

ATTACHMENT A

**INDEPENDENT VERIFICATION REPORT FOR AVISTA'S NATURAL GAS
DSM SAVINGS**

YEAR ENDED DECEMBER 31, 2008



research/into/action^{inc}

Final Report

Independent Third-Party Verification of Natural Gas DSM Energy Savings, 2006 through 2008: Washington and Idaho Programs

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VERIFICATION OF 2006-2008 NATURAL GAS DSM ENERGY SAVINGS: WASHINGTON AND IDAHO PROGRAMS



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EXECUTIVE SUMMARY

Avista Utilities (Avista) operates a variety of energy efficiency programs with its residential, limited-income, and nonresidential customers. These programs have the potential to create significant energy savings for Avista's customers, as well as to enable Avista to achieve the gas Demand Side Management (DSM) goals required under an approval agreement for a three-year natural gas decoupling pilot.

Avista must verify achievement of its DSM goals on an annual basis by an independent third-party assessment for the calendar years 2006 through 2008. Research Into Action, together with its subcontractor, Nexant, Inc., has performed the independent verification audit for 2006 through 2008. The verification was done through a combination of engineering evaluations of the estimated impacts of actions involved in the programs, together with an audit of the program documentation, to determine whether or not the savings and costs were applied to the measures appropriately.

We used common and accepted data sampling and analysis methods to examine multiple strata within each customer group¹, with the goal of obtaining sufficient statistical power to produce estimates of audit measurements with a minimum precision of $\pm 10\%$, at a confidence of 90%, over the three-year course of the evaluation.

The verification methodology for all three programs shared three common components:

1. Reviewing the paper documentation of the sampled cases to verify that the input data used to calculate the therms saved on a case-by-case method were correct;
2. Performing an engineering review of the assumptions that went into Avista's calculations of therm savings for the various measures; and
3. Independently calculating therm savings on a case-by-case basis, using either Avista's assumptions or other sets of assumptions resulting from the engineering review.

Specific details of the methodology for each program reflected differences among the programs and program strata in how measures were taken.

¹ For the 2007 and 2008 audits, we modified the stratification plan that we had followed for the 2006 audit. In combining the 2006-2008 results, we used the new stratification. This is described in detail in Section 3, *Audit Methods*.



DOCUMENTATION REVIEW

For program year 2008, the documentation review was able to obtain sufficient documentation for the majority (209 of 222) of projects. Table ES.1 shows the number of documentation problems within each program, along with the percentage of all projects in that program that had documentation problems, for 2008 and the combined 2006-2008 data.

Table ES.1: Frequency of Documentation Problems by Group

GROUP	PROJECTS WITH UNRESOLVED DOCUMENTATION PROBLEMS			
	2008		2006-2008	
	COUNT	%	COUNT	% ¹
Residential Program	5	3.9	34	11.8
Limited-Income Program	0	0.0	2	0.4
Nonresidential Program – Census of Largest Projects	5	45.5	7	30.4
Nonresidential Program – Sampled Projects	14	45.5	38	27.2

¹ With the exception of the "Largest Projects" stratum of the nonresidential program, the percentages shown are weighted to account for different sampling ratios across strata and program years (see Chapter 3, *Audit Methods*). However, the counts shown in this table are raw counts.

In the residential program, three types of documentation error each accounted for roughly equal percentages of program records across the three program years. These were documentation that was insufficient to confirm the claimed savings; documentation that produced savings values that contradicted (exceeded) the claimed savings; and documentation that showed that the measure in question did not actually qualify for a rebate. Based on the sampled data, weighted to account for differences in sampling ratios, we estimate that these three types of documentation error together accounted for 10% of records.² The measure was incorrectly coded on an additional 1.8% of records.

As seen above, we encountered few unresolved documentation problems in the limited-income program. The counts of documentation problems for the residential and limited-income programs, shown in the above table, do not include a larger number of cases in each sample for which we requested and received additional documentation from Avista.

² Previously, we reported that the first type of error—insufficient documentation—was most frequent, but that was based on raw, unweighted, counts. When the strata were weighted to account for different sampling ratios, this type of error was no more frequent than the others mentioned.



The nonresidential program had a higher percentage of documentation problems than the others. Most of these problems consisted in the inability to obtain some of the inputs used to generate the model behind Avista's estimates. By far, the majority of these cases were rooftop services projects from the *AirCare Plus* program. We were able to calculate estimates for these and some other projects for which we had limited input data, but we do not necessarily recommend that Avista use our estimates rather than their own, as the estimates are not comparable. We continue to recommend that additional review be conducted of the *AirCare Plus* program.

In addition to the above documentation problems identified in the sample, we identified several records in the residential program's database, not selected for the sample, that were miscoded. The identified records accounted for about 0.5% of the 2008 database, which does not substantially affect the rate of miscoding estimated from the sample.

We offer some recommendations in the *Conclusions and Recommendations* chapter for how Avista can improve documentation.

ENGINEERING REVIEW AND ANALYSIS OF ENERGY SAVINGS

Our analysis of Avista's reporting energy savings found variances between Avista's savings estimates and our computations in all three programs for 2008 and the combined 2006-2008 data. Table ES.2 shows the mean differences between Avista's reported therm savings and our computations for 2008 sample and across the three program years.

Table ES.2: Variances Between Avista's Reported Savings and Audit Results by Group

GROUP	MEAN DIFFERENCE BETWEEN AVISTA'S REPORT AND AUDIT RESULTS			
	2008		2006-2008	
	THERMS	PERCENT	THERMS	PERCENT
Residential Program	-0.2	-0.2	3.2	4.3
Limited-Income Program	30.7	23.7	23.6	17.5
Nonresidential Program – Largest Projects	1,058	4.2	4,872	15.8
Nonresidential Program – Sampled Projects	738.8	79.5	204.1	20.5

As Table ES.2 shows, we found that the mean level of discrepancy between Avista's claimed savings and our computations differed among the programs. The following outlines our findings from the engineering review and analysis for each program (residential, limited-income, and nonresidential).



Findings for the Residential Program

As part of our 2006 audit, we performed an engineering review of Avista's residential program that consisted of a check against standard engineering practices. We compared Avista's reported energy savings to other utility DSM program offerings and performed engineering calculations to verify savings on a measure-by-measure basis.

For the audit of the 2007 and 2008 program years, we determined whether any of our previous recommendations should be revised based on new information either reported by Avista or found in the literature. We also performed engineering reviews on newly identified measures.

The main findings regarding the residential program were:

- **During the 2006 audit, we arrived at per-unit therm savings that were close to Avista-reported values for most of the prescriptive measures in the residential program.** Although there were some variances, in most cases they were not so great as to justify recommending a different value from the one that Avista uses. For subsequent audits, we made few modifications to our previous recommendations.
- **For two of the prescriptive measures – high-efficiency 40-gallon and 50-gallon water heaters – we previously recommended higher per-unit reported savings than the ones that Avista reported.** In the 2006 report, we recommended some changes, but still accepted Avista's values as reasonable. For the 2008 program, Avista followed our recommended values.
- **For high-efficiency continuous-flow (tankless) water heaters, we previously recommended higher per-unit reported savings than the ones that Avista reported.** Avista increased its per-unit claimed savings for that measure for the 2008 program year based on an increase in the minimum efficiency rating, and we have accepted the new value as reasonable.
- **Across all measure types and program years, the weighted differences between Avista's values and the audit's values were relatively small (3.2 therms, 4.3%).** The mean difference was much smaller for 2008 (-0.2 therms, -0.2%) than we found previously, suggesting an improvement in rebate application review procedures.
- **Across the three program years, the precision of the mean difference in estimated savings was about 3.5% of Avista's mean estimate.** This well surpassed the requirement of 10% precision (at 90% confidence).

Findings for the Limited-Income Program

The engineering evaluation of Avista's limited-income program consisted of a customer-by-customer analysis based on the inputs provided in the CAP reports.



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- **For 2008, the number of sampled cases with large discrepancies between the claimed savings and the audit's estimated savings was greater than in the previous years' audits.** This produced a larger mean discrepancy for 2008 (30.7 therms, 23.7%) than was found previously—the three-year mean was 23.6 therms. We are unable to account for this large difference.
- **The 90% confidence interval around the mean discrepancy was large in all years owing to the general high level of variability.** Therefore, we cannot conclude with a high level of confidence that the actual level of error within the 2008 population was greater than in previous years. The primary finding is the overall high level of variability and the relatively high mean level error.
- **Across the three program years, the precision of the difference between Avista's estimated savings and the audit's estimates was 10.4% (at 90% confidence).**

Findings for the Nonresidential Program

The engineering review of Avista's nonresidential program consisted of project-by-project analyses based on the inputs and assumptions provided by Avista, along with a check against standard engineering practices. In the case of pre-rinse sprayers, which were included in the 2006 and 2007 programs, but not in the 2008 program, the engineering review consisted of an evaluation of Avista's metering data study completed in 2007 for a sample of installed units. The following summarizes our findings for the nonresidential program:

- **The review of the 11 largest projects resulted in energy savings that were within 10% of Avista's reported values for five projects and they were within 20% of Avista's values for eight projects.** Across the three program years, our results were within 20% of Avista's for 13 of 23 large projects. The likely reason for the large differences in energy savings in the other projects was the unavailability of some assumptions used by Avista to calculate energy savings, which resulted in the use of our own engineering assumptions in our models.
- **The review of the measures in the sampled custom measures stratum (HVAC, shell, rooftop service, and appliances) resulted in values that were within 20% of Avista's reported values in about three-fifths of the cases.** The largest differences were in a few HVAC projects and several rooftop services projects. We evaluated the rooftop service projects using eQuest and the assumptions provided to us by PECI. There were significant differences in our values and Avista's reported values due to the lack of clarifying information provided by PECI and because we modeled the savings in eQuest as opposed to PECI's own modeling tool. We had similar difficulties in evaluating rooftop service projects in the 2006 and 2007 audits.



- **In addition to calculating the mean difference between the audit's estimates and Avista's estimates, we used two other methods to calculate the mean difference.** The methods were based on how we treated cases in which our estimate was based on incomplete data. Expectedly, accepting Avista's estimates for those cases decreased the calculation of Avista's mean overestimate of savings. Substituting a randomly generated number between our estimate and Avista's estimate (under the assumption that, with more input, we would have calculated an estimate that was closer to Avista's) actually increased the calculation of Avista's mean overestimate of savings for 2008 and had no substantial impact on the 2006-2008 figure.
- **Across the three program years, the precision of the difference between Avista's estimated savings and the audit's estimates ranged from about 13% to 18% (at 90% confidence).** The value depended on which method we used to calculate the mean difference between the audit's and Avista's estimates.
- **For the 2006 and 2007 programs, we accepted the prescriptive per-unit savings of 44 therms for Stratum 1 (*Pre-Rinse Sprayers*), but noted that this may be conservative.**
- **For the 2008 program, we noted a wide variation in estimated energy savings for prescriptive demand controlled ventilation (a new prescriptive measure).** The variation was based upon the analysis tool used. We believe that Avista adopted a reasonably conservative approach to this measure but recommend that it be investigated further for accuracy.

RECOMMENDATIONS

Avista accepted all our previous recommended changes in claimed savings for particular measures. Further, the results of the 2008 audit suggest that Avista has improved documentation and internal review and Avista has made modified how it records and tracks application data for some measures, making verification easier and possibly more accurate. We repeat recommendations that Avista may not yet have fully implemented, in some cases with modifications.

Residential Program

- **Request more detailed documentation from residential customers and their contractors submitting rebate requests.**
- **Provide outreach to vendors to educate them about what kind of information is needed on the invoices.**
- **Continue to improve review of rebate applications to ensure that the information on the backup documentation is completely consistent with that listed on the rebate forms.**



- Identify furnace, boiler, and water heater models that do and do not meet minimum efficiency requirements and provide this information to vendors or customers or use it to review incoming applications.
- Institute an internal system for checking data entry accuracy to ensure that incorrect measure types are not recorded in rebate records.
- Institute a system for reviewing the entire database on a regular basis to identify and report therm values that are inconsistent with the measure.
- Continue to review rules and procedures for assigning or calculating therms in the database to ensure that they are consistent with engineering-established rules and procedures.

Limited-Income Program

- Review the calculation methodologies used by all CAPs to ensure that there is consistency across the various agencies and that energy savings are being calculated correctly.
- Request that all necessary baseline information be recorded and maintained by the agencies.

Non-Residential Program

- Increase documentation of baseline and retrofit equipment, including model numbers, efficiencies, and shell information.
- Complete a separate evaluation of PECCI's *AirCare Plus* program to determine the accuracy of reported energy savings.
- Further investigate the prescriptive values assigned for demand controlled ventilation.





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INTRODUCTION

In February 2007, Avista Utilities (Avista) received approval for a three-year natural gas decoupling pilot, under which it must achieve certain gas Demand Side Management (DSM) goals (i.e., energy savings, expressed in therms) in order to be able to recover tracked margin. The savings are achieved through a variety of residential, limited-income, and nonresidential programs that Avista has undertaken. Avista must verify achievement of its DSM goals on an annual basis by an independent third-party assessment for each of the three years of the pilot.

Avista chose Research Into Action, Inc., to carry out the verification. Together with its subcontractor, Nexant, Inc., Research Into Action has performed independent verification audits for the calendar years 2006 through 2008. The verifications were done through a combination of engineering evaluations of the estimated impacts of actions involved in the programs, together with audits of the program documentation, to determine whether or not savings and costs were applied to measures appropriately.

The audits were based on desk review of the paper trail, with possible telephone contacts or in-person visits, of samples drawn separately for residential, limited-income, and nonresidential customer categories. The purpose of the audits was to determine whether or not Avista's savings estimates in each case are reasonable. Specifically, we set out to answer the following questions:

1. Were the input data that Avista used to calculate therm savings on a case-by-case basis adequately supported by invoices and related documentation?
2. Were Avista's methods for estimating therm savings for the various measures installed justified from an engineering standpoint?
3. Assuming adequate estimation methods and input data, were Avista's calculations of savings on a case-by-case basis accurate?

In August 2007 and July 2008, Research Into Action submitted reports to Avista detailing the results of the audit of year 2006 and 2007 programs, respectively. The reports described: Avista's residential, limited-income, and nonresidential energy efficiency incentive programs; the audit methods used; the results of the audit; and our recommendations to Avista, based on the audit results.

The current report covers the audit of the 2008 programs as well as cumulative 2006-08 results. It includes the descriptions of the Avista programs and audit methods as well as the 2008 and cumulative results. Based on the results of the 2006 audit, we made some changes to the sampling method for the 2007 and 2008 audits, which we describe in the appropriate section of this report.



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AVISTA UTILITIES ENERGY EFFICIENCY PROGRAMS

Since 2006, Avista Utilities has implemented energy efficiency incentive programs with its residential, limited-income, and nonresidential gas customers. The programs provide rebates for a variety of energy efficiency measures carried out at customers' homes and businesses. For the calendar years 2006, 2007 and 2008, Avista's customer service database recorded completed installations of 17,830 residential measures, 1,777 limited-income residential measures, and 2,128 nonresidential measures that resulted in therm savings. The details of how each program is implemented vary among the three customer categories and, to some degree, among measure types within certain customer categories.

RESIDENTIAL PROGRAM

The residential program provides rebates to residential customers for prescriptive energy efficiency improvements for a range of gas measures. These measures, along with their eligibility criteria, assumptions, and prescriptive therm savings are shown in Table 2.1. Any changes that have been made since 2006 to any of the foregoing are discussed in table notes.

Table 2.1: Eligibility Criteria and Assumptions for Computing Savings for Residential Measures

MEASURE	ELIGIBILITY CRITERIA	BASELINE / ASSUMPTIONS	THERM SAVINGS
High-Efficiency Gas Furnace	Minimum Annual Fuel Utilization Efficiency (AFUE) of 90%	Federal minimum AFUE (78%)	123 ¹
High-Efficiency Gas Boiler	Minimum AFUE of 90%	Federal minimum (80%)	123 ²
High-Efficiency 40-Gallon Water Heater	Minimum Efficiency Factor (EF) of .62	.59 to .62	8 ³
High-Efficiency 50-Gallon Water Heater	Minimum EF of .60	.58 to .60	9 ⁴
High-Efficiency Tankless Water Heater	Minimum EF of .82	(not specified)	60 ⁵
Ceiling/Attic Insulation	Existing insulation less than R-22; a minimum increase of R-10; installed only in areas that separate conditioned from unconditioned areas of the residence	R15 to R25	.09 per square foot ⁶
Floor or Wall Insulation	Existing insulation less than R-11; minimum increase of R-10; installed only in areas that	R5 to R15	.31 per square foot ⁶



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MEASURE	ELIGIBILITY CRITERIA	BASELINE / ASSUMPTIONS	THERM SAVINGS
	separate conditioned from unconditioned areas of the residence		
Duct Insulation (Discontinued in 2007)	Minimum increase of R-10; installed on heating ducts in unconditioned areas	Average 2 square feet per linear foot	2.8 per linear foot
New Windows (Discontinued in 2008)	Minimum U-factor of .35	U-factor .55 or higher	.42 per square foot of window installed ⁷
Replacement Windows	Minimum U-factor of .35	U-factor .55 or higher	.83 therms per square foot of window installed
Programmable Thermostat	7-day programmable	(not specified)	31
Fireplace Damper	Standard damper	(not specified)	76
Ground Source Heat Pump (Added in 2008)	Minimum 13.6 HSPF	(not specified)	787
ENERGY STAR [®] Homes	Certified as ENERGY STAR [®]	(not specified)	197
ENERGY STAR [®] Clothes Washer (Added in 2008)	Certified as ENERGY STAR [®]	(not specified)	9
ENERGY STAR [®] Dishwasher (Added in 2008)	Certified as ENERGY STAR [®]	(not specified)	5

¹ Avista claimed 72 therms for this measure in 2006 and 2007. In 2008, Avista increase the therm savings to 123 based on an updated analysis of annual heating BTU consumption requirements, primarily driven by a change in area of heat loss for the shell to include floor space, which was not included previously. As noted in the Results chapter, below, our engineering review confirmed the new value of 123 therms.

