codebook Definition	Codebook Location*	First Year in New Sample	Final Year in New Sample	Number of Years in Survey
6 HEQUIP	Main heating equipment	Utilities	1985	2011	14
7 FREEZE	Unit cold for 24+ hrs was uncomfortable	Unit Quality	1985	2011	14
8 IFCOLD	Main heating equipment broke down	Unit Quality	1985	2011	14
9 NUMCOLD	Number of times main heating equipment broke down	Unit Quality	1985	2011	14
10 OTHCLD	Unit cold for some other reason	Unit Quality	1985	2011	14
11 WHYCLD	Why unit cold	<i>Unit Quality</i>	1985	1995	6
12 WHYCD1	Unit cold due to utility interruption	Unit Quality	1997	2011	8
13 WHYCD2	Unit cold due to inadequate heating capacity	Unit Quality	1997	2011	8
14 WHYCD3	Unit cold due to inadequate insulation	Unit Quality	1997	2011	8
15 WHYCD4	Unit cold due to cost of heating	Unit Quality	1997	2011	8
16 WHYCD5	Unit cold because of some other reason	Unit Quality	1997	2011	8

\*If a variable is found only in the 1985-through-1993 codebook, its location is given in italics.

**Table 7. AHS Variables Related to Electricity and Wiring**

Variable Name	Codebook Definition	Codebook Location	First Year in New Sample	Final Year in New Sample	Number of Years in Survey
17 BUYE	Pay for electricity separately (different coding)	Utilities	1985	2011	14
18 NOWIRE	Electrical wiring concealed by walls/wiring	Unit Quality	1985	2011	14
19 PLUGS	Every room has working electrical plug	Unit	1985	2011	14
20 IFBLOW	Fuses blown or circuit breakers tripped	Unit Quality	1985	2011	14
21 NUMBLOW	Number of times fuses blown or breakers tripped	Unit Quality	1985	2011	14

<sup>11</sup> In the 1997-through-2011 period, BUYE is a recode of BUYE2.

**Table 8. AHS Variables Related to Outside Water Leaks**

	<b>Variable Name</b>	<b>Codebook Definition</b>	<b>Codebook Location</b>	<b>First Year in New Sample</b>	<b>Final Year in New Sample</b>	<b>Number of Years in Survey</b>
22	LEAK	Any outside water leaks in past 12 months	Unit Quality	1985	2011	14
23	RLEAK	Water leak in roof	Unit Quality	1985	2011	14
24	WLEAK	Water leak in wall or closed door/window	Unit Quality	1985	2011	14
25	BLEAK	Water leak in basement	Unit Quality	1985	2011	14
26	OTLEAK	Water leak from other outside source	Unit Quality	1985	2011	14

**Table 9. AHS Variables Related to Inside Water Leaks**

	<b>Variable Name</b>	<b>Codebook Definition</b>	<b>Codebook Location*</b>	<b>First Year in New Sample</b>	<b>Final Year in New Sample</b>	<b>Number of Years in Survey</b>
27	ILEAK	Any inside water leaks in last 12 months	Unit Quality	1985	2011	14
28	PILEAK	Inside water leak from leaking pipes	Unit Quality	1985	2011	14
29	PLEAK	Inside water leak from plumbing fixtures	Unit Quality	1985	2011	14
30	NLEAK	Interior leak from other or unknown source	<i>Unit Quality</i>	1985	1995	6
31	NLEAK1	Inside water leak from some other source	Unit Quality	1997	2011	8
32	NLEAK2	Source of inside water leak unknown	Unit Quality	1997	2011	8

\*If a variable is found only in the 1985-through-1993 codebook, its location is given in italics.

Table 10 reports on problems with walls, floors, and ceilings. These variables have been consistently recorded since 1985, although the criterion for peeling paint changed from 1 square foot before 1997 to 8 by 11 inches (a sheet of paper) beginning in 1997.

Table 11 (on the following page) contains an eclectic grouping of variables. RATS (37) reports signs of rats or mice in surveys from 1985 through 1995, and EVROD (36) reports the same concept (evidence of rodents) from 1997 onward. A possible source of confusion was the redefinition of RATS (38) in 1997 to “rats seen in unit recently.” These variables (33, 34, and 35) are used in the structural problems component of the definition

of severe inadequacy. Variables 39 and 40 record toilet breakdowns. We kept the toilet breakdowns separate from the bathroom variables in table 5 because the previous variables (1 through 5) are used in determining severe inadequacy whereas variables 38 and 39 are used in determining moderate inadequacy.

Table 12 contains the elements used in defining a complete kitchen. Variable 41, KITCHEN, is used in the definition of moderately inadequate. Page 118 of the *AHS Codebook*, version 2.0, contains a definition of complete kitchen, which is found in the following excerpt.

**Table 10. AHS Variables Related to Walls, Floors, and Ceilings**

	<b>Variable Name</b>	<b>Codebook Definition</b>	<b>Codebook Location</b>	<b>First Year in New Sample</b>	<b>Final Year in New Sample</b>	<b>Number of Years in Survey</b>
33	HOLE	Holes in floor	Unit Quality	1985	2011	14
34	CRACKS	Open cracks wider than dime	Unit Quality	1985	2011	14
35	BIGP	Area of peeling paint larger than 8” x 11” (previously 1 sq ft)	Lead Based Paint	1985	2011	14

**Table 11. AHS Variables Related to Rodents and Toilet Breakdowns**

	<b>Variable Name</b>	<b>Codebook Definition</b>	<b>Codebook Location*</b>	<b>First Year in New Sample</b>	<b>Final Year in New Sample</b>	<b>Number of Years in Survey</b>
36	EVROD	Evidence of rodents in unit	Unit Quality	1997	2011	8
37	RATS	Signs of rats or mice in building in past 90 days	<i>Unit Quality</i>	1985	1995	6
38	RATS	Rats seen in unit recently	Unit Quality	1997	2011	8
39	IFTLT	Any toilet breakdowns in past 3 months	Unit Quality	1985	2011	14
40	NUMTLT	Number of toilet breakdowns 6 hours or more	Unit Quality	1985	2011	14

\*If a variable is found only in the 1985-through-1993 codebook, its location is given in italics.

**Table 12. AHS Variables Related to Kitchens**

	<b>Variable Name</b>	<b>Codebook Definition</b>	<b>Codebook Location*</b>	<b>First Year in New Sample</b>	<b>Final Year in New Sample</b>	<b>Number of Years in Survey</b>
41	KITCHEN	Complete kitchen facilities in unit	Unit	1985	2011	14
42	COOK	Unit has working cookstove or range/oven (separate use 1985–95)	Unit	1985	2011	14
43	OVEN	Unit has an oven for household's use only	<i>Equipment</i>	1985	1995	6
44	OVEN	Unit has a working microwave oven	Unit	1997	2011	8
45	BURNER	Unit has working built-in cooking burners (separate use 1985–95)	Unit	1985	2011	14
46	REFR	Unit has a working refrigerator (separate use 1985–95)	Unit	1985	2011	14
47	SINK	Unit has kitchen sink (separate use 1985–95)	Unit	1985	2011	14
48	KEXCLU	Kitchen facilities for household use only	Unit	1997	2011	8

\*If a variable is found only in the 1985-through-1993 codebook, its location is given in italics.

**Complete Kitchen Facilities:** A unit has complete kitchen facilities if it has all three of the following for the exclusive use of the occupants of the unit: (1) an installed sink with piped water, (2) a mechanical refrigerator, and (3) built-in burners, not portable. All kitchen facilities must be located in the structure. They need not be in the same room. Quarters with only portable cooking equipment are not considered as having a range or stove. An icebox is not included as a mechanical refrigerator. The kitchen facilities are for the exclusive use of the occupants when they are used only by the occupants of one housing unit, including lodgers or other unrelated people living in the unit. When a structure consists of only one housing unit, all equipment located inside the structure is classified, by definition, for exclusive use.

Page 1062 contains the following elaboration of the concept of complete kitchen facilities.

**Complete kitchen facilities.** A housing unit has complete kitchen facilities when it has all of the following: (1) kitchen sink; (2) burners, cook stove, or microwave oven; and (3) refrigerator. These terms are further defined below. The same criteria are used for occupied and vacant units in determining complete kitchen facilities. In some areas of the country it is common for the occupant to bring a refrigerator. In these cases the vacant unit, lacking a refrigerator, has an incomplete kitchen.