² Avista claimed 72 therms for this measure in 2006 and 2007. In 2008, Avista increase the therm savings to 123 based on an updated analysis of annual heating BTU consumption requirements, primarily driven by a change in area of heat loss for the shell to include floor space, not included previously. Avista also increased the minimum AFUE% from 85% to 90% in 2008.

³ Avista claimed 11 therms for this measure in 2006 and 2007. In 2006 and 2007, our audit verified 11 therms but recommended that 8 therms be claimed. Avista changed the claimed savings to 8 therms for the 2008 program.

⁴ Eight therms were claimed for this measure in the 2006 and 2007 programs. In 2006 and 2007, our audit verified 16 therms but recommended that 11 therms be claimed. Avista changed the claimed savings to 9 therms for the 2008 program.

⁵ Eleven therms were claimed for this measure in the 2006 and 2007 programs (with a minimum Efficiency Factor of .65). In 2006, our audit verified 28 therms for this measure and recommended that 28 therms be claimed. In 2007, our audit verified at least 52 therms for this measure and recommended that at least 52 therms be claimed. Avista changed the claimed savings to 60 therms for the 2008 program, and increased the minimum Efficiency Factor to .82.

⁶ Avista claimed .042 therms per square foot of qualifying ceiling/attic insulation installed and .209 therms per square foot of qualifying floor/wall insulation installed (not .042 or .209 therms per square foot per R-10 added, as reported in the 2006 report). In 2008, Avista increased these to .09 and .31 therms, respectively. The increase was based on a review of records from prior program years that showed that average existing insulation levels were lower than had been assumed and that, on average, more than the minimum R-10 was being added.

⁷ The original table reported that the claimed savings for new windows was calculated as .24 therms per square foot, but review of the data reported (for both 2006 and 2007) indicated that the claimed savings actually was calculated as .42 therms per square foot, and this figure was supported by our engineering review. Therefore, we have altered this table to show that claimed savings were calculated as .42 therms per square foot of window installed.



In the residential customer program, customers deal directly with contractors for installation of measures. The customers record pertinent data about the measures on an Avista *Home Improvement Incentive Form* (rebate form) and submit this form, together with invoices and other relevant documentation from the contractor, to Avista. If the installation meets Avista's eligibility criteria, Avista issues a rebate to the customer.

LIMITED-INCOME PROGRAM

The limited-income program provides rebates to limited-income residential customers for energy efficiency improvements for the following gas measures:

- Air infiltration
- ENERGY STAR® windows
- ENERGY STAR® doors
- High-efficiency furnace
- High-efficiency 40-gallon water heater
- High-efficiency 50-gallon water heater
- High-efficiency tankless water heater
- Ceiling/attic insulation
- Floor or wall insulation
- Duct insulation

To qualify for an energy audit through the limited-income program, customers must attend a workshop to learn about saving energy and are provided low-cost/no-cost tips. After attending the workshop, customers then receive an in-home assessment and a Community Action Program (CAP) agency determines cost-effective measures for installation, based on existing equipment, the shell, and so forth.

One salient characteristic of the limited-income program is that, while there are recommended or suggested guidelines for the installation of measures, the analyses are performed and the incentives are offered on a site-specific basis. Thus, the minimum required efficiencies that apply to some measures in the residential program—such as water heaters and furnaces (see above)—do not necessarily apply in the limited-income program.

The reasoning for this was that the assumptions differed for the residential and limited-income programs. For the residential program, Avista assumed that customers receiving a rebate were



replacing a system on or near burnout and that they would need to buy at least a code replacement water heater.

For the limited income program, the assumption was that customers often would replace an inefficient, but still functional, system before burnout, so replacement with a new system would provide a higher savings potential, even with a lower efficiency level. Furthermore, Avista assumed that many limited-income customers in manufactured housing may not have the ability to install a higher efficiency system in the available space.

A second salient characteristic of the limited-income program, which affects the verification methodology, is that all measures in this program are directly installed by CAP agencies. Therefore, the customer neither completes a rebate form nor receives invoices or other supporting documentation from the installer. Instead, CAP installers record all input data (including pre-existing conditions as relevant), either directly into software installed on notebook computers that they carry with them to the location of installation or onto paper forms. The software or paper forms that are used vary among CAPs. With some minor exceptions, no independent hard-copy documentation exists for any of the measures in this group.

NONRESIDENTIAL PROGRAM

The nonresidential program provides rebates for energy efficiency improvements for the following customized gas measures:

- Appliances
- Heating, ventilation, and air conditioning (HVAC)
- LEED certification
- Shell
- Rooftop service

In addition, the nonresidential program has offered various measures with prescriptive gas savings. In 2006 and 2007, the program offered prescriptive incentives for pre-rinse sprayers. In 2008, the program offered prescriptive incentives for food service equipment, steam trap replacement, and demand controlled ventilation. These accounted for about 5% of the total number of projects and a much smaller percentage of the total savings for the nonresidential program.

The procedures for implementing measures and claiming rebates differ for the various measure types. For rebate applications involving pre-rinse sprayers, Avista hired contractors who installed the measures directly. For rooftop service, Avista hires contractors who perform an audit. In both cases, contractors record relevant data about the installation (including pre-existing conditions)



directly into software installed on a notebook computer. Little or no additional paper documentation is created for these measures.

For the rebate applications involving lighting, motors, food service and other prescriptive measures, and commercial HVAC variable frequency drive equipment, the customer can purchase and install the measure and submit a rebate form and invoices to Avista.

Avista offers a third-party shell measure for multifamily dwellings. For this measure, the third-party contractor approaches the property owner and directly installs the measure in all units.

The program for the remaining measure types is site specific, in which customers receive an analysis from Avista prior to ordering and installing equipment, which estimates energy savings and potential incentive. Avista enters into an *Energy Efficiency Agreement* with each customer, which states that they can be reimbursed upon completion of the project, based on project costs and type of equipment installed. The customers sign this agreement and either hire a contractor to install the measure or install it themselves. Upon completion of the project and receipt of invoices, Avista energy efficiency engineers post-verify the installation. If the installation is verified and meets Avista's eligibility criteria, Avista issues a rebate.



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3

AUDIT METHODS

We used data sampling and analysis methods that are common and accepted in evaluation research. The sampling methods, described in detail below, examined multiple strata within each customer group. The data analysis, described in the next section, combined an engineering review of Avista's therm-savings calculation methods, a review of the documentation submitted with each record in the samples to determine whether the input data that Avista used to calculate therm savings were accurate, and a data review to evaluate the accuracy of Avista's calculated savings.

SAMPLING METHODOLOGY

The primary consideration that informed our sampling approach was that each sample should have sufficient statistical power to produce estimates of audit measurements with good precision and confidence levels over the three-year course of the evaluation. In the report of the 2006 audit, we indicated a goal of achieving $\pm 5\%$ and 95% confidence. These levels were based on the assumption of a very low rate of documentation error. However, based on the results of the 2006 audit, achieving these highly stringent precision/confidence levels would require significantly larger samples. Since these levels go beyond industry standards (typically $\pm 10\%$ precision and 90% confidence) and were not mandated by WUTC, we have relaxed them slightly to $\pm 10\%$ precision and 95% confidence.

Thus estimates of measurements that are expressed as a proportion or percentage of the sample (e.g., percentage of the sample for which the input data recorded on the rebate forms were confirmed by accompanying documentation) should be accurate within plus-or-minus 10 percentage points. Estimates of the degree of error in Avista's calculation of therm savings should be accurate within $\pm 10\%$ of the mean Avista-calculated therm savings.

A second important consideration was that to each sample should include the broadest possible range of measure types. An initial review of the distribution of the population of measure types within each program revealed that a few measure types accounted for a large percentage of measures taken, while several other measure types each accounted for very low percentages. A simple random sample of such a population would have been dominated by the high-frequency measures, and some low-frequency measures might not even be sampled.

We used a stratified sampling approach to prevent such an occurrence. As described below, we divided each population of measures into several strata, with the highest-frequency measure types each constituting their own strata, and one stratum comprised of all low-frequency measures. The high-frequency measure types were sampled from their own strata so that they would not dominate the overall sampling. Even with stratification, it was possible that some low-frequency



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measure types would not be included, but excluding very low-frequency measure types should have little impact on the results.

The following describes our methodology for each customer type, as it was initially developed for the 2006 audit as well as any subsequent refinements.

Residential Program

For each program year, Avista provided Research Into Action with a data file with a separate record for each residential measure. The data file showed the following information for each measure:

- Customer ID
- Measure type (code and description)
- Entry date
- Customer rebate amount (\$)
- Estimated kWh savings
- Estimated therm savings

Initial Identification of Residential Strata for 2006 Audit

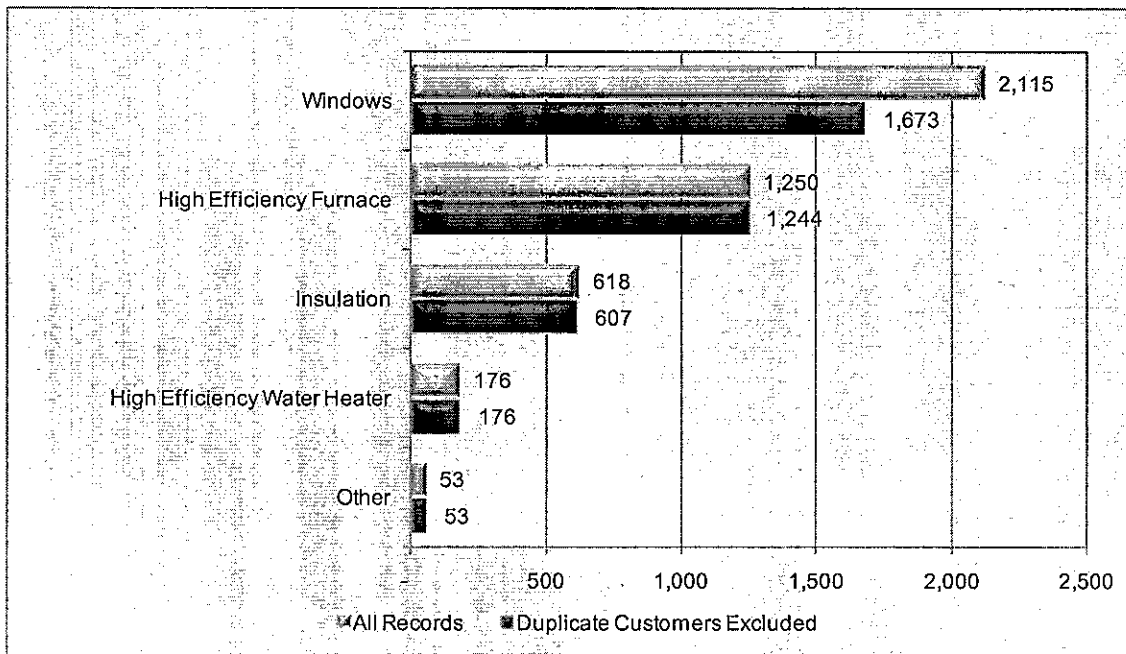
We found that some measures were installed at many residences while others were installed at a few. However, the overall distribution of measure types was similarly skewed regardless of whether we counted a single case or multiple cases of each measure type for a given customer (see Figure 3.1, next page **Error! Reference source not found.**).

The most frequent single measure type was high-efficiency furnaces, with approximately 30% of the cases. Replacement windows together made up about 44% of the cases. The remaining measure types made up about 26% of the cases. Therefore, we identified three strata from which to sample: *High-Efficiency Furnaces*, *Replacement Windows*, and *All Other Measures*.³

³ Names of strata are designated with initial caps and italics. When not used to identify a stratum, measure names are in plain font.



**Figure 3.1: Frequency Count of Residential Program Codes:
All Cases Counted and Duplicate Customers Excluded**



Refinement of Residential Stratification Plan for 2007 and 2008 Audits

The distribution of measure types in the 2007 program was similar to that for 2006 (see Figure 3.2, next page). However, for a variety of reasons, we decided to modify the stratification plan for the 2007 and 2008 audits somewhat to include four strata rather than three.

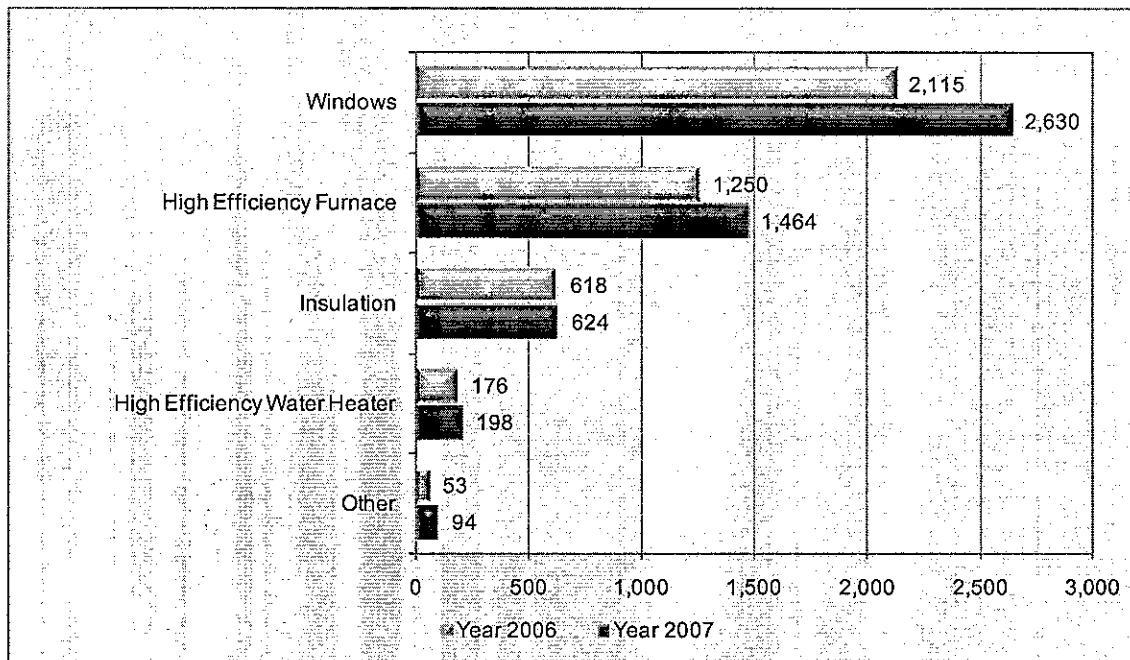
First, in the 2006 verification, *Replacement Windows* was a single stratum and new windows were included with *All Other Measures*. The method for calculating therm savings is similar for both types of windows (the difference is only in the coefficient that is applied) and so the potential sources of error for these measure types are very similar. This argues for combining these two measure types into a single stratum. By taking new windows out of the *All Other Measures* stratum, a larger number of other measure types can be included in that division.

Second, the *All Other Measures* stratum in the 2006 verification included insulation measures together with a variety of prescriptive and non-prescriptive measures. Given that insulation measures constitute a substantial portion of total measures, it seems reasonable to sample them as a separate stratum.



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Figure 3.2: Frequency Distribution of Residential Measure Types
Year 2006 and Year 2007



Third, and finally, high-efficiency furnaces are a prescriptive measure and so data-entry error is the only source of variation in the amount of claimed savings. In fact, there was no error at all recorded for that measure in the 2006 audit. Even though it accounts for a large percentage of cases, it accounts for a small percentage of the error in savings estimation. Some cases of this measure should still be included in the documentation review; however, it seems reasonable that it should consist of a smaller percentage of the residential sample than previously represented.

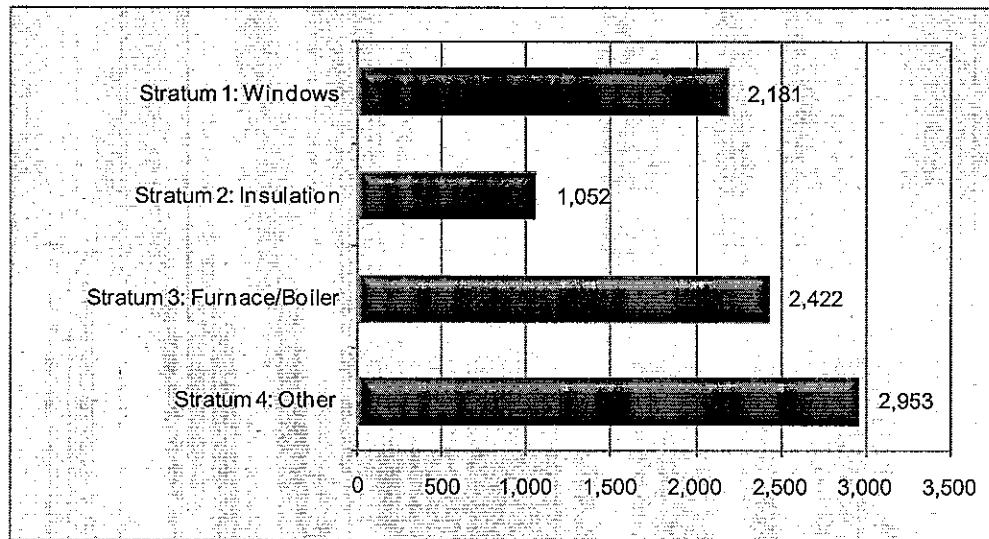
Based on the above considerations, we stratified the 2007 and 2008 residential data as follows:

- Stratum 1: *New and Replacement Windows*
- Stratum 2: *Insulation*
- Stratum 3: *High-Efficiency Furnaces and Boilers*
- Stratum 4: *All Other Measures*

Two new prescriptive measures introduced in 2008—ENERGY STAR[®] clothes washer and ENERGY STAR[®] dishwasher—were included in Stratum 4. These measures turned out to be very popular, which greatly increased the size of that stratum (see Figure 3.3). Although this meant that Stratum 4 was disproportionately represented by these two new measures in 2008, we decided that changing the stratification again would unnecessarily complicate sampling and analysis.



Figure 3.3: Frequency Distribution of 2008 Residential Measure Types



The size of each stratum is explained below.

Limited-Income Program

For each program year, Avista provided Research Into Action with a data file containing records of limited-income residential measures from its customer service database. The data file showed the following data for each measure:

- Customer ID
- Measure type (code and description)
- Entry date
- Customer cost (\$)
- Customer rebate amount (\$)
- Estimated kWh savings
- Estimated therm savings

Initial Identification of Limited Income Strata for 2006 Audit

The limited-income list had characteristics similar to the residential list: a large number of cases with multiple measures per customer and a highly unequal distribution of cases across measure type. In this case, air infiltration accounted for approximately 29% of the cases; insulation



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measures (ceiling, floor, and wall) accounted for about 49%; and all other measures made up about 22%.

As with the residential category, the distribution of measure types was similarly skewed regardless of whether only a single case or multiple cases of a measure type were counted for a given customer (graphics not included). Following the reasoning for the residential group, we identified three strata from which to sample: *Air Infiltration*, *Insulation*, and *All Other Measures*.

Refinement of Limited-Income Stratification Plan for 2007 and 2008 Audits

As with the residential program, the distribution of measure types in the 2007 limited-income program was similar to that for 2006. The 2006 verification found moderate levels of error in claimed therms for both insulation and air infiltration; as they continue to constitute more than two-thirds of the entire limited-income pool, we decided to continue sampling each as separate strata.

However, for the 2007 and 2008 verifications, we decided to sample the remaining measures in two strata rather than one. One stratum includes ENERGY STAR[®] windows and ENERGY STAR[®] doors. The other stratum includes the remaining measures (high-efficiency furnaces, 40- and 50-gallon high-efficiency water heaters, and programmable thermostats), each of which constitutes a small proportion of the measures.

By dividing the sample into four strata instead of three, we were able to sample fewer of the insulation and air infiltration measures and therefore were able to include more of the others.

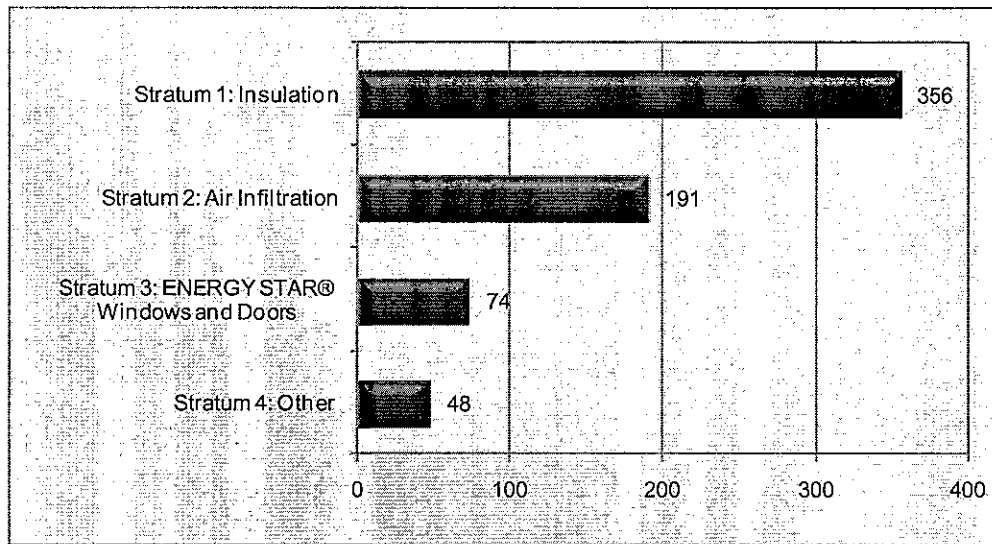
Therefore, we stratified the 2007 and 2008 limited-income data as follows:

- Stratum 1: *Insulation*
- Stratum 2: *Air Infiltration*
- Stratum 3: *ENERGY STAR[®] Windows and Doors*
- Stratum 4: *All Other Measures*

Figure 3.5 shows the distribution of measures across the above strata for the 2008 limited-income program.



Figure 3.5: Frequency Distribution of 2008 Limited Income Measure Types



Nonresidential Program

For each program year, Avista provided Research Into Action with a data file containing a separate record for each nonresidential project. The data file showed the following information for each record:

- Application number
- Measure type
- Building type
- Estimated therm savings
- Date created
- Phase (completed for all measures)
- State (Washington or Idaho for all measures)



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Initial Identification of Nonresidential Strata for 2006 Audit

The size of reported savings (therms) was highly positively skewed, with a small number of measures representing extremely high reported savings. Therefore, the largest projects were singled out and evaluated as one stratum, separately from the random sample.⁴

We examined the remaining 644 projects for dependencies between measure type and project type, as such dependencies might influence the method of sample selection. A cross-tabulation showed a clear tendency for pre-rinse sprayer to be associated with food service (Table 3.1). However, other than the fact that rooftop service was somewhat underrepresented in office buildings relative to other measure types, there were no other clear relationships between measure type and project type.

Table 3.1: Measure Type by Project Type

PROJECT TYPE	MEASURE TYPE						Total
	APPLIANCE	HVAC	LEED CERTIFICATION	PRE-RINSE SPRAYER	ROOFTOP SERVICE	SHELL	
Agricultural	0	4	0	0	0	4	8
Church	0	1	0	0	0	0	1
Food Service	4	8	0	245	15	3	275
Government	4	21	2	57	7	12	103
Health Care	0	1	0	8	1	0	10
Hospitality	1	13	0	16	3	8	41
Manufacturing	1	6	0	0	0	5	12
Office	2	42	0	4	12	34	94
Residential	0	1	0	0	0	4	5
Retail	4	19	0	8	45	19	95
TOTAL	16	116	2	338	83	89	644

Pre-rinse sprayers accounted for a very large number of total measures and represented a fairly narrow band of reported savings sizes (although there was some variability). The other measure types appeared to be distributed more-or-less similarly across the building types.

⁴ Technically speaking, these five projects did not constitute a sample; they constituted the entire population of the stratum identified as the largest projects.



On the basis of this, we treated pre-rinse sprayers (the most common measure type and highly concentrated in food service, the most common building type) as a second stratum and all other measures as a third stratum. Separating pre-rinse sprayers out from the other measures prevented them from dominating the overall sample.

Therefore, the data collection approach for nonresidential customers consisted of a census of one stratum (the *Five largest Measures*) and random samples of two other strata: *Pre-Rinse Sprayers* and *All Other Measures*.

We found three cases in which the same application number was found on two records; in all other cases, there was only one record per application number. In all three cases, the two records with the same application both had identical information (i.e., same measure type, building type, estimated therm savings, and so forth), with one exception: the date that the record was created was different by one day for one set of duplicate application numbers. We notified Avista of the duplications and requested the record files associated with those three application numbers to determine, on a case-by-case basis, whether the two records with the same application number represented separate measures or whether they were the same measure recorded twice. None of the six records with duplicated application numbers was randomly drawn for the survey. We did not identify any similar cases in the 2007 or 2008 data.

Refinement of Nonresidential Stratification Plan for the 2007 and 2008 Audits

The only substantial difference between the 2006 and subsequent audits of nonresidential data was in the number of “largest” projects selected for evaluation. The difference related to the locations of an observable break in the distribution of claimed therms in the data. For the 2006 audit, there was an observable break in the distribution after the seventh-largest projects (i.e., a noticeably larger difference between the seventh- and eighth-largest than between the sixth- and seventh-largest projects), so we selected the seven largest projects. For the 2007 audit, the break was between the fifth- and sixth-largest projects, so we selected the five largest projects.

The situation was complicated for the 2008 audit. As explained in more detail below, an abbreviated timeline for completing the audit necessitated selecting projects for the first three quarters of 2008 separately from the final quarter. This allowed us to begin the audit of the first set of projects during the final quarter of 2008. To be certain that we examined at least the six largest projects, we identified the six largest from the first three quarters. Later, when the fourth quarter data became available, we identified another five projects that were at least as large as the smallest of the six that we identified earlier. This resulted in a total of 11 large projects. In fact, there was an observable break in the distribution of size of these projects between the fifth- and sixth-largest, and the size range of the five largest was comparable to the range of the largest drawn for the 2006 and 2007 audits, while the remaining six project fell below the size range seen in 2006 and 2007.



Otherwise, we sampled from two other strata. One stratum was made up solely of projects with prescriptive measures. However, we redefined this stratum somewhat. In 2006 and 2007, it had been entirely comprised of pre-rinse sprayers offered with a prescriptive rebate. However, Avista discontinued that measure in 2008 and instead offered a variety of other prescriptive measures. Even though relatively few rebates applications were submitted for these prescriptive measures in 2008, we continued to treat prescriptive measures as a separate stratum to maintain consistency across program years. The difference is that this stratum was comprised only of pre-rinse sprayers in 2006 and 2007 and of other prescriptive measures in 2008. Since all were prescriptive measures, however, the only variance should be in the documentation of the installation.

The other stratum consisted of all projects with non-prescriptive, custom measures that were not selected as part of the “largest projects” stratum. They were all site-specific and were largely comprised of rooftop service, HVAC, and shell measures. A very small number of miscellaneous project types (12 projects) were not sufficiently frequent to justify creating a separate stratum.

Based on the above considerations, we stratified the nonresidential data as follows:

- Stratum 1: *Largest Projects*
- Stratum 2: *Prescriptive Measures*
- Stratum 3: *All Other Measures*

Sample Size Determination

Prior to the 2006 verification, we calculated sample sizes to yield precise estimates for both the paper train audit and the check of Avista’s calculated therm savings for the completed three-year verification. We determined the sample size for each year by dividing the three-year sample size by three.

Also as noted above, our initial sample size estimates were based on a desire to achieve very high levels of confidence and precision, combined with assumptions of very low rates of documentation error, which turned out to be incorrect. The following describes how we revised sample-size estimates based on error rates obtained during the 2006 verification, to achieve confidence and precision levels that still meet or exceed industry standards.

Sample Size Determination for the Audit of Avista’s Savings Estimates

The formula for calculating the sample size for the audit of Avista’s calculations for a particular group includes the standard deviation of the differences between Avista’s and the audit’s estimated therm savings across all measures within that group. Prior to the 2006 verification, this value was not known, so it was necessary to estimate it.



In most cases, the 2006 verification results showed greater variance (larger standard deviations) than was anticipated. This meant that larger samples would be needed to achieve the 95/5 level of confidence and precision than we originally had set for this evaluation. In fact, the sample sizes needed would be impractical and cost-prohibitive to achieve in the 2007 and 2008 verifications. However, as noted above, the 95/5 confidence level was not mandated by the Settlement Agreement, and it is more stringent than the industry-standard levels of 90% confidence and 10% precision.

We re-calculated revised sample sizes using the standard deviations of the differences between Avista's and the audit's savings estimates from the 2006 data. We re-calculated both the estimated three-year sample sizes along with those for the 2007 verification.

In contrast to the approach taken previously, the new sample size calculations for the audit of savings estimates considered only measures that require some computation to arrive at the therm savings, such as windows or insulation (where the savings is calculated as some number of therms per square foot of window or insulation installed), as opposed to purely prescriptive measures, such as furnaces or water heaters (where each unit has the same therm savings). We continued to sample prescriptive measures as part of the paper-trail audit and compared the savings recorded for each of those measures against Avista's prescribed savings (see below). However, since the only source of variance in those measures would be data-entry error (not calculation error), we did not consider them part of the savings estimates audit.

To compute the sample sizes for the calculated measures, we used the pooled standard deviations across those strata with calculated measures within each group. The results are shown in Table 3.2. Even using the 95/10 confidence/precision level, which is somewhat more stringent than the industry-standard 90/10 level, the re-calculated sample size estimates are smaller than the sample sizes for the 2006 verification for the limited-income and nonresidential samples (61 vs. 68 and 5 vs. 23, respectively), while that for the residential group is only somewhat larger than for the 2006 verification.

The required sample size for the nonresidential group is very small, despite a large standard deviation of the Avista-audit differences. This is because these projects generally had very large savings and so the margin of error was proportionately large. Thus, while the standard deviation of the differences between Avista's and the audit's estimates was larger than in the other strata, it was small in comparison to the margin of error and, therefore, a relatively small sample delivers good precision. As explained below, however, the requirements of the paper-trail audit resulted in a much larger sample for the nonresidential group than that shown in Table 3.2.



Table 3.2: Revised Sample Size Estimates for Therm Savings Audit – Calculated Measures Only

GROUP	ESTIMATED ¹ THREE-YEAR POPULATION	2006 ESTIMATED ² STANDARD DEVIATION OF AVISTA AUDIT DIFFERENCE	2006 DATA		SAMPLE SIZE ESTIMATE			
			SAMPLE SIZE	STANDARD DEVIATION OF AVISTA AUDIT DIFFERENCE ³	USING 95/10 STANDARD CONFIDENCE/PRECISION LEVEL		USING 90/10 STANDARD CONFIDENCE/PRECISION LEVEL	
					THREE-YEAR	2007, 2008 ⁴	THREE-YEAR	2007, 2008 ⁴
Residential Sample	6,331	6.9	72	59.9	231	83	163	(55)
Limited-Income Sample	1,525	23.2	68	85.7	182	(61)	134	(45)
Nonresidential ⁵	935	209.5	23	285.0	14	(5)	10	(4)

¹ The three-year populations were estimated by multiplying the 2006 populations (excluding duplicate records for a given customer) for each group by three; comparison of 2006 and 2007 data indicated similar levels of calculated measures when duplicate records were removed from each population.

² These estimated standard deviations were used to approximate the sample sizes for the 2006 verification; the method used to generate them is described in the Final Report for the 2006 verification.

³ The standard deviation for the Residential sample was computed as a pooled standard deviation across those strata that were comprised only of calculated measures: Stratum 1 (New and Replacement Windows) and Stratum 3 (Insulation).

⁴ The 2007 and 2008 sample sizes were calculated by subtracting the 2006 sample size from the estimated three-year sample size and dividing by two; however, this produced very small 2007 and 2008 sample sizes for strata comprised of prescriptive measures as well as for some other measure types with very low error rates, which had resulted in larger-than-necessary 2006 samples. In those cases, we conservatively set the estimated 2007 and 2008 sample sizes at one-third of the estimated three-year sizes; the sample sizes for those strata are shown in parentheses.

⁵ Note that the required sample size for this group is very small, despite the fact that the standard deviation of the Avista audit differences was quite large. This is because the projects in this stratum generally had very large savings and so the margin of error was proportionately large. Thus, while the standard deviation of the differences between Avista's and the audit's estimates was larger than in the other strata, it was small in comparison to the margin of error, and therefore a relatively small sample delivers good precision.

Sample Size Determination for the Paper-Trail Audit

In originally calculating the sample size for the paper-trail audit, we assumed that Avista's inputs would be adequately documented in at least 95% of the cases. As Table 3.3 shows, we found no documentation errors in four of the eight strata. However, the rate of documentation error in the other four strata ranged from about 14% to 37%, which was much larger than that used to generate the estimated three-year sample sizes. This affects the sample size required for the 95/5 level of confidence/precision.