**Kitchen sink.** Only a sink in the unit or on an enclosed porch is counted, but it does not matter whether it is in the kitchen. However, a bathroom sink does not count as a kitchen sink.

**Refrigerator.** It may or may not have a freezer. Kerosene refrigerators are counted, but not ice boxes.

**Microwave oven.** Data for microwave ovens were collected only if the respondent did not report having a cooking stove with oven, or burners. Prior to 1997, the data collected included all types of ovens except toaster ovens.

**Burners.** Data for burners were collected only if the respondent did not report having a cooking stove with oven. Burners built into a stove or counter top are counted, as are burners in a woodburning stove.

**Cooking stove.** The cookstove can be mechanical or wood burning.

KITCHEN (41) is the summary variable that is derived from the answers to other variables (42 through 48). A sink (47) and a refrigerator (46) are necessary components. A unit satisfies the requirements for a complete kitchen if it has either a cook stove (COOK, 42), a microwave or other oven (OVEN, 43 or 44), or built-in burners (BURNER, 45). The definition of the OVEN variable changed beginning in 1997. Before 1997, any oven satisfied the conditions for OVEN; in 1997 and later, the question refers specifically to a microwave oven. Before 1997, COOK, OVEN, BURNER, REFR, and SINK indicated positive answers only if the equipment was for the exclusive use of the household. Beginning in 1997, KEXCLU (48) indicated exclusive use but was asked only in multiunit structures.

Table 13 contains variables (49 through 59) that do not figure in the AHS determination of the physical adequacy of a unit (ZADEQ), although the variables identify potentially serious problems. Before the 1997 survey, the answers to these questions were based on the observations of the enumerator. ENOB (59) indicated that the enumerator could not observe the exterior of the unit. With the shift to telephone surveying, these questions have been asked of respondents since 1997, and ENOB was no longer relevant. It is not clear whether BOARD (50) and



**Table 13. AHS Variables Related to External Structural Problems**

Variable Name	Codebook Definition	Codebook Location*	First Year in New Sample	Final Year in New Sample	Number of Years in Survey	
49	EBROKE	Windows broken	Unit Quality	1985	2011	14
50	BOARD	Unit boarded up	<i>Unit Quality</i>	1985	1995	6
51	EBOARD	Windows boarded up	Unit Quality	1997	2011	8
52	ECRUMB	Holes/cracks or crumbling in foundation	Unit Quality	1985	2011	14
53	EHOLER	Roof has holes	Unit Quality	1985	2011	14
54	EMISSR	Roof missing shingles/other roofing materials	Unit Quality	1985	2011	14
55	EMISSW	Outside walls missing siding/bricks/etc.	Unit Quality	1985	2011	14
56	ESAGR	Roof's surface sags or is uneven	Unit Quality	1985	2011	14
57	ESLOPW	Outside walls slope/lean/slant/buckle	Unit Quality	1985	2011	14
58	EGOOD	No listed conditions seen in/on unit	Unit Quality	1985	2011	14
59	ENOB	Unable to observe exterior condition of unit	Unit Quality	1985	1995	6

\*If a variable is found only in the 1985-through-1993 codebook, its location is given in italics.

EBOARD (51) are identical concepts. BOARD might represent a more serious condition. EGOOD (58) indicates the absence of any specific external problem.

In combination, CLIMB (60) and ELEV (61) in table 14 function to identify a problem for some units in highrise buildings.

Table 15 (variables 62 through 66) identifies potentially serious problems. They may or may not be problems with the unit. Breakdowns at the municipal level could account for interruptions in the provision of water (62 and 63) or sewage services (64 and 65), but the breakdowns could also occur on the unit's property and, therefore, be the responsibility of the property owner. If breakdowns at the municipal level occurred

frequently, then these problems would become common knowledge and be reflected in property values and rents. Crime problems that would necessitate putting bars on windows (66) would also be reflected in property values and rents. Including EBAR in the list is arguable because it definitely moves beyond the unit to the neighborhood as a source of problems.

The final two variables that are available throughout the 1985-through-2011 period are overall assessments of unit quality (table 16). The first, ZADEQ (67), is assigned by the AHS based on the answers to other questions. The second, HOWH (68), is the respondent's assessment of the unit on a scale of 1 to 10.

**Table 14. AHS Variables Related to Stair Climbing**

Variable Name	Codebook Definition	Codebook Location	First Year in New Sample	Final Year in New Sample	Number of Years in Survey	
60	CLIMB	Number of floors from main entrance to apartment	Unit	1985	2011	14
61	ELEV	Working passenger elevator	Unit	1985	2011	14
59	ENOB	Unable to observe exterior condition of unit	Unit Quality	1985	1995	6

**Table 15. AHS Variables Related to Problems Outside Unit**

Variable Name	Codebook Definition	Codebook Location	First Year in New Sample	Final Year in New Sample	Number of Years in Survey	
62	IFDRY	Unit completely without running water	Unit Quality	1985	2011	14
63	NUMDRY	Number of times completely without running water	Unit Quality	1985	2011	14
64	IFSEW	Sewage system broke down	Unit Quality	1985	2011	14
65	NUMSEW	Number of sewage system breakdowns	Unit Quality	1985	2011	14
66	EBAR	Windows covered with metal bars	Unit	1985	2011	14

**Table 16. AHS Variables Related to Overall Unit Quality**

Variable Name	Codebook Definition	Codebook Location	First Year in New Sample	Final Year in New Sample	Number of Years in Survey	
67	ZADEQ	Recoded adequacy of housing	Unit Quality	1985	2011	14
68	HOWH	Rating of unit as a place to live	Unit Quality	1985	2011	14

Table 17 contains 34 variables (69 through 102) that are NOT available in all the PUFs. The first 3 of these (69 through 71) were used in the derivation of ZADEQ from 1985 through 2005 but were discontinued after the 2005 survey, and the definition of ZADEQ was changed to accommodate the loss. All but 1 of the remaining variables were introduced in 1997 or 1999; the one exception was introduced in 2011. Although

most of the new variables are found in all the later PUFs, 9 of the variables that were introduced in 1997 were dropped after that survey, and 3 introduced in 1999 were dropped after the 2009 survey. Because these variables cannot be used for tracking unit quality over the entire period, we do not discuss them further.

**Table 17. AHS Variables Related to Housing Deficiencies Not Available for All Surveys**

	<b>Variable Name</b>	<b>Codebook Definition</b>	<b>Codebook Location</b>	<b>First Year in New Sample</b>	<b>Final Year in New Sample</b>	<b>Number of Years in Survey</b>
69	LTSOK	Hallway lights working	Unit Quality	1985	2005	11
70	BADSTEP	Loose/broken/missing steps in common stairs	Unit Quality	1985	2005	11
71	RAILOK	Railings on common stairs firmly attached	Unit Quality	1985	2003	10
72	BSINK	Unit has a bathroom sink	Unit Quality	1997	2011	8
73	DISAS	Type C severely damaged by natural disaster	Unit Quality	1997	2011	8
74	EXPOSE	Type B interior exposed to elements	Unit Quality	1997	2011	8
75	GRDMNT	Satisfaction with grounds maintenance	Unit Quality	1997	2011	8
76	MICE	Mice seen in unit recently	Unit Quality	1997	2011	8
77	NOTSUR	Not sure if rodents were rats or mice	Unit Quality	1997	2011	8
78	TREP	Repairs made because of inspection/test	Unit Quality	1997	2011	8
79	WATERS	Water safe for drinking and cooking	Unit Quality	1997	2011	8
80	BLDMNT	Satisfaction with building maintenance	Unit Quality	1999	2011	7
81	M3ROD	Rodents seen in unit recently	Unit Quality	1997	2009	7
82	MAJR1	Starts major maintenance/repairs soon enough	Unit Quality	1999	2011	7
83	MAJR2	Solves major problems quickly	Unit Quality	1999	2011	7
84	MAJR3	Polite/considerate of home (major repairs)	Unit Quality	1999	2011	7
85	MINR1	Starts minor maintenance/repairs soon enough	Unit Quality	1999	2011	7
86	MINR2	Solves minor problems quickly	Unit Quality	1999	2011	7
87	MINR3	Polite/considerate of home (minimum repairs)	Unit Quality	1999	2011	7
88	TALWIR	Aluminum wiring inspected before purchase	Unit Quality	1997	2009	7
89	TASB	Unit tested for asbestos before purchase	Unit Quality	1997	2009	7
90	TRADON	Unit tested for radon before purchase	Unit Quality	1997	2009	7
91	TWATER	Water quality tested before purchase	Unit Quality	1997	2009	7
92	WTRHRL	Source of inside water leak is broken water heat	Unit Quality	1999	2011	7
93	ELEVWK	At least one elevator in working order	Unit Quality	2001	2011	6
94	BDSTPQ	Loose/broken/missing steps in common stairs	Unit Quality	1997	1997	1
95	DFIRE	Type C-30/31 severely damaged by fire	Unit Quality	1997	1997	1
96	DORREP	Any doors repaired/replaced in unit	Unit Quality	1997	1997	1
97	IMAIN	Receive adequate maintenance	Unit Quality	1997	1997	1
98	LTSOK1	Hallway lights working	Unit Quality	1997	1997	1
99	LTSOK2	All hallway lights working	Unit Quality	1997	1997	1
100	OMAIN	Buildings and grounds maintained properly	Unit Quality	1997	1997	1
101	RAILOK1	Railings on stairs firmly attached	Unit Quality	1997	1997	1
102	RAILOK2	All stair railings firmly attached	Unit Quality	1997	1997	1