Table 3.3: Documentation Error and Mean Error of Savings Estimation by Group, 2006 Verification

GROUP	DOCUMENTATION ERROR		MEAN ESTIMATION ERROR (As Percent of Total)
	COUNT	PERCENT OF PROJECTS IN STRATUM	
Residential Stratum 1 (<i>High-Efficiency Furnaces</i>)	0	0.0%	0.0%
Residential Stratum 2 (<i>Replacement Windows</i>)	8	33.3%	8.4%
Residential Stratum 3 (<i>All Other Measures</i>)	9	37.5%	29.4%
Limited-Income Stratum 1 (<i>Air Infiltration</i>)	0	0.0%	20.1%
Limited-Income Stratum 2 (<i>Insulation</i>)	0	0.0%	17.6%
Limited-Income Stratum 3 (<i>All Other Measures</i>)	4	19.0%	60.7%
Nonresidential, Stratum 1 (<i>Largest Projects</i>)	1	14.3%	56.7%
Nonresidential Stratum 2 (<i>Pre-Rinse Sprayers</i>)	0	0.0%	0.0%
Nonresidential Stratum 3 (<i>All Other Measures</i>)	7	30.4%	-2.3%

Again, as noted above, the 95/5 confidence level was not mandated by the Settlement Agreement, and it is more stringent than the industry-standard levels of 90% confidence and 10% precision. Moreover, we calculated our original sample-size estimates for each stratum, whereas the results of interest pertain to the entire sample rather than the individual strata (the reason for stratifying the sample was to ensure that a broad range of measure types would be included, but we report the weighted combined results for each entire sample).

While we believe that it nevertheless is desirable to have a reasonable sample of as many measure types as possible to allow us to determine whether there are any systematic sources of error, it is not necessary to adhere to the original method for determining sample size.

As shown in Table 3.4, we used the 2006 error rates to re-calculate the estimated three-year sample sizes, along with those for the 2007 and 2008 verifications. In contrast to the case with the therm savings audit, the paper trail audit should apply to all measure types, prescriptive as



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Table 3.4: Revised Sample Size Estimates for Paper Trail Audit

GROUP	ESTIMATED ¹ THREE-YEAR POPULATION	2006 DATA		SAMPLE SIZE ESTIMATES		
		SAMPLE SIZE ²	ERROR RATE ^{2,3}	USING 95/10 STANDARD CONFIDENCE/PRECISION LEVEL		USING 90/10 STANDARD CONFIDENCE/PRECISION LEVEL
				THREE-YEAR	2007, 2008 ⁴	THREE-YEAR
RESIDENTIAL						
Residential – Calculated	6,331	41	29.2%	302	131	78 (26)
Residential – Prescriptive	3,990	31	16.1%	197	83	51 (17)
Residential Sample – Combined ⁵	10,320	72	23.6%	270	99	69 (23)
LIMITED INCOME						
Limited-Income Sample – Combined ⁵	1,524	64	5.9%	81	(27)	21 (7)
NONRESIDENTIAL						
Nonresidential – Calculated	935	23	30.4%	241	109	75 26
Nonresidential – Prescriptive	1,019	23	0%	15	(5)	4 (1)
Nonresidential Sample – Combined ⁵	1,953	46	15.2%	180	67	48 (16)

¹ The three-year strata populations were estimated by multiplying the estimated three-year population for each group by the proportion each stratum contributed to the 2006 sample.

² Sizes and error rates of the sample strata were determined by re-assigning the 2006 measures to the currently defined strata and performing counts within the new strata.

³ To calculate sample size when the error rate was 0%, an error rate of 1.0% was substituted, as using the 0% rate would have produced a sample size of 0.

⁴ The 2007 and 2008 sample sizes were calculated by subtracting the 2006 sample size from the estimated three-year sample size and dividing by two; however, this produced very small 2007 and 2008 sample sizes for several strata that had very high error rates and, hence, larger-than-necessary 2006 samples. In those cases, we conservatively set the estimated 2007 and 2008 sample sizes at one-third of the estimated three-year sizes; the sample sizes for those strata are shown in parentheses.

⁵ We calculated sample sizes that apply the 95/5 and 95/10 confidence/precision levels to the calculated measures in the Residential, Limited-Income, and Nonresidential groups as a whole, collapsed across strata. We used the pooled error rate for calculated measures for each group. We calculated the pooled 2007 and 2008 sample sizes by subtracting the 2006 group-level sample sizes from the estimated three-year pooled sample sizes and divided by two; however, in several cases, this produced very small samples for 2007 and 2008. In those cases, we conservatively set the estimated pooled 2007 and 2008 sample sizes at one-third of the estimated three-year pooled sizes; these are shown in parentheses.

well as calculated. We first computed sample sizes separately for calculated and prescriptive measures⁵, using both 95/5 and 95/10 confidence/precision levels. We also calculated the sample sizes for each sample as a whole, using pooled error rates across the calculated and prescriptive measures for each group. We did this to identify the minimum sample size needed for each group, irrespective of the type of measure.

As expected, a 95/5 confidence/precision level would necessitate larger residential and nonresidential samples than we obtained in the 2006 verification (99 vs. 72 and 67 vs. 46, respectively). The 2007 and 2008 limited-income samples would be smaller than for the 2006 verification (27 vs. 64) because the documentation error rate for that group was relatively small. In fact, the estimated three-year pooled sample for the limited-income group (81) was only slightly greater than was obtained in the 2006 verification (64); to ensure that each year's verification would include at least one-third of the three-year pooled total, we indicated that the 95/5 sample size for the 2007 and 2008 limited-income paper-trail audits would be at least 27. When the 95/10 standard is applied, the pooled 2007 and 2008 sample sizes for all three groups are much smaller than those obtained in the 2006 verification (23 vs. 72, 7 vs. 64, and 16 vs. 46).

Based on the above considerations, it was possible to produce results with acceptable levels of confidence and precision—nearly as high as originally planned, at least at the entire-group levels—by drawing and examining samples that are not much larger than those examined in the 2006 verification.

Planned Sample Sizes for the Combined Paper-Trail and Savings Estimate Audit

Table 3.5 shows the planned sample sizes for the 2007 and 2008 verifications by group. We arrived at these figures by combining the sample requirements for the savings estimate audit of the calculated measures with the paper-trail audit requirements of both calculated and prescriptive measures. The primary criterion was that each group should, at a minimum, meet the 90/10 confidence/precision standard for both the paper-trail and savings estimate audit.

The sample sizes for the calculated measures in the residential and limited-income groups were driven by the confidence/precision requirements of the therm savings audit. However, the sample size for the calculated measures in the nonresidential group was driven by the requirements of the paper-trail audit. As a result, the confidence/precision levels for the therm savings audit for this stratum are higher than for the others (>95/5 vs. 95/10).

We allocated the sample sizes within each group as shown in Table 3.6.

⁵ As noted above, none of the measures in the Limited-Income were prescriptive.



Table 3.5: Revised Planned Sample Sizes

GROUP	SAMPLE SIZE		COMMENT
	THREE-YEAR	ONE-YEAR	
RESIDENTIAL			
Residential – Calculated	231	80	Achieves 95/10 confidence/precision for therm savings audit, >95/10 for paper trail audit
Residential – Prescriptive	51	17	Achieves 95/10 confidence/precision for paper trail audit
Residential Total	282	97	
LIMITED INCOME			
Limited-Income	182	61	Achieves 95/10 confidence/precision for therm savings audit, >95/10 for paper trail audit
NONRESIDENTIAL			
Nonresidential – Calculated	75	26	Achieves >95/5 confidence/precision for therm savings audit, 95/10 for paper trail audit
Nonresidential – Prescriptive	15	5	Achieves 95/10 confidence/precision for paper trail audit
Nonresidential Total	90	31	

Table 3.6: Planned 2007 and 2008 Sample Sizes by Stratum

STRATUM	SAMPLE SIZE	COMMENT
RESIDENTIAL		
Stratum 1, Windows (calculated)	40	"Calculated" measures divided evenly between Stratum 1 and 2; combined in paper-trail and therm savings audit.
Stratum 2, Insulation (calculated)	40	
Stratum 3, High-Efficiency Furnace (prescriptive)	4	No variability in HE Furnace in 2006; combined with Stratum 4 in paper-trail audit; number of HE Furnace approximately equal to number of most common measure type in Stratum 4.
Stratum 4, Other (prescriptive)	13	
Residential Total	97	
LIMITED-INCOME		
Stratum 1, Insulation	15	All strata are calculated measures. Under-sampled Stratum 1 and 2 and over-sampled Stratum 3 and 4. Stratum 4 is largest stratum because it is comprised of several measure types.
Stratum 2, Air Infiltration	15	
Stratum 3, ENERGY STAR® Windows/Door	12	
Stratum 4, Other	19	
Limited-Income Total	61	continued



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STRATUM	SAMPLE SIZE	COMMENT
NONRESIDENTIAL		
Stratum 1, Largest Projects	5	N/A
Stratum 2, Calculated	26	No stratification within calculated measures
Stratum 3, Prescriptive	5	No stratification within prescriptive measures
Nonresidential Total	31	

Randomization

Within each customer type, we partitioned the list into the specified strata discussed above. Within each stratum, we created a new variable that was populated with a different random number for each record (using a uniform distribution). We ordered each data set by the random variable, which randomized the order of the cases within that set. Then, within each data set, we selected the first n cases, where n was the specified sample size for that stratum.

VERIFICATION METHODOLOGY

The verification methodology for all three programs shared three common components:

1. Reviewing the paper documentation of the sampled cases to verify that the input data used to calculate the terms saved on a case-by-case method were correct;
2. Performing an engineering review of the assumptions that went into Avista's calculations of term savings for the various measures; and
3. Independently calculating term savings on a case-by-case basis, using either Avista's assumptions or other sets of assumptions resulting from the engineering review.

Generally speaking, the verification methodology for the 2007 and 2008 audits did not differ from that for the 2006 audit. Any differences are indicated.

Review of Paper Documentation

Some differences existed among the programs and program strata in how measures were installed. These differences resulted in variances in the nature of the input data sources and how they were documented. We describe the procedures we followed in our review of paper documentation separately for each program (residential, limited-income, and nonresidential).



Residential Program

In the residential program, customers dealt directly with contractors for installation of measures. The customers recorded pertinent data about the measures on an *Avista Home Improvement Incentive Form* (rebate form) and submitted this form, together with invoices and other relevant documentation from the contractor, to Avista. Avista forwarded electronic copies of rebate forms, invoices, and other relevant documentation for the sample cases to Research Into Action.

Data Entry and Coding

For each sample stratum, we created an *Excel* workbook for recording details about the documentation received from Avista. Each workbook included columns for recording, on a case-by-case basis: the customer identification number (ID); the measure that was installed; whether or not the records, including an invoice, had been received; disposition codes; and notes describing any exceptions. In addition, each workbook included columns for recording the input data recorded for each case, such as R-values for insulation or U-factor for windows, as well as the therm savings claimed in Avista's database. Finally, each workbook had columns for recording the therm savings determined by the audit (as explained below) for each case.

For each case, we reviewed all invoices and other documentation to confirm the information listed on the rebate form for the measure in question. For example, if the rebate form listed a 40-gallon, high-efficiency gas water heater with an Efficiency Factor (EF) of .63, we checked to see whether the invoice and/or other documentation confirmed all of that information. Based on the initial review of the documents, we assigned an *Initial Disposition Code* to each case. For the residential strata, the possible codes were:

- 1 = Invoice or other documentation confirms rebate form*
- 2 = Invoice does not provide sufficient information to confirm rebate form*
- 3 = Invoice contradicts rebate form*
- 4 = Measure was incorrectly coded in the Avista database*
- 5 = Does not qualify for a rebate*

We assigned a code of "1" if the invoice or other documentation provided sufficient details to compute therm savings based on Avista's criteria and confirmed the information provided on the rebate form. For example, if the measure was a 40-gallon high-efficiency water heater and the invoice or other material documented that measure, as well as either the EF or the model number (which could be used to determine the EF), and the EF met Avista's eligibility standard, then we assigned a code of "1". Similarly, if the measure was a high-efficiency furnace and the invoice or other materials documented that measure as well as the AFUE% or model number, and the AFUE% met Avista's eligibility standard, then we assigned a code of "1". Note: if the invoice did not document the EF or AFUE%, we assigned a code of "1" if we were able to obtain this



information based on the model information. In the case of insulation, the measure, area, and pre- and post- R-values were necessary.

For windows, it was necessary for the invoice to document the measure, as well as the area covered. In 2006 and 2007, different measure codes were used for windows facing different directions, which were listed separately on the rebate form. Documenting a particular window measure required documenting the direction of windows installed. However, we found that the invoice typically did not specify the direction that the windows faced. Therefore, our protocol was that if the invoice documented windows and a) it was possible to determine the total area of the windows and b) the total area recorded on the rebate form did not exceed the total area documented on the invoice, then we considered the measure verified and assigned a code of “1”.

In 2008, a single measure code was used for all new windows regardless of direction and a different single measure code was used for all replacement windows regardless of direction. All windows installed under a single project, therefore, were listed as a single measure on the rebate form, and so it was no longer necessary to document the direction the window faced.

We assigned a code of “2” if the invoice and other materials did not provide sufficient input data to confirm information on the rebate form. For example, if the invoice and other materials did not document the input data recorded on the rebate form, we assigned a code of “2”. Similarly, if the invoice and supporting materials documented neither EF nor the model for a water heater, or did not document the model or AFUE% for a furnace, we assigned a code of “2”. In the case of windows, we assigned a “2” if the area covered was not documented. For insulation, we assigned a “2” if the area, the existing R-value, or the final R-value was not documented.

We assigned a code of “3” if the invoice and/or other materials showed input data—such as the square feet of windows or insulation installed—that contradicted that shown on the rebate form. For the purposes of this audit, we defined “contradiction” as a difference such that the therm savings based on the value shown on the rebate form exceeds the therm savings based on the value documented in the input data by more than 5%.

For example, if the measure in question was windows or insulation, and the square footage recorded on the rebate form exceeded that recorded on the invoice or other documentation by more than 5%, we then assigned a disposition code of “3” (because the savings estimated from the rebate form exceeded by more than 5% the amount that would be estimated from the value on the invoice).

We assigned a code of “4” if the invoice or other documentation showed a measure other than what was recorded for that case in the Avista database.

Finally, we assigned a code of “5” if we found that the measure did not qualify for a rebate. This occurred in a few cases in which the EF of a water heater or AFUE% of a furnace was not



documented, but in which we were able to obtain this information from the manufacturer and the EF or AFUE% did not meet Avista's eligibility standards even though a rebate had been issued.

Note that a code of "3", "4", or "5" did not necessarily mean that there was not sufficient documentation of input data, but simply that those data may not have been correctly reported.

If the *Initial Disposition Code* was other than "1", we recorded an explanation in the workbook.

Data Clarification

If the information on the supporting documentation was incomplete, we attempted to obtain the missing information by contacting Avista and/or the manufacturer, supplier, or dealer of the installed measure. For example, if the EF for a water heater was not documented but the model number was, we contacted the manufacturer, supplier, or dealer to find out the EF for the listed model. Using the information obtained through these contacts, we assigned a *Final Disposition Code* to each case and updated the case notes.

Limited-Income Program

The limited-income program is non-prescriptive, so the analyses are performed and incentives offered on a site-specific basis. As noted above, CAPs directly install all measures in the limited-income program and record all input data either directly into software installed on notebook computers that they carry with them to the location of installation or onto paper forms. The customer neither completes a rebate form nor receives invoices or other supporting documentation from the installer, and little or no independent hard-copy documentation exists for any of the measures in this sample.

Avista forwarded to Research Into Action electronic copies of software screen captures or paper forms from the CAP agencies. All such documents were labeled *Invoice Form* and showed output data for the measure; in some cases, forms were included that showed input data that went into computing the output data.

Data Entry and Coding

As with the residential program, we created an *Excel* workbook to record details about the documentation we received for each case in the limited-income sample strata. Each workbook included columns for recording, on a case-by-case basis: the customer identification number (ID); the measure that was installed; whether or not the records had been received; disposition codes; and notes describing any exceptions. In addition, each workbook included columns for recording the input data recorded for each case, including the Avista-claimed therm savings, as well as a column for recording the therm savings determined by the audit.