## 4. Recent Interest in the AHS Measure of Housing Adequacy

Although a great deal of interest existed in finding a measure of housing adequacy in the early years of the AHS, interest in this topic has been scant in recent years. The paucity of new research on physical inadequacy probably results from three causes. First, the work leading up to the current AHS definition was extensive and involved the persons most interested in the topic. Second, the AHS definition appeared to be doing precisely what it was intended to do, that is, identify units requiring major renovation or perhaps elimination from the stock. These first two reasons explain the absence of any immediate interest in further research. Third, the perceived level of inadequacy declined steadily after the new definition was instituted. Not only has the percentage of severely inadequate units declined, but also the incidence of severe housing problems has shifted. Orr and Peach make the following observation.

In 1975, roughly 5 percent of all housing units in the United States were rated severely inadequate; by 1997, that figure had fallen to around 2 percent. . . . Moreover, the most dramatic reduction in the share of severely inadequate units—from around 12 percent in 1975 to about 3 percent in 1997—occurred in the lowest income quintile. Within this quintile, housing adequacy improved for households with relatively young heads (twenty-five to thirty-four years old) as well as for those with relatively older heads (sixty-five years of age and older)—regardless of whether the household head was an owner or a renter.<sup>12</sup>

The decline in the percentage of severely inadequate units, particularly among low-income households, eliminated any sense of urgency for further work on this measure.

A notable recent study of housing quality measures is a paper by Paul Emrath and Heather Taylor.<sup>13</sup> Emrath and Taylor constructed hedonic models to estimate the value of owner-occupied housing and the gross rents of renter-occupied units. In these regressions, variables indicating that the unit was severely inadequate or, alternatively, either moderately or severely inadequate failed to be statistically significant and

had the wrong sign three out of four times. Emrath and Taylor believed that the failure of these variables to have a meaningful effect on value or rent suggests the measures are themselves inadequate.

Various arguments can be made to explain the lack of statistical significance, such as the small number of severely inadequate units, the lack of persistence of the conditions associated with AHS inadequacy, or the possibility that the full panoply of other variables related to quality made these variables redundant. We wonder, however, whether the predominant influence of “sharing plumbing” in determining inadequacy could account for the lack of significance. As noted, the lack of persistence is a puzzling feature of “no exclusive use.” If this negative feature is being measured incorrectly, then it would not be surprising to find that the severely inadequate variable is unrelated to value or rent.

At least in the past, the AHS measure performs well in identifying—at a given point in time—the most seriously troubled units, but it does not recognize varying quality levels among the 95 percent of units classified as adequate, which represent most units. Being characterized as inadequate in one survey does not mean that the unit is at a high risk of leaving the stock or of being inadequate in the next survey. As shown in table 3, of those units with severe physical problems in 2005 or in 2007 and that remained occupied in the next survey, more than 80 percent were adequate in the next survey, and less than 12 percent were still severely inadequate in the next survey.

Although little attention has been given to a single measure of quality, researchers have made use of the extensive information in the AHS on housing quality in studies of housing and related matters. Rather than employing a single measure of adequacy, authors have generally used multiple AHS variables in regression frameworks to control for variations in housing quality.<sup>14</sup> Tables 5 through 16 list AHS quality-related variables that are generally available in most AHS datasets available for use by researchers.