Based on the initial review of the documents, we assigned an *Initial Disposition Code* to each case. Disposition codes were defined so as to be consistent, to the degree possible, with the codes



for the residential program. However, because of the way that measures were installed and documented in the limited-income program, the definitions of the first two codes are slightly different from those for the residential program. Moreover, the residential disposition code “3” – which indicates a data disagreement between the rebate form and other documentation – does not apply to the limited-income program, as typically there was no independent paper documentation other than the rebate form in this program. Thus, the possible codes for the limited-income strata were:

- 1 = Sufficient input data and no coding errors*
- 2 = Input data were not detailed*
- 3 [This disposition not assigned]*
- 4 = Measure was incorrectly coded in the Avista database*
- 5 = Does not qualify for rebate*

We assigned a code of “1” based on criteria similar to those for the residential program, except that there was no criterion of independently confirming the information on the rebate form (since there typically was no independent documentation). Instead, the criteria were that the invoice form should provide sufficient detail to compute therm savings, based on Avista’s criteria, and to verify that the measure qualified for a rebate. For example, if the measure was a 40-gallon, high-efficiency water heater, and the invoice form documented that measure as well as either the EF or the model number (which could be used to determine the EF), and the EF met Avista’s eligibility standard, then we assigned a code of “1”. Similarly, if the measure was a high-efficiency furnace, and the invoice documented that measure, as well as the AFUE% or model number, and the AFUE% met Avista’s eligibility standard, then we assigned a code of “1”. As with the cases in the residential program, even if the invoice did not document the EF or AFUE%, if we were able to obtain this information based on the model information, then we assigned a code of “1”. For windows, it was necessary for the invoice to document the measure, as well as the area covered. In the case of insulation, the measure, area, and pre- and post- R-values were necessary.

We assigned a code of “2” based on criteria similar to those for the residential program, except for the reference to confirming the information on the rebate form. Instead, the criteria were that the invoice form did not provide input data sufficient to compute therm savings or to verify that the measure qualified for a rebate. For example, if the invoice documented neither EF nor the model for a water heater, or it did not document the model or AFUE% for a furnace, we assigned a code of “2”. In the case of windows, we assigned a “2” if the area covered was not documented. For insulation, we assigned a “2” if the area, the existing R-value, or the final R-value was not documented.

We did not assign a code of “3” to any of the cases in the limited-income program, as explained above.



We assigned a code of “4” if the invoice form showed a measure other than what was recorded for that case in the Avista database.

Finally, we assigned a code of “5” if the measure did not qualify for a rebate. As in the residential program, this occurred in a few cases in which the invoice did not document the EF of a water heater or AFUE% of a furnace but we were able to obtain this information from the manufacturer and found that the EF or AFUE% did not meet Avista’s eligibility standards, even though a rebate had been issued.

As with the residential program, a code of “4” or “5” did not mean that there was not sufficient documentation of input data, but only that those data may not have been correctly reported.

Data Clarification

If the *Initial Disposition Code* was other than “1”, we recorded an explanation in the workbook. For all such cases, we contacted Avista to attempt to obtain additional information to clarify the cases’ disposition. Based on the results of our efforts, we assigned a *Final Disposition Code* to each case, using the same coding scheme as for the initial disposition.

Nonresidential Program

Projects in the nonresidential program included both non-prescriptive, custom engineering projects and prescriptive-rebate projects with a set energy savings value per item. For the custom projects, Avista completed the individual energy calculations either in spreadsheet tools or through modeling programs.

For each custom engineering project, Avista forwarded electronic copies of the project evaluation report, the agreement, invoices, and other relevant documentation to Research Into Action. Information for the pre-rinse sprayers consisted of an *Excel* spreadsheet, also supplied to Research Into Action, that listed: number of sprayers installed; equipment manufacturer; location of the sprayer; pre- and post-GPM data; water temperature data; and additional notes as necessary. Invoices for the purchase of the sprayer were not provided.

Data Entry and Coding

For each group, we created an *Excel* workbook to record details about the documentation received from Avista. Each workbook included columns for recording, on a case-by-case basis: the customer identification number (ID); the measure that was installed; whether or not records had been received; disposition codes; and notes describing any exceptions.



Based on the initial review of the documents, we assigned an *Initial Disposition Code* to each case. For the nonresidential strata, we assigned only two disposition codes:⁶

1 = Documentation reasonable

2 = Documentation problematic

We assigned a code of “1” if the documentation provided sufficient detail to compute therm savings that we felt reasonably confident in using to evaluate Avista’s claimed savings. Sufficient documentation included data such as modeling inputs and/or outputs, baseline assumptions, and spreadsheet tools that allowed us to evaluate the project through our own use of models or spreadsheet, and to confirm the energy savings value reported by Avista.

We assigned a code of “2” if the documentation provided did not offer sufficient data to compute therm savings that we felt reasonably confident in using to evaluate Avista’s claimed savings. Even if we assigned a code of “2”, we nevertheless may have calculated estimates, but in such cases we do not necessarily recommend that our estimates be used instead of Avista’s claimed therms.

If the *Initial Disposition Code* was other than “1”, we recorded an explanation in the workbook.

Data Clarification

If the information in the supporting documentation was incomplete, we attempted to obtain the missing data by contacting Avista. For example, if the baseline assumptions used in the spreadsheet calculation of a project were not provided, we asked Avista for these assumptions. Using the information obtained, we assigned a *Final Disposition Code* to each case and updated the case notes.

Engineering Review

Residential Program

The engineering review of Avista’s residential program consisted of a check against standard engineering practices, comparing Avista’s reported energy savings to other utility DSM program offerings, and performing engineering calculations to verify savings on a measure-by-measure basis. We used Avista’s assumptions and rebate qualifications for each measure (e.g., window U-

⁶ For the 2006 audit, we attempted to use a coding system that was closer to the ones we used for the residential and limited-income programs. However, we found that the range of documentation issues that we encountered tended to be project-specific and did not fit neatly into a limited set of categories. Therefore, we simplified the coding system as described above.



value requirements, EF of water heaters) in the engineering review. We also evaluated them for appropriateness, such as by comparing them to code values for Washington and Idaho.

We performed the initial review of each measure during the program year when the measure was first identified in the sample. As described in Chapter 4, we repeated the review for some measures in response to new information, changes in baseline assumptions or efficiency standards reported by Avista, or other similar changes.

The following outlines the review methods for each measure in the program:

- **High-Efficiency Furnace and Gas Boiler:** The review included the use of ENERGY STAR®'s online calculator⁷ for the regions in Avista's Washington and Idaho territory, along with values used by other utility companies for similar baseline and retrofit requirements, adjusted for heating-degree-days.
- **High-Efficiency Water Heater (40- and 50-gallon):** The review included engineering calculations using Avista's Energy Factor (EF) qualifications and a comparison with other utility company reported values for similar baseline and retrofit requirements.
- **High-Efficiency Tankless Water Heater:** The review included engineering calculations using a baseline EF of 0.58 and a retrofit EF of 0.82 (typical for tankless water heaters), and a comparison with savings values reported by other utility companies and the California Database for Energy Efficient Resources (DEER).
- **Ceiling/Attic/Floor/Wall/Duct Insulation Measures:** The review included engineering calculations based on the *modified heating-degree-day* method, using Avista's stated baseline and retrofit assumptions. We also used heating-degree-days for specific cities where insulation measures were installed and a seasonal equipment efficiency rating of 0.60 in the calculations.
- **New Windows:** The review of this measure included engineering calculations based on a decrease in air infiltration (using the *2005 ASHRAE Fundamentals*⁸ method for infiltration reduction) and conduction (using the *modified heating-degree-day* method) due to the installation of a new window. We used baseline and retrofit assumptions for U-factors, as stated by Avista, in the analysis. We also used heating-degree-days for specific cities where insulation measures were installed and a seasonal equipment efficiency rating of 0.60 in the review.

⁷ See the ENERGY STAR® website: http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorProgrammablethermostat.xls.

⁸ *2005 ASHRAE Handbook Fundamentals*, Section 27.21, "Residential Calculations Examples," Equation 40.



- **Replacement Windows:** The review of this measure included engineering calculations based on a decrease in air infiltration (using the *2005 ASHRAE Fundamentals* method for infiltration reduction) and conduction (using the *modified heating-degree-day* method) due to the installation of a replacement window. We used baseline and retrofit assumptions for U-factors, as stated by Avista, in the analysis. We also used heating-degree-days for specific cities where insulation measures were installed and a seasonal equipment efficiency rating of 0.60 in the calculations.
- **Programmable Thermostats:** The review included running ENERGY STAR®'s online calculator for programmable thermostats, using all available locations in Avista's Washington and Idaho service territory, and averaging the savings results across all regions. We discounted the ENERGY STAR® savings value to 25%, based on Energy Information Administration (EIA) surveys, which reported that only 25% of installed programmable thermostats are correctly programmed.⁹
- **ENERGY STAR® Homes.** The review included a comparison of deemed values used by other utility companies (Rocky Mt. Power and UniSource Energy Services) for Energy-Star homes. We compared the baseline and retrofit assumptions, as well as heating degree days in each region.
- **High-Efficiency Clothes Washer.** The review of this measure included the use of ENERGY STAR®'s online calculator¹⁰ for the estimated annual natural gas usage for conventional clothes washers, along with a comparison of the baseline Modified Energy Factor (MEF) of 1.26 to the replacement clothes washer MEF.
- **High-Efficiency Dishwasher.** The review of this measure included the use of ENERGY STAR®'s online calculator¹¹ for the estimated annual natural gas usage for conventional dishwashers, along with a comparison of the baseline Energy Factor (EF) of 0.45 to the replacement dishwasher EF.

Limited-Income Program

All of the projects in the limited-income program were custom projects. Therefore, our engineering review of the limited-income program consisted of a check against standard

⁹ *A Look at Residential Energy Consumption in 1997*, DOE/EIA-0632 (97), Energy Information Administration.

¹⁰ See the ENERGY STAR® website: http://www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers-CalculatorConsumerClothesWasher.xls.

¹¹ See the ENERGY STAR® website: http://www.energystar.gov/index.cfm?c=dishwash.pr_dishwashers-CalculatorConsumerDishwasher.xls.



engineering practices. We used baseline and retrofit values reported for each measure (e.g., window U-values, insulation R-values) in the engineering review.

The following outlines the review methods for each measure in the program:

- **Air Infiltration:** The review included calculating heating energy savings achieved by heating less infiltrated outside air to the desired inside air temperature. Air change rates before and after infiltration reductions were used to capture the associated heating energy savings. The assumptions and inputs used in the calculations were taken from customer files provided by Avista or from standard engineering manuals' practices.
- **ENERGY STAR® Windows:** The review of this measure included engineering calculations based on a decrease in air infiltration (using the *2005 ASHRAE Fundamentals* method for infiltration reduction) and conduction (using the *modified heating-degree-day* method) due to the installation of ENERGY STAR® windows. Baseline and retrofit values for each customer were provided by Avista and used in the analysis.
- **ENERGY STAR® Doors:** A review of the measure was not completed because no such measure was selected in the sample.
- **High-Efficiency Furnace:** The review included the use of ENERGY STAR®'s online calculator for the regions in Avista's Washington and Idaho territory, along with values used by other utility companies for similar baseline and retrofit requirements, adjusted for heating-degree-days.
- **High-Efficiency Water Heater (40- and 50-gallon):** The review included engineering calculations using Avista's Energy Factor (EF) qualifications and a comparison with other utility company reported values for similar baseline and retrofit requirements.
- **High-Efficiency Tankless Water Heater:** The review included engineering calculations using a baseline EF of 0.58 and a retrofit EF of 0.80 (typical for tankless water heaters), and a comparison with savings values reported by other utility companies and the California DEER database.
- **Ceiling/Attic/Floor/Wall/Duct Insulation Measures:** The review included engineering calculations based on the modified heating-degree-day method. Baseline and retrofit values for each customer were provided by Avista and used in the analysis.
- **Health and Human Safety:** These measures typically fell under one of the categories already provided and the methodology used to evaluate the energy savings was the same as provided for each measure type (e.g., air infiltration reduction).



Nonresidential Program

For the engineering review of the Avista nonresidential programs, we carried out a project-by-project analysis of the measures installed and the energy savings reported. As part of the evaluation, we reviewed the engineering calculations, modeling simulations, and assumptions that Avista used for each project, along with a check against standard engineering practices, in order to determine the accuracy of the methodologies used to determine energy savings. We performed separate engineering calculations and modeling simulations to verify accuracy if we deemed it necessary.

As noted earlier, prescriptive incentives for several new food service measures were introduced in 2008. The sample applications included prescriptive applications for demand controlled ventilation (DCV), vent hoods, gas fryers, and gas combination ovens. Nexant evaluated assumptions, methods, and calculations for each of these measures, utilizing pertinent resources from the Food Service Technology Center (FSTC) and the Regional Technical Forum (RTF). For other prescriptive measures, Nexant consulted other sources such as Database for Energy Efficient Resources (DEER) and calculators provided by EnergyStar

Calculation of Therm Savings

Residential Program

As a check of Avista's therm savings estimates, we independently calculated therm savings for each record using the input data recorded on the rebate form as verified or revised through our audit of the accompanying documentation. If our engineering review of residential measures supported Avista's prescribed per-unit savings values or recommended a higher per-unit value, we used the Avista value. If our engineering review recommended a lower per-unit value, we used that.

For each case in each sample stratum, we computed the difference between Avista's estimate of therm savings and ours. We excluded cases for which the documentation did not provide sufficient data to compute an estimate, as specified above. However, we included cases with final disposition codes of "3" (invoice and/or other documentation contradicts the rebate form) or "4" (incorrectly coded) if we had sufficient data to compute an estimate; we also included cases with a final disposition code of "5" (not qualified), assigning a value of "0" saved therms. The reasoning was that these cases provide appropriate information regarding Avista's computations of therm savings on a case-by-case basis. Note, however, that they also are included in our paper-trail analysis, which shows the percentage of cases with documentation problems.

Limited-Income Program

For the limited-income sample, we calculated savings on a measure-by-measure basis. We used Avista's assumptions and methods if confirmed in our engineering review; if our engineering



review did not confirm Avista's assumptions and methods, we substituted our own proposed ones.

For each case, in each sample stratum, we computed the difference between Avista's estimate of therm savings and ours. We excluded cases for which the documentation did not provide sufficient data to compute an estimate. However, we included cases with final disposition codes of "3" (invoice and/or other documentation contradicts the rebate form) or "4" (incorrectly coded) if we had sufficient data to compute an estimate; we also included cases with a final disposition code of "5" (not qualified), assigning a value of "0" saved therms. The reasoning was that these cases provide appropriate information regarding Avista's computations of therm savings on a case-by-case basis. Since we performed this analysis simply as a check of Avista's computations, not to provide alternative estimates of therm savings, including these cases is proper. Note, however, that they also are included in our paper-trail analysis, which shows the percent of cases with documentation problems.

Nonresidential Program

The nonresidential Stratum 1 (*Largest Projects*) and Stratum 3 (*All Other Measures*) are custom projects, in which the calculated energy savings are based on the conditions of the baseline and retrofit system. In the data analysis for these groups, we recalculated the therm savings for all cases, based on the results of our engineering analysis; in most cases, this did not involve a "check" of Avista's computation for the project. Stratum 2 (*Prescriptive Measures*) involved a pre-negotiated energy savings value per item and, therefore, was the only nonresidential group that involved a check of Avista's assumed therm value and recorded data. For this group, we used an Avista-supplied value per unit and the input data (number of units per location) recorded in Avista's tracking spreadsheet to compute therm savings for each case. For each case, in all three strata, we computed the difference between Avista's estimate of therm savings and ours.

Unlike the residential and limited-income cases, we did not exclude cases based on disposition code. However, we noted cases in which documentation issues resulted in audit estimates that should not be used to evaluate Avista's claimed savings.

DATA ANALYSIS AND PRESENTATION

Paper-Trail Analysis

Our paper-trail analysis for all programs consisted of computing the percent of cases in each residential stratum with each final disposition code, along with 90% confidence intervals (CIs).



Therm Savings Analysis

For each stratum, we calculated the mean, standard deviation, and mean standard error of the case-by-case difference between Avista's estimated therm savings and our calculation of the saved therm. We used the standard errors to compute 90% CIs around the mean differences.

Weighting Data for Combined Results

As in the 2006 and 2007 audit, before we combined the data from the various strata we assigned weights to each stratum to account for the fact that the population-to-sample ratio differed among them. We did this for both the paper-trail audit and the savings estimate audit.

For each disposition, the formula for determining the weighted n was:

$$(n_1 * w_1) + (n_2 * w_2) + \dots + (n_z * w_z)$$

where:

n_1, n_2, \dots and n_z = the number of cases with disposition x in Stratum 1, 2, ... to z

w_1, w_2, \dots and w_z = the weights of Stratum 1, 2, ... to z

Weights were calculated as:

$$(N_i/n_i)/(N_{1-z}/n_{1-z})$$

where:

N_i = the population for Stratum i

n_i = the sample size for Stratum i

N_{1-z} = the combined population for all strata

n_{1-z} = the combined sample size for all strata

Similarly, in the therm savings analysis, we applied weights to each stratum mean before combining the strata.

Combining 2006, 2007, and 2008 Results

We also report data for the combined 2006, 2007, and 2008 samples. Since we redefined the sample strata for the 2007 audit, we re-stratified the 2006 audit data using the 2007 (and 2008) audit definitions. In addition, before we combined the data across the three years of the audit, we applied weights to account for the fact that the population-to-sample ratio for each stratum differed by year.