<sup>12</sup> Orr and Peach (1999: 53).

<sup>13</sup> Emrath and Taylor (2012).

<sup>14</sup> See, for example, Gordon and vanGoethem (2005).

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## Appendix. Analysis of Severe Plumbing Problems Over AHS Surveys

Econometrica did some additional analysis of the bathroom condition variables primarily to determine whether the wording change in 1997 regarding exclusive use (see discussion of table 5 in the main body of this report) had any effect on the measurement of severe plumbing problems. The analysis suggests that, despite what appears to be a change in concept, no easily discernible effect on the count of units with severe plumbing problems is evident. This analysis is far from conclusive, however and suggests other issues with the measurement of plumbing problems.

For this analysis, Econometrica used the summary data for the national American Housing Survey (AHS), specifically tables 2-4 and 2-7. The numbers in rows 1, 2, and 4 through 10 in table A-1 are taken directly from published reports for the AHS surveys from 1985 to 2009. The numbers in these rows for 2011 come from tabulations based on the third test version of the public use file (PUF).<sup>15</sup>

The U.S. Department of Housing and Urban Development (HUD) and the Census Bureau were not satisfied with the reliability of the plumbing data in the 1985 and 1987 surveys. The publications for those years contain an overall estimate of severe plumbing problems in table 2-7 but do not contain breakdowns of plumbing problems in table 2-4. The notation in table 2-4 for those years is “Data not up to publications standards.” Whatever problems were experienced resulted in rather low estimates of severe plumbing problems. The ratios of units with severe plumbing problems to all occupied units for these two surveys are one-third to one-half the same ratios for the next four surveys and are substantially lower than any subsequent ratio.

Table A-1 shows that HUD and the Census Bureau changed the way they report plumbing problems in table 2-4 beginning in 1997. In 1989 through 1995, row 4 in table A-1 records the number of units that are lacking complete plumbing fixtures, and row 8 reports the number of units with no exclusive use. These counts are mutually exclusive, because the counts in rows 4 and 8 add up to the count in row 9 for these surveys.<sup>16</sup>

Beginning with the 1997 publication, row 4 is the same as row 9; that is, it reports the number of units that have severe plumbing problems, either lacking a plumbing fixture or lacking exclusive use.

To obtain a rough estimate of how many units suffer from only lacking exclusive use for the survey years beginning in 1997, the analysts calculated two numbers. Row 11 is the maximum number of units with only no exclusive use; they calculated this estimate by subtracting the largest count from rows 5, 6, and 7 from row 9. This calculation presumes, for example, that the 385,000 units in 1997 that had no hot piped water included the 328,000 units with no bathtub or shower and the 296,000 units with no flush toilets. Row 12 is the minimum possible number of units with only no exclusive use; we calculated this estimate by subtracting the sum of rows 5, 6, and 7 from row 9. This calculation presumes no overlap in the units that had no hot piped water, no bathtub or shower, or no flush toilet.

Ignoring the unreliable 1985 and 1987 survey results, Table A-1 shows a decline in the number and percent of occupied units with severe plumbing problems over the period, but the pattern suggests that several conceptual changes in measuring severe plumbing problems may have occurred. Looking at row 9, the counts jumped in 1989, fell sharply in 1993, fell substantially again in 1997, and then rose again in 1999.

Row 14 shows that “no exclusive use” was the predominant cause of severe plumbing problems in the 1989-to-1995 period, the period before the change in the questionnaire language. Rows 15 and 16 indicate that it was an important cause in the 2003-to-2011 period and perhaps an important cause in the 1997-to-2001 period.

In the report, we noted that “no exclusive use” can arise from two situations. First, multiple units in the same structure may share the same bathroom. Because the bathroom is in the same structure, each unit is credited by the AHS as having access to all the essential elements of a full bathroom, but they do not have exclusive use. Second, a household in a unit within a structure without a full bathroom may use the bathroom in a

<sup>15</sup> As part of the same contract that funded this research, Econometrica reviews early versions of the PUF for 2011 to help HUD and the Census Bureau check these files for reliability. When we revised this paper, we had access to an early version of the 2011 PUF.

<sup>16</sup> From the table wording, we presume that unit row 8 includes “no exclusive use-only” problems through 1995.