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RESULTS

We present the results separately for the residential, limited-income, and nonresidential programs. For each program, the results for the documentation review are followed by those for the engineering review and evaluation of Avista's savings estimates. Results are shown for the 2008 audit and the combined 2006-2008 program years. (The individual data for each project for program year 2008 are presented in Table A.1 through Table A.3 in Appendix A.)

RESIDENTIAL PROGRAM

The following describes the results of the documentation review and analysis of estimated savings for the residential program for both the 2008 program year and the combined 2006-2008 program years.

Database Review

During preparation of the sample weights for the 2008 residential audit, we identified several database records, not selected for the sample, that were classed as gas measures but showed no therm savings or that showed therm savings that were inconsistent with the prescribed amount. We brought these to the attention of Avista's database manager, who reviewed the records and provided explanations.

A total of 43 such records were identified. The following issues were identified:

- **One (1) record identified as "Electric ENERGY STAR[®] home – gas only" showed no therm savings.** Avista's database manager verified that this record was miscoded: it was an electric-only measure and should not have been identified as "gas only." No therm savings were claimed.
- **Nine (9) records identified as "Gas high-efficiency tankless water heater" showed no therm savings.** Avista's database manager verified that these records were miscoded and should have been recorded as "All electric window replacement." No therm savings were claimed.
- **Five (5) records identified as "Electric new high-efficiency ground pump", six (6) identified as "Electric to ground heat pump conversion", and 22 identified as "Gas ENERGY STAR[®] home – gas only" showed a range of therm savings.** Avista's database manager verified that these records were miscoded and should have been recorded as gas window measures with the claimed therms as recorded.



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Avista's database manager reported correcting the database for all of the above cases. The identified records accounted for about 0.5% of the 2008 database. This was a significantly lower rate of misclassification than that identified in the sample, as reported below. Therefore, it is likely that the general rate of misclassification of records does not substantially exceed that reported below.

Documentation Review

Table 4.1 shows the summary final disposition data for the residential sample for program year 2008 and the combined weighted data for program years 2006 through 2008. The table shows the number and percentage of cases with each of five dispositions plus the 90% CIs around the percentages. The table shows the raw, or unweighted, number of cases with each disposition. However, the percentages shown in the table are weighted to account for differences in the sampling ratios across sample strata and across program years.¹²

Table 4.1: Final Disposition of Sampled Residential Cases

YEAR	DISPOSITION	2008 DATA		
		NUMBER OF CASES ¹	PERCENT	90% CONFIDENCE INTERVAL (CI)
2008	1 = Documentation supports input data	106	96.1	95.8 - 96.4
	2 = Insufficient documentation	1	0.2	0.2 - 0.3
	3 = Documentation contradicts input data	3	1.5	1.3 - 1.7
	4 = Measure was incorrectly coded	1	2.1	1.9 - 2.3
	5 = Measure does not qualify for rebate	0	0.0	0.0 - 0.0
	TOTAL	111	100.0	
2006-2008 (Weighted)	1 = Documentation supports input data	247	88.2	87.9 - 88.4
	2 = Insufficient documentation	11	3.0	2.9 - 3.1
	3 = Documentation contradicts input data	12	3.4	3.3 - 3.5
	4 = Measure was incorrectly coded	4	1.8	1.8 - 1.9
	5 = Measure does not qualify for rebate	7	3.6	3.5 - 3.7
	TOTAL	280 ²	100.0	

¹ For readability, raw (unweighted) counts are shown in the table. However, percentages were based on counts that were weighted to account for differences in the sampling ratios across strata and across program years.

² The number of cases of each disposition sum to 280, not 281, because one case represented both disposition '3' and disposition '4'. If that case had been counted twice, the total would be 281.

¹² Henceforth, all percentages discussed are based on weighted data unless otherwise specified.



Final Dispositions

For the 2008 sample, the input data were well documented for 106 of the 111 cases sampled. When weights are applied to the individual strata data to account for differences in sampling ratios, the weighted percent of cases with well-documented input is 96.1% ($\pm 0.3\%$).¹³ This represents an increase over that found in the 2007 audit (83.5%) and the 2006 audit (82.0%). The weighted percentage across program years is 88.2% ($\pm 0.2\%$).

Summary data on final dispositions are shown for each stratum and each program year in Table B.1 in Appendix B.

Types of Documentation Problems

Only five documentation errors were identified in the 2008 residential sample. A total of 34 documentation errors were identified over the three-year audit.

Cases for which the invoice and/or other documentation provided insufficient detail to verify the therm savings recorded in Avista's database (disposition '2') accounted for 1 of the 5 cases with documentation errors in 2008 and 11 of 34 across the three-year audit. Seven of the 11 records were for windows installation in which the invoice did not provide details on window dimensions or size and it could not be obtained from the vendor. The other four were for insulation for which the invoice similarly did not document the amount of insulation installed and that information could not be obtained from the vendor. Based on the sample, we estimate that this type of error occurred in 0.2% of all 2008 records and 3.0% of all records across the three program years.

We uncovered three cases in which the invoice provided information that contradicted the rebate form (disposition '3') in 2008, and 12 cases across the three-year audit.¹⁴ Eight of these cases were windows installation in which the therm savings claimed in Avista's database exceeded by at least 5% the savings that could be calculated from the documented square footage of windows installed. Four cases were insulation installation in which the therm savings claimed in Avista's database similarly were at least 5% greater than the savings that could be calculated from the documented square footage of insulation installed. We estimate that this type of error occurred in 1.5% of all 2008 records and 3.3% of all 2006-2008 records.

¹³ For the convenience of the reader, the 90% CI is expressed in the text as \pm half the CI.

¹⁴ In the 2006 report, three additional cases were reported as having documentation that contradicted the rebate form. All were cases of replacement windows. A review of all records indicating documentation errors, carried out for this final report, found that all three should have been classified as confirmed because the square footage of windows on the invoice, although differing somewhat from that shown on the rebate form, was within 5%. The IDs for these cases are 1214, 1787, and 2173.



We found one measure that was incorrectly coded (disposition '4') in the 2008 audit and four, total, from 2006 through 2008.¹⁵ All four cases were different: one was a high-efficiency 50-gallon water heater that was coded as a 40-gallon model; one was an all-electric ENERGY STAR[®] home that was coded as a gas measure; one was an ENERGY STAR[®] clothes washer that was coded as a dishwasher; and one was duct insulation that was miscoded as a fireplace damper. The last case—the miscoded duct insulation—also was counted as disposition '4' because the number of therms claimed in Avista's database exceeded the amount that could be determined from the documented amount of duct insulation for that case. The estimated rate of occurrence of this type of error is 2.1% for 2008 and 1.8% across the three program years.

There were no 2008 cases in which a measure should not have qualified for a rebate (disposition '5'), seven cases in the combined 2006-2007 data. In four cases, the measure was a water heater that did not meet the prescriptive efficiency standard. Each of the other three cases was different: one was replacement windows installation for which the windows did not meet the prescriptive efficiency standard; one was insulation installed under exterior siding, which does not qualify; and one was for a boiler that did not meet the prescriptive efficiency standard. The estimated rate of occurrence of this type of error across the three program years is 3.6%.

A description of each sampled residential case with disposition 2, 3, 4, or 5 is shown in Table C.1 in Appendix C.

Engineering Review

The engineering review of Avista's residential program consisted of a check against standard engineering practices, comparing Avista's reported energy savings to other utility DSM program offerings, and performing engineering calculations to verify savings on a measure-by-measure basis. The initial review was carried out on measures identified in the 2006 audit; it has been updated in subsequent years to account for newly identified measures, new information, or changes to existing measures.

Our engineering evaluation of most measures produced per-unit estimates that were slightly at variance with Avista's, but in most cases not so much as to warrant replacing Avista's per-unit estimates with our own. In some cases, Avista has revised its claimed therm savings for a measure based on new information, changes in efficiency standards, or some other reason. In such cases, we re-evaluated the claimed savings for the measure and generally agreed with

¹⁵ In the 2006 report, two additional cases were reported as having been incorrectly classified. In both cases, the rebate form indicated the measure was "High-Efficiency Water Heater 50-gallon" but the invoice stated that they were tankless water heaters. Subsequent discussion with Avista clarified that Avista used the same measure code for both measures, since they both had the same level of prescribed savings. Our engineering review accepted Avista's prescribed savings for both the measures (but recommended a higher level of savings for the tankless water heaters), so there is no reason to consider these as misclassified. The IDs for these cases are 121 and ID 1083.



Avista's values. We also re-evaluated the claimed savings for a measure if new information became available for that measure, even if Avista did not change its claimed savings for it.

Table 4.2 summarizes the results of our engineering evaluations for the three program years. The following provides more detail on our engineering evaluation of each measure:

- ➔ **High-efficiency natural gas furnace and high-efficiency natural gas boiler:** In 2006 and 2007, Avista claimed 71.6 therms per unit for these measures, which our engineering review confirmed. In 2008, Avista increased the therm savings to 123 based on an updated analysis of annual heating BTU consumption requirements, primarily driven by a change in area of heat loss for the shell to include floor space, which was not included previously. In addition, Avista increased the minimum efficiency standard for the boiler measure to 90% to match that of the furnace measure. Our engineering review confirmed the new value of 123 therms for the furnace; the boiler was not identified in the 2008 sample, so our engineering review did not re-evaluate it.
- ➔ **High-efficiency natural gas water heater (40- and 50-gallon):** Avista claimed 11 and 8 therms, respectively, for these measures in 2006 and 2007. In 2006 and 2007, our engineering review verified that savings would be at least those that Avista claimed, based on engineering calculations using the baseline and retrofit qualifications listed by Avista, with some assumptions about usage and water consumption. We accepted sampled records with those savings as verified. However, we recommended that in the future, Avista should reverse the claimed savings for these two measures, as switching from a less efficient to a more efficient 50-gallon water heater should produce more savings than switching from a less efficient to a more efficient 40-gallon water heater. In 2008, Avista changed the claimed savings to 8 therms for the 40-gallon water heater and 11 therms for the 50-gallon heater, which our engineering review accepted.
- ➔ **High-efficiency natural gas water heater (tankless):** Avista claimed 11 therms for this measure in the 2006 and 2007 programs. In 2006, our audit verified 28 therms for this measure and recommended that 28 therms be claimed. In 2007, based on new information¹⁶, our audit verified at least 52 therms for this measure and recommended that

¹⁶ *Residential Deemed Savings, Efficiency, and Installation Standards for Arkansas Statewide QUICKSTART Programs*, Frontier Associates LLC, April 2, 2007.



at least 52 therms be claimed.¹⁷ In 2008, Avista increased the minimum EF for this measure from .65 to .82 and changed the claimed savings to 60 therms. Our engineering review verified these claimed savings.

¹⁷ The exact level of savings is based on the size of replaced storage tank. If a 50-gallon tank is replaced, up to 66 therms could be claimed. We cite 52 therms as a conservative minimum.



Table 4.2: Summary of Engineering Evaluation for Residential Program

MEASURE	UNIT	2006 AUDIT		2007 AUDIT		2008 AUDIT	
		SAVINGS AVISTA REPORTED AS PROGRAM STANDARDS	AUDIT RECOMMENDED SAVINGS	SAVINGS AVISTA REPORTED AS PROGRAM STANDARDS	AUDIT RECOMMENDED SAVINGS	SAVINGS AVISTA REPORTED AS PROGRAM STANDARDS	AUDIT RECOMMENDED SAVINGS
High-Efficiency Natural Gas Furnace	per measure	71.6	71.6	71.6	71.6	123	123
High-Efficiency Natural Gas Boiler	per measure	71.6	71.6	71.6	71.6	123	-- ¹
High-Efficiency Natural Gas Water Heater (40-Gallon)	per measure	11	8	11	8	8	-- ¹
High-Efficiency Natural Gas Water Heater (50-Gallon)	per measure	8	11	8	11	11	11
High-Efficiency Natural Gas Water Heater (Tankless)	per measure	11	28	11	≥52	60	60
Ceiling/Attic Insulation	per sq ft	0.042	0.042	0.042	0.042	0.09	0.09
Floor Insulation	per sq ft	0.209	0.209	0.209	0.209	0.31	0.31
Wall Insulation	per sq ft	0.209	0.209	0.209	0.209	0.31	0.31
Duct Insulation	per linear ft	2.8	2.8	2.8	--	2.8	-- ²
New Windows	per sq ft	0.42	0.42	0.42	0.42	0.42	0.42
Replacement Windows	per sq ft	0.83	0.83	0.83	0.83	0.83	0.83
Programmable Thermostat W/AC	per measure	31	31	31	31	31	-- ¹
ENERGY STAR [®] Homes	per measure	197	-- ³	197	197	197	-- ¹

4. RESULTS

MEASURE	UNIT	2006 AUDIT		2007 AUDIT		2008 AUDIT	
		SAVINGS AVISTA REPORTED AS PROGRAM STANDARDS	AUDIT RECOMMENDED SAVINGS	SAVINGS AVISTA REPORTED AS PROGRAM STANDARDS	AUDIT RECOMMENDED SAVINGS	SAVINGS AVISTA REPORTED AS PROGRAM STANDARDS	AUDIT RECOMMENDED SAVINGS
ENERGY STAR® Dishwasher	per measure	--	--	--	--	5 ⁴	5
ENERGY STAR® Clothes Washer	per measure	--	--	--	--	9 ⁴	9

¹ This measure was not identified in the 2008 sample, so it was not re-evaluated.

² Duct insulation has been discontinued in Avista's residential program, so no savings are recommended for program year 2008.

³ This measure was not identified in the 2006 sample, so it was not evaluated until 2007.

⁴ New measure in 2008.

- **Insulation (ceiling/attic and floor/wall):** In 2006 and 2007, Avista claimed .042 therms per square foot of qualifying ceiling/attic insulation installed and .209 therms per square foot of qualifying floor/wall insulation installed. In 2008, Avista increased these to .09 and .31 therms, respectively. The increase was based on a review of records from prior program years that showed that average existing insulation levels were lower than had been assumed and that, on average, more than the minimum R-10 was being added. Our engineering review verified these values.
- **Duct insulation:** In 2006 and 2007, Avista claimed 2.8 therms per linear foot of this measure, which our engineering review verified. Duct insulation has been discontinued in Avista's residential program, so no savings are recommended for program year 2008.
- **New and replacement windows:** Our engineering review verified Avista's claimed savings of 0.42 and .83 therms per square foot for energy-efficient new and replacement windows, respectively, which has remained the same from 2006 through 2008. In 2008, Avista discontinued the rebate for new windows, although some rebates were given before it was discontinued.
- **Programmable thermostat:** Our engineering review verified Avista's claimed savings of 31 therms per unit for this measure, which has remained the same from 2006 through 2008.
- **ENERGY STAR[®] homes.** No engineering review was performed for ENERGY STAR[®] Homes as part of the 2006 audit as there were no cases of this measure in the sample. The engineering review performed for the 2007 audit indicates that the heating-degree-days-adjusted value could be as high as 283 therms for this measure; however, we recommended that Avista continue using its value of 197. This was not re-evaluated in 2008.
- **ENERGY STAR[®] dishwasher and ENERGY STAR[®] clothes washer:** These were new measures in 2008. Our engineering review verified Avista's claimed savings of five and nine therms per measure, respectively, and recommended these savings.

Analysis of Avista's Savings Estimates

For each case, we subtracted our calculation of saved therms from Avista's estimates to yield a *difference score* for that case. Therefore, a positive number indicated that Avista's estimate exceeded our calculation and a negative number indicated that Avista's estimate was less than our calculation. The purpose of computing a difference score was to remove any variance associated with differences among measure types from the comparison of our estimates with Avista's estimates.



Table 4.3 summarizes the results for the difference scores for both 2008 and the combined 2006-2008 data. For each, the table shows the mean Avista-reported savings, the mean savings as computed by the audit, the mean difference between Avista's reported savings and our computed savings, the mean difference expressed as a percentage of Avista's estimate¹⁸, the 90% confidence interval around the mean difference, and the minimum and maximum difference scores found within that stratum.

Table 4.3: Comparison of Avista's Reported Residential Therm Savings and the Audit's Values

YEAR	AVISTA MEAN	AUDIT MEAN	MEAN DIFFERENCE		90% CONFIDENCE INTERVAL (CI)	RANGE
			VALUE	PERCENT		
2008	83.3	87.0	-0.2	-0.2	-1.5 – 1.2	-55 – 189
2006 to 2008	75.3	74.3	3.2	4.3	0.7 – 5.8	-63 – 280

Note: As described in Chapter 3, *Audit Methods*, the mean difference is based on difference scores computed on a case-by-case basis and then weighted to account for differences in sampling ratios between sample strata and from year to year. This mean of the individual difference scores is not necessarily equal to the difference between the Avista and audit means.

As described above, we assigned weights that reflect the sampling ratio of each stratum before computing the means, confidence interval, and difference percent for each program year. The minimum and maximum values for the combined sample are simply the minimum and maximum values found across all strata.