Table A-1. Published AHS Data on Severe Plumbing Problems, 1985 Through 2011 (all counts in thousands)

Table	1985	1987	1989	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009	2011 QC PUF
1 2-4 Occupied units	88,425	90,888	93,683	93,147	94,724	97,693	99,487	102,803	106,261	105,842	108,871	110,692	111,806	114,907
2 2-4 With complete plumbing	*	*	91,154	90,869	93,345	96,234	98,320	101,367	104,885	104,487	107,574	109,433	110,574	113,470
3 Calculated Difference			2,529	2,278	1,379	1,459	1,167	1,436	1,376	1,355	1,297	1,259	1,232	1,437
4 2-4 Lacking some plumbing facilities	*	*	276	233	227	188	1,167	1,436	1,376	1,355	1,279	1,259	1,232	1,438
5 2-4 No hot piped water	*	*	48	38	57	42	385	319	292	225	223	169	112	189
6 2-4 No bathtub nor shower	*	*	231	194	181	141	328	316	277	166	160	179	113	146
7 2-4 No flush toilet	*	*	155	133	131	85	296	293	264	139	141	132	102	121
8 2-4 No exclusive use	*	*	2,253	2,045	1,152	1,271	707	1,065	1,022	1,063	1,034	1,031	1,065	1,185
9 2-7 Severe problems: plumbing	660	574	2,529	2,278	1,379	1,459	1,169	1,436	1,376	1,355	1,297	1,259	1,232	1,435
10 2-4 No exclusive use only	NA	NA	2,253	2,045	1,152	1,271	NA	NA	NA	NA	NA	NA	NA	NA
11 Calculated Maximum possible with only "no exclusive use"	NA	NA	NA	NA	NA	NA	784	1,117	1,084	1,130	1,074	1,080	1,119	1,246
12 Calculated Minimum possible with only "no exclusive use"	NA	NA	NA	NA	NA	NA	160	508	543	825	773	779	905	979
13 Calculated Severe plumbing problems as percent of occupied units	0.7%	0.6%	2.7%	2.4%	1.5%	1.5%	1.2%	1.4%	1.3%	1.3%	1.2%	1.1%	1.1%	1.2%
14 Calculated "No exclusive use" as percent of severe plumbing problems	NA	NA	89.1%	89.8%	83.5%	87.1%	NA	NA	NA	NA	NA	NA	NA	NA
15 Calculated "Maximum possible" as percent of severe plumbing problems	NA	NA	NA	NA	NA	NA	67.1%	77.8%	78.8%	83.4%	82.8%	85.8%	90.8%	86.8%
16 Calculated "Minimum possible" as percent of severe plumbing problems	NA	NA	NA	NA	NA	NA	13.7%	35.4%	39.5%	60.9%	59.6%	61.9%	73.5%	68.2%

\* Data not up to publications standards. NA = data not available. QC PUF = quality control version of the public use file.

unit occupied by a second household in another structure. In this case, the unit occupied by the first household would be listing as lacking one or more elements of a full bathroom, and the unit occupied by the second would be credited with all the elements of a complete bathroom except exclusive use.

Our presumption is that the first situation is the most common. The characteristics of these units would appear to be persistent, however, from survey to survey. Although persistence would not be expected in the second situation, the reported numbers limit the scope of this situation. The second situation requires each unit with “no exclusive use” to be linked to one or more units without all the elements of a full bathroom; otherwise, why would the household in the linked units need to use the bathroom in the “no exclusive use” unit?

In 2011, at most, 456,000 units were without the elements of a full bathroom (189,000 with no hot piped water, 146,000

with no tub or shower, and 121,000 with no flush toilet). This statistic assumes no overlap among the units that lack one of these three elements; if complete overlap existed, then only 189,000 units lacked one or more of the three elements. This statistic means that between 189,000 and 456,000 units had households that could possibly use the full bathrooms in a unit located in another structure. Thus, the second situation could account for no more than 47 percent of the units with no exclusive use ( $456,000/[1,435,000-456,000]$ ).

Therefore, at least 53 percent of the units with no exclusive use were in units in multiunit structures that shared bathrooms, units that should have the same “no exclusive use” characteristic in repeated surveys. Table 4 shows that less than 6 percent of the units with no exclusive use in one survey, however, have the same condition in the next survey.