The weighted combined results of the 2008 audit showed a mean underestimation of -0.2 ± 1.3 therms, representing a weighted mean underage of 0.2%. The combined 2006-2008 data showed a mean overestimation of 3.2 ± 2.6 therms, a mean excess of 4.3%. Based on the 90% CI for the combined data, we can have 90% confidence that, across all measures for the combined 2006, 2007 and 2008 program years, Avista overestimated savings by a mean of no more than 5.8 therms and by as little as 0.7 therms per measure.

Across the three program years, the precision of the mean difference estimate was ± 2.6 therms, which is about 3.5% of Avista's mean estimated savings. Thus, the requirement of 10% precision (at 90% confidence) was well surpassed for the residential program.

¹⁸ In the 2006 audits, we reported the difference expressed as a percentage of our estimate, rather than as a percentage of Avista's estimate. However, this prevents the computation of a percentage in instances in which we assigned a value of 0 saved therms (e.g., in the case of measures that should not have qualified for a rebate), since it is not possible to divide by 0. Therefore, the difference is expressed as a percentage of Avista's estimate, which was nonzero in all cases.



In the combined 2006-2008 data, new and replacement windows showed the smallest mean difference between Avista's claimed savings and the audit's results and insulation showed the largest mean raw difference; other measures showed larger percent differences.

Summary data are shown for each stratum and each program year in Table B.2 in Appendix B.

LIMITED-INCOME PROGRAM

Documentation Review

Table 4.4 shows summary final disposition data for the limited-income sample. For the 2008 audit and the combined 2006-2008 sample, this table shows: the number and percentage of cases (with 90% CIs) with each of the four dispositions available for the limited-income group.

Table 4.4: Final Disposition of Sampled Limited-Income Cases

YEAR	DISPOSITION	2008 DATA		
		NUMBER OF CASES ¹	PERCENT	90% CONFIDENCE INTERVAL (CI)
2008	1 = Documentation supports input data	68	100.0	100.0 – 100.0
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	3 = Documentation contradicts input data	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	0	0.0	0.0 – 0.0
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	68		
2006-2008 (Weighted)	1 = Documentation supports input data	191	99.6%	99.5 – 99.6
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	3 = Documentation contradicts input data	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	2	0.4	0.4 – 0.5
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	193		

We were able to obtain sufficient documentation to perform analyses for all 68 cases sampled in 2008. Across the combined 2006-2008 data, we were able to perform analyses for 99.6% (weighted) of the cases, with a 90% CI of 99.5% to 99.6%.

Note that a disposition of '1' does not mean that documentation was perfect. In the 2006 through 2008 audits, we encountered cases in which it was necessary to assume baseline and retrofit



assumptions and for which we discovered that some test measurements had not been recorded correctly by the CAP agencies that performed them.

Summary data on final dispositions are shown for each stratum and each program year in Table B.3 in Appendix B. A description of each sampled limited-income case with disposition 2, 4, or 5 is shown in Table C.2 in Appendix C.

Analysis of Avista's Savings Estimates

The engineering evaluation for all measures of the limited-income program included a project-by-project analysis based on the inputs provided by the CAPs. For each case for which we were able to calculate energy savings, we computed a *difference score* and computed the percent by which Avista's claimed savings exceeded or fell below our calculation.

Table 4.5 summarizes the results for the difference scores for each stratum of the limited-income sample. As for the residential sample, it shows the mean difference score with its 90% confidence interval, the mean difference percentage, and the range of difference scores found within each stratum as well as for the entire 2007 sample and the combined 2006-2007 sample.

Table 4.5: Comparison of Avista's Reported Limited-Income Therm Savings and the Audit's Values

YEAR	AVISTA MEAN	AUDIT MEAN	MEAN DIFFERENCE		90% CONFIDENCE INTERVAL (CI)*	RANGE
			VALUE	PERCENT		
2008	98.8	129.5	30.7	23.7	9.8 – 51.7	-79 – 343
2006 to 2008	112.0	135.0	23.6	17.5	10.7 – 36.8	-175 – 343

Note: As described in Chapter 3, *Audit Methods*, the mean difference is based on difference scores computed on a case-by-case basis and then weighted to account for differences in sampling ratios between sample strata and from year to year. This mean of the individual difference scores is not necessarily equal to the difference between the Avista and audit means.

* The sample sizes generally were at least 5% of the population; therefore, the 90% CI incorporates finite population correction factor.

We found a large number of discrepancies between Avista's claimed savings and our estimates when comparing them on a case-by-case basis. In fact, the number of cases with large discrepancies was greater for 2008 than in previous years.

This is reflected in the fact that the weighted mean difference between Avista's reported savings and the audit's estimate was greater for the 2008 sample (30.7 ±21.0 therms, a mean overestimate of 23.7%) than in the combined 2006-2008 sample (23.6 ±13.2 therms, a mean overestimate of about 17.5%).

Across the three program years, the precision was ±13.2 therms, which is 10.4% of Avista's mean estimated savings. Thus, the precision for the limited-income program was only very slightly less than the targeted value of 10% precision (at 90% confidence).



We are unable to account for the large discrepancies in the 2008 data or for the greater number of large discrepancies found in 2008 than previously. However, note that the 90% CI for 2008 is not much larger than that for the combined sample. Thus, we cannot reject with much certainty the idea that the population from which the 2008 sample was drawn was similar to those for the previous program years. This implies that, had we evaluated all limited-income records, or even a larger sample of them, the mean discrepancy might have been similar for all program years.

Summary data are shown for each stratum and each program year in Table B.4 in Appendix B.

NONRESIDENTIAL PROGRAM

Documentation Review

Table 4.6 shows summary final disposition data for the three nonresidential groups. Recall that, for the nonresidential program, we performed a census evaluation of the *Largest Projects* and a stratified random sample of the remaining projects. The two sampled strata were: *Prescriptive Measures* and *Other Measures*. This table shows, for each group, the number and percentage of cases (with 90% confidence intervals) with each of two dispositions, and weighted data for the combined sample (excluding the largest projects), calculated with the same method as for the residential program (see above).

Table 4.6: Disposition of Nonresidential Cases

YEAR	DISPOSITION	2008 DATA		
		NUMBER OF CASES ¹	PERCENT	90% CONFIDENCE INTERVAL (CI)
LARGEST PROJECTS (STRATUM 1)				
2008	1 = Documentation reasonable	6	54.5%	N/A
	2 = Documentation problematic	5	45.5%	N/A
	TOTAL	11	100.0%	N/A
2006-2008	1 = Documentation reasonable	16	69.6%	N/A
	2 = Documentation problematic	7	30.4%	N/A
	TOTAL	23		N/A
SAMPLED STRATA				
2008	1 = Documentation reasonable	18	54.5%	49.8 – 59.2
	2 = Documentation problematic	14	45.5%	40.8 – 50.2
	TOTAL	32	100.0%	
continued				



YEAR	DISPOSITION	2008 DATA		
		NUMBER OF CASES ¹	PERCENT	90% CONFIDENCE INTERVAL (CI)
2006-2008 (Weighted)	1 = Documentation reasonable	71	72.8%	71.8 – 73.7
	2 = Documentation problematic	38	27.2%	26.3 – 28.2
	TOTAL	109		

The table shows that for 6 of the 11 largest projects we were able to obtain detailed documentation sufficient to calculate an independent estimate of savings against which we were confident in evaluating Avista's claimed savings. This is a somewhat lower percentage of large projects compared to the previous audits, in which we were able to obtain detailed documentation for six of the seven largest projects in 2006 and four of the five largest in 2007. In total, over the three program years, we have been able to calculate independent estimates that we considered reliable for 16 of the 23 largest projects.

In the cases that we coded as "documentation problematic" (Applications 25005, 25006, 25032, 25056, and 26379), we were unable to obtain or verify many details of the model used to generate Avista's estimate; in addition, other inputs that were provided appeared to be possibly inaccurate and were inconsistent with the documentation. For example, baseline boiler efficiencies and HVAC system types in the eQUEST models did not correspond to the documentation provided, or there were inconsistencies with the ESCO reports regarding the HVAC systems. In the case of Applications 25056 and 26379, the selection of the baseline HVAC system for comparison strongly affects the savings (See Appendix D for additional details).

For the sampled strata, we obtained sufficient documentation to calculate a reliable estimate for 18 of 32 cases. Across the three audited program years, we have judged the documentation in 38 of the 109 cases (27%) in these strata to be problematic. The 90% CI suggests that between 26% and 28% of the cases in the database likely have problematic documentation.

In the sampled cases, we encountered documentation issues with several HVAC projects that were similar to the ones we encountered in the largest projects. We also found insufficient/problematic documentation for the six rooftop service projects (*AirCare Plus*, or ACP) that we reviewed in this stratum. The primary measures of the ACP program under review were the programmable thermostat modification and replacement measures, as these were the only measures that resulted in gas (therms) savings. The calculated energy savings for these measures were difficult to reproduce based on the data that we were provided. We also found documentation problems with two prescriptive demand controlled ventilation (DCV) projects and one appliances project.



Engineering Review

As described above, the engineering evaluation for all measures of the nonresidential program included a project-by-project analysis based on the assumptions and calculations provided in Avista's application and documentation. When sufficient documentation was provided, we recalculated energy savings using standard engineering methods or modeling simulations. When insufficient documentation was provided, the methodology used by Avista and the reported energy savings were evaluated for appropriateness.

We simulated each of the ACP projects using the latest commercial version of eQUEST (version 3.61e). Although overall there are more than six types of facilities, Nexant constructed only three baseline models (in line with the three facility types represented in the sample population). This entailed separate models for 1) small retail, 2) large retail, and 3) classroom wing. The main parameters documented for each model include envelope construction, square footage, schedules (lighting, equipment, and occupancy), internal loads (occupancy density, sensible and latent heat gains, lighting power density, and equipment power density), infiltration, and thermal set points.

Note that each ACP project has at least one and oftentimes several rooftop units (RTUs) which underwent modifications. Based on the documented inputs for each RTU (which included set points and schedules for pre-maintenance as well as post-maintenance) in the applications, parametric runs were performed for the models. Because the baseline models often have much more conditioned area than the actual projects, the results must be scaled down to the estimated project area (based upon therm savings on a per-square-foot basis).

The results of the simulations indicate a realization rate of about 80% or better for four of the six projects; the other two projects showed considerably less savings than that estimated by Avista. Again, however, it should be noted that several crucial parameters are unknown even to the on-site technicians, such as the heating capacity of the RTU, thermal efficiency, airflow rate for the RTU (cfm), fan operating characteristics, actual conditioned area, and zones characteristics (e.g., internal gains).

Although we were able to calculate estimates for these cases, we do not necessarily recommend that they be used instead of Avista's figures since they are not directly comparable to Avista's claimed savings. We recommend that additional review be conducted of the *AirCare Plus* program.

The engineering evaluation for various prescriptive measures included a check of Avista's reported savings value for accuracy and appropriateness. For example, we evaluated the assumptions used for gas fryers and gas combination ovens, and found that the savings values were appropriate. In the case of prescriptive steam traps (Application 28143), we judged that the assumed operating hours seemed high for a dry cleaning establishment. They were reduced from 8,760 to 2,808, which reduced the therm savings proportionately.



Regarding prescriptive DCV, we note that there was wide variation in estimated energy savings, based upon the analysis tool used (e.g. eQUEST, Honeywell, and Airtest). It may be more accurate to base the savings upon occupancy schedules, served (conditioned) area, and cfm's of the applicable air handling units, than on gross square footage or facility type. We believe that Avista adopted a reasonably conservative approach to this measure, but recommend that it be investigated further for accuracy.

Analysis of Avista's Savings Estimates

For each case for which we were able to calculate energy savings, we computed a *difference score*. We discuss the differences scores for the largest projects separately from the sampled nonresidential groups.

Recall that there were several cases from the sampled strata for which we stated that our calculated savings were not directly comparable to Avista's because we did not have access to all relevant inputs; for those cases, we indicated that we do not necessarily recommend that our estimates be used instead of Avista's figures. We encountered such questionable cases in all three years of the audit.

For the reports of the 2006 and 2007 audits, we nevertheless used the audit estimates for those cases in our calculations of the summary data. That is the most conservative approach, but it may overstate the degree of error in Avista's estimates.

For this final audit, we calculated summary data with three different methods that differ only in how we dealt with those questionable cases. The first method accepts the audit's estimates for those cases; this is the method we used in the 2006 and 2007 audits. The second method accepts Avista's claimed savings for the questionable cases. The third method substitutes a random value lying between our estimate and Avista's. The assumption behind this method is that there is some error in Avista's estimate, but that it is not as great on a case-by-case basis as our estimate would indicate.

The Largest Projects (Stratum 1, Census)

Results of our engineering review for the largest nonresidential projects are presented in Table 4.7, along with the results for the largest projects from the 2006 and 2007 program years. This table shows the actual audit estimates of savings for each case and the summary data based on those values (method 1). Following the table, we present the summary results that we obtained when we used the second and third methods described above.



Table 4.7: Comparison of Avista's Reported Nonresidential Therm Savings for the Largest Projects with the Audit's Computations

APPNUM	DESCRIPTION	AVISTA	AUDIT	DIFFERENCE	
25006	HVAC Combined	40,753	47,400	-6,647	
26379	HVAC Combined	25,771	24,033	1,738	
25005	HVAC Combined	23,894	8,550	15,344	
25056	HVAC Combined	18,315	12,659	5,656	
22206	HVAC Combined	14,305	14,305	0	
25032	HVAC Combined	14,303	26,003	-11,700	
22842	HVAC Combined	65,953	68,039	-2,086	
25245	HVAC Combined	19,647	17,238	2,409	
27948	HVAC Combined	18,679	18,682	-3	
26700	HVAC Combined	14,703	14,171	532	
26751	HVAC Heating	31,300	24,900	6,400	
				2008 Mean	1,058
				2007 Mean	-5,879
				2006 Mean	20,822
				2006-2008 Mean (Unweighted)	4,872

On average, across the 11 largest 2008 projects, our estimate was 1,058 therms below Avista's, representing a mean overestimate by Avista of about 4%. Across the three program years, the mean difference between Avista's claimed therms and our estimate for the largest projects is 4,872 therms, representing a mean overestimation by Avista of about 16% over the three-year period. Note, however, that most of that difference comes from 2006, and in particular, from a single project in 2006.

When we accepted Avista's estimates for those cases for which we did not consider our estimates reliable, the 2008 mean difference fell to 598 therms, representing about a 2% overestimate by Avista; the three-year figures were 2,731 therms and 8.5%.

When we substituted a randomly generated number between our estimate and Avista's, the 2008 mean difference was 1,762 therms, a 7.2% overestimate by Avista, and the three-year mean difference was 4,638 therms, a 15.3% overestimate.

Summary descriptions of the six largest nonresidential projects are provided in Appendix D.



Sampled Strata (Stratum 2, Prescriptive, and Stratum 3, Other)

Table 4.8 summarizes the results for the two sampled strata. This table shows the 2008 and combined 2006-2008 results calculated with each of the three methods described above.

Table 4.8: Comparison of Avista's Reported Nonresidential Therm Savings with the Audit's Computations: Sampled Strata

YEAR	AVISTA MEAN	AUDIT MEAN	MEAN DIFFERENCE		90% CONFIDENCE INTERVAL (CI)*	RANGE
			VALUE	PERCENT		
ACCEPTING ALL AUDIT ESTIMATES						
2008	1,667.6	928.8	738.8	79.9	174.9 – 1,302.7	-331 – 8,581
2006 to 2008	1,194.7	996.2	204.1	20.5	14.1 – 394.2	-10,367 – 8,581
ACCEPTING AVISTA'S ESTIMATES FOR UNCERTAIN CASES						
2008	1,667.6	1,630.6	135.8	8.3	25.0 – 246.6	-331 – 7,171
2006 to 2008	1,194.7	1,237.7	123.1	9.9	-81.3 – 327.5	-10,367 – 7,171
SUBSTITUTING RANDOM VALUE FOR UNCERTAIN CASES						
2008	1,667.6	1,303.9	363.7	27.9	101.7 – 625.7	-142 – 3,645
2006 to 2008	1,194.7	1,104.2	90.5	8.2	-50.4 – 231.4	-10,367 – 3,645

Using the first method, the weighted mean difference between Avista's estimates and our independently computed estimates, across all sampled 2008 projects, was 739 ± 564 therms; Avista's estimates were, on average, about 80% higher than ours. Across all three program years, the weighted mean difference for sampled projects was 204 ± 190 ; Avista's reported savings were, on average, about 20% higher than our estimates.

With the second method (accepting Avista's estimates for the questionable cases) reduces the mean difference for 2008 to 136 ± 111 therms, about an 8% overestimate by Avista. It reduces the three-year difference to 123 ± 205 therms, making Avista's overestimate about 10%.

Finally, under the third method, the mean difference for 2008 is 364 ± 262 and the mean overestimate is 28%. Across all three years, the mean difference becomes 90 ± 141 therms and the overestimate becomes about 8%.

The three methods resulted in somewhat different precision estimates. The three-year precision ranges from 13% (method 3) to 18% (method 2) of Avista's mean estimated savings. These fall short of the targeted value of 10% precision (at 90% confidence) despite our use of sample sizes intended to achieve that precision level. The loss of precision is the result of greater-than-anticipated levels of variability in the difference between Avista's claimed therms and the audit's calculated values.



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CONCLUSIONS AND RECOMMENDATIONS

Avista's calendar year 2006, 2007, and 2008 natural gas residential, limited-income, and nonresidential programs are broad in nature, providing multiple opportunities to its customer base. In most cases, we found the projects to have well-documented records with sufficient supporting documentation.

Our audits of the 2006 through 2008 program years confirmed the per-unit therm savings that Avista reported for the majority of the prescriptive measures in the residential program. The one exception is that our engineering review for the 2006 audit suggested a value of 28 therms for high-efficiency tankless water heaters, rather than 11 therms, which Avista reported. We noted that Avista has proposed to increase the deemed value to 60 therms for the 2008 program, based on an increase in the minimum efficiency requirement. Our engineering review supports the use of this value, depending on the mix of 40- and 50-gallon tanks that are replaced. (No tankless water heaters were found in the database of 2007 projects.)

In our audit of the 2006 program, we confirmed Avista's use of 176 therms per unit for pre-rinse sprayers in the nonresidential program. Based on its own Measurement and Verification (M&V) study conducted in 2007, Avista drastically reduced its claimed savings for this measure to 44 therms per unit. As stated in the 2007 report, we believe this to be conservative, but accepted Avista's value.

The discrepancies between Avista's savings estimates and our computations varied widely in size. We were not able to account for much of the variance in the limited-income and nonresidential samples, as we did not receive information on the computation methods used for some of the measures that were involved.

The results revealed varying degrees of documentation issues among the programs and program strata. Part of the reason for the documentation problems and for our inability to review the computation methods for some measures is that Avista had to depend on several CAPs for this information. Below, we repeat our recommendations regarding CAPs; however, Avista is ultimately dependent on the CAPs' cooperation.

Following is a brief summary of the main problems we faced in verifying Avista's savings estimates. Below, we offer some recommendations for how Avista can improve documentation and its ability to carry out accurate engineering calculations in 2008.



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SUMMARY OF VERIFICATION ISSUES

For the audit of the 2008 program, we found unresolved documentation problems in 5 of 111 cases in the residential sample. This represents a weighted mean of about 4% of all cases, a substantial decrease from the 2006 and 2007 audits.

Of the five cases with documentation problems in the 2008 residential sample, there were three cases in which the invoice provided information (e.g., window size or amount of insulation installed) that contradicted the rebate form and one each of insufficient documentation and an incorrectly coded measure. Over all three years, we identified 11 cases of insufficient documentation, 12 of contradictory documentation, 4 miscodes, and 7 measures that should not have qualified for a rebate.

Insufficient documentation for a residential project meant that we could not adequately check Avista's estimated therm savings for that project. In such cases, we excluded that project from our case-by-case analysis of savings estimates. The alternative—assigning a value of 0—would not have substantially altered the results: the mean number of claimed therms for such projects divided over the total number of residential projects was 0.3 therms.

Our review of the residential data used both Avista-supplied input data and Avista-supplied per-unit therm values or formulas. Therefore, differences found between Avista's calculations and ours for that program reflect one of three possible sources: a) data entry errors; b) errors in calculation; or c) the use by Avista of input data, per-unit therm values, or formulas other than those they provided to us. In most cases, the difference between Avista's estimate and ours appeared to come from Avista's having accepted input data on the rebate form (e.g., square feet of windows or of insulation) that was not supported on the accompanying documentation.

Some discrepancy in savings claimed for windows may possibly be the result of variability in how window dimensions were calculated. We found sometimes that only a single set of dimensions (height and weight) was provided, which could have been either rough opening or frame size. If the customer used rough opening to calculate window dimensions, the resulting total size and, hence, claimed savings, would be overestimated somewhat. Although the difference would be small, it would contribute somewhat to error. Although we consider that this would contribute little to the overall level of discrepancy between Avista's claimed savings and our estimates, Avista may wish to consider, in addition to the other recommendations we list below, establishing more clear guidelines for calculating window dimensions.

In the limited-income sample, none of the 68 cases had irresolvable documentation problems, nor did any from the 2007 program; there were only two cases with unresolvable documentation issues from 2006. For both of those cases, the measure was incorrectly coded. We did not exclude any limited-income measures from the savings analysis on the basis of insufficient documentation.



As in the previous audit, the above figures do not include a larger number of cases in the residential and limited-income samples for which we requested and received additional documentation from Avista to compute therm savings estimates. For example, the initial case-by-case documentation that we received from Avista for several of the limited-income cases (and which Avista had received from the CAPs) was insufficient to provide independent estimates of savings. We requested additional documentation from Avista and received it in all cases.

By contrast to the residential and limited-income programs, nearly one-half of the custom nonresidential projects had notable documentation problems; this was lower than in the 2007 audit but somewhat higher than what we found in the 2006 audit. We found fewer documentation problems with nonresidential prescriptive measures, and none from 2006 or 2007.

Almost all of the documentation problems in the nonresidential program were an issue of lack of detailed or explicit input, most of which were *AirCare Plus* rooftop service projects. The documentation problems we found in nonresidential projects did not prevent our calculating estimated savings; however, in several cases we noted that our results could not be used to evaluate Avista's estimates.

We found large variations in the degree to which our calculations agreed with Avista's. The mean percent difference between our estimate and Avista's was greater for some sample strata than for others. In the 2008 audit, it varied from 0% in residential Stratum 3, comprised of prescriptive measures (high-efficiency furnaces) to 80.3% in nonresidential Stratum 2. The 90% CI around the estimated mean difference for the 2008 residential sample encompasses zero difference; however, the CI for all other 2008 programs and for the combined 2006-2008 data for all three programs excludes zero difference.

We believe that implementation of the following recommendations will decrease both the amount of documentation error and the overall discrepancy between Avista's claimed savings and the audit's estimates.

RECOMMENDATIONS FOR IMPROVING ENGINEERING AND REPORTING ACCURACY

Residential Program

In the reports of the 2006 and 2007 audits, we suggested several actions for the residential program to increase accuracy of engineering calculations and reporting. Avista accepted all our recommended changes in claimed savings for particular measures.

In addition, a decrease in documentation errors and an improvement in therm calculations for the residential program suggest that Avista has adopted some of our other recommendations for improving documentation and internal review. Moreover, whether prompted by our recommendations or not, Avista has made some modification to its method of recording and tracking application data that have made verification easier and possibly more accurate. For



example, Avista no longer requires that window direction be recorded on the residential program application; window direction frequently was missing from invoices and other documentation, making it difficult to verify the information recorded on the application forms.

We repeat recommendations that Avista may not yet have fully implemented, in some cases with modifications.

To improve documentation:

- ➔ **Request more detailed documentation from residential customers and their contractors submitting rebate requests.** In the previous audits, we recommended that Avista request that invoices and/or other documentation provide the following data: the number of square feet of insulation used for each type of area insulated (walls, floors, ceiling/attic); the model number and AFUE% of high-efficiency furnaces and boilers; and the model number and EF of high-efficiency water heaters. We continue to recommend this action. Most applications submitted already included the requested information, and it is possible that many or most of those who omitted it did so because they were not aware of its importance. Requiring it would allow stricter review of rebate applications as they come in, resulting in reduced error in reported savings.
- ➔ **Provide outreach to vendors to educate them about what kind of information is needed on the invoices.** Although we did not systematically interview vendors, we found when we contacted them to resolve documentation issues that the majority were familiar with Avista and supported its energy efficiency programs. We believe, therefore, that vendors will respond positively to outreach efforts to achieve more consistent documentation.

To improve internal review procedures:

- ➔ **Continue to improve review of rebate applications to ensure that the information on the invoices and/or other documentation is completely consistent with that listed on the rebate forms.** If the information on the rebate form is not thoroughly documented, contact the customer, contractor, and/or manufacturer to obtain the additional needed information and document that information on a separate form for inclusion in the files and later review. Not only would this help to ensure better accuracy of input data, but it also would help ensure that rebates are not given for measures that do not meet Avista's program standards.
- ➔ **Identify furnace, boiler, and water heater models that do and do not meet minimum efficiency requirements.** Provide a list of models that do or do not qualify, which vendors and customers can examine or use such a list to check against incoming rebate applications. Possibly pre-code the customer service database to flag records with non-qualifying models.



- **Institute an internal system for checking data entry accuracy to ensure that incorrect measure types are not recorded in rebate records.** For example, print lists of newly entered records and check them against the hard-copy rebate forms.
- **Institute a system for reviewing the entire database on a regular basis to identify and report therm values that are inconsistent with the measure.** Relatively few measures were incorrectly coded. Nevertheless, those few prescriptive measures that are incorrectly coded could easily be identified and resolved. A thorough review would include, at a minimum, the following actions:
 - Identify measures with zero or negative savings;
 - For each non-calculated prescriptive measure type (i.e., equipment that has a prescribed savings value per item), identify cases with values that are inconsistent with the documented prescribed amount;
 - For each calculated measure type (e.g., windows, insulation), identify statistical outliers.
- **Continue to review rules and procedures for assigning or calculating therms in the database to ensure that they are consistent with engineering-established rules and procedures.**

Limited-Income Program

We repeat the following recommendations to increase the accuracy of engineering calculations and reporting for the limited-income measures:

- **Review the calculation methodologies used by all CAPs to ensure that there is consistency across the various agencies and that energy savings are being calculated correctly.**
- **Request that all necessary baseline information be recorded and maintained by the agencies.** This will permit greater accuracy for future evaluations or checks that Avista may choose to do throughout the year. We found multiple cases for which important baseline information – such as insulation square feet, house volume, R-values, and U-factors – was not recorded in the customer files and had to be requested separately.

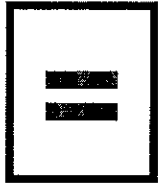
Nonresidential Program

Regarding the nonresidential program, we repeat the following recommendations to increase the accuracy of engineering calculations and reporting:



- **Increase documentation of baseline and retrofit equipment, including model numbers, efficiencies, and shell information.** This will allow for more accurate verification of reported energy savings values.
- **Complete a separate evaluation of PECO's *AirCare Plus* program to determine the accuracy of reported energy savings.**
- **Further investigate the prescriptive values assigned for demand controlled ventilation.**





APPENDICES

APPENDIX A: CASE-BY-CASE RESULTS

APPENDIX B: SUMMARY DATA BY YEAR AND STRATUM

**APPENDIX C: RESIDENTIAL AND LIMITED-INCOME
DOCUMENTATION PROBLEMS**

APPENDIX D: LARGEST NONRESIDENTIAL PROJECTS



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APPENDICES



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VERIFICATION OF 2006-2008 NATURAL GAS DSM ENERGY SAVINGS: WASHINGTON AND IDAHO PROGRAMS



CASE-BY-CASE RESULTS

RESIDENTIAL PROGRAM

Table A.1: Case-by-Case Results for Residential Program, 2006-2008

YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
STRATUM 1 (WINDOWS)						
2008	130105627	G NEW WINDOWS	3	233	216	17
2008	330110683	G NEW WINDOWS	1	58	58	0
2008	749236	G REPLC WINDOWS	1	5	5	0
2008	900346	G REPLC WINDOWS	1	107	110	-3
2008	911234	G REPLC WINDOWS	1	113	115	-2
2008	1405090	G REPLC WINDOWS	1	146	146	0
2008	1816320	G REPLC WINDOWS	1	73	75	-2
2008	1819913	G REPLC WINDOWS	1	12	50	-38
2008	2013594	G REPLC WINDOWS	1	28	0	28
2008	2314513	G REPLC WINDOWS	1	224	230	-6
2008	2427017	G REPLC WINDOWS	1	103	105	-2
2008	2514412	G REPLC WINDOWS	1	45	46	-1
2008	2541696	G REPLC WINDOWS	1	33	36	-3
2008	50035090	G REPLC WINDOWS	1	19	20	-1
2008	50078584	G REPLC WINDOWS	1	64	64	0
2008	90052513	G REPLC WINDOWS	1	32	33	-1
2008	130028887	G REPLC WINDOWS	1	6	6	0
2008	130059256	G REPLC WINDOWS	1	58	59	-1
2008	130110926	G REPLC WINDOWS	1	108	111	-3
2008	130114051	G REPLC WINDOWS	1	199	204	-5
2008	170054344	G REPLC WINDOWS	1	50	52	-2
2008	210015443	G REPLC WINDOWS	1	21	22	-1

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2008	210090202	G REPLC WINDOWS	1	51	106	-55
2008	210116978	G REPLC WINDOWS	1	195	200	-5
2008	290015455	G REPLC WINDOWS	1	37	56	-19
2008	290059881	G REPLC WINDOWS	1	200	205	-5
2008	370030730	G REPLC WINDOWS	1	90	92	-2
2008	370045711	G REPLC WINDOWS	1	41	42	-1
2008	450113567	G REPLC WINDOWS	1	71	73	-2
2008	490099788	G REPLC WINDOWS	3	171	103	68
2008	490114602	G REPLC WINDOWS	1	104	99	5
2008	530014517	G REPLC WINDOWS	1	8	9	-1
2008	570063063	G REPLC WINDOWS	1	142	146	-4
2008	610030788	G REPLC WINDOWS	1	47	48	-1
2008	610042803	G REPLC WINDOWS	1	676	693	-17
2008	650091986	G REPLC WINDOWS	1	46	51	-5
2008	690015813	G REPLC WINDOWS	1	355	364	-9
2008	730023438	G REPLC WINDOWS	1	16	17	-1
2008	730047728	G REPLC WINDOWS	1	41	43	-2
2008	730090423	G REPLC WINDOWS	1	187	192	-5
2008	770081573	G REPLC WINDOWS	1	23	25	-2
2007	170096666	G NEW WINDOWS	1	45	45	0
2007	250109418	G NEW WINDOWS	5	100	0	100
2007	450096382	G NEW WINDOWS	1	43	43	0
2007	570103547	G NEW WINDOWS	1	114	110	4
2007	730099205	G NEW WINDOWS	1	110	110	0
2007	730103964	G NEW WINDOWS	1	71	71	0
2007	640593	G REPLC WINDOWS	1	57	107	-50
2007	902365	G REPLC WINDOWS	3	116	70	46
2007	1010248	G REPLC WINDOWS	3	57	53	4
2007	1010427	G REPLC WINDOWS	3	45	19	26
2007	1100553	G REPLC WINDOWS	1	134	135	-1
2007	1304539	G REPLC WINDOWS	1	7	7	0

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2007	1809816	G REPLC WINDOWS	3	137	101	36
2007	2501240	G REPLC WINDOWS	1	27	27	0
2007	2521063	G REPLC WINDOWS	1	59	59	0
2007	10032460	G REPLC WINDOWS	1	25	25	0
2007	10058093	G REPLC WINDOWS	1	87	88	-1
2007	10098464	G REPLC WINDOWS	1	33	33	0
2007	10110915	G REPLC WINDOWS	1	43	44	-1
2007	50101779	G REPLC WINDOWS	1	134	135	-1
2007	90036387	G REPLC WINDOWS	1	11	12	-1
2007	130019678	G REPLC WINDOWS	1	108	114	-6
2007	170102118	G REPLC WINDOWS	1	22	23	-1
2007	210039444	G REPLC WINDOWS	3	49	44	5
2007	210095159	G REPLC WINDOWS	1	37	38	-1
2007	210105923	G REPLC WINDOWS	1	63	63	0
2007	250029773	G REPLC WINDOWS	1	9	9	0
2007	250106035	G REPLC WINDOWS	1	62	79	-17
2007	330073965	G REPLC WINDOWS	1	64	127	-63
2007	330104627	G REPLC WINDOWS	1	64	64	0
2007	370004701	G REPLC WINDOWS	1	55	55	0
2007	370024438	G REPLC WINDOWS	1	67	66	1
2007	370104699	G REPLC WINDOWS	1	45	44	1
2007	450082177	G REPLC WINDOWS	2	286	---	---
2007	450103766	G REPLC WINDOWS	1	269	293	-24
2007	450104855	G REPLC WINDOWS	1	42	42	0
2007	690105505	G REPLC WINDOWS	1	100	101	-1
2007	730009786	G REPLC WINDOWS	1	34	34	0
2007	770042729	G REPLC WINDOWS	1	341	341	0
2007	770077733	G REPLC WINDOWS	1	72	73	-1
2006	1269	G NEW WINDOWS	2	17	---	---
2006	3018	G NEW WINDOWS	1	147	147	0
2006	3298	G NEW WINDOWS	2	21	---	---

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2006	115	G REPLC WINDOWS	2	41	---	---
2006	418	G REPLC WINDOWS	1	52	1	51
2006	641	G REPLC WINDOWS	1	133	133	0
2006	768	G REPLC WINDOWS	1	33	33	0
2006	985	G REPLC WINDOWS	1	40	40	0
2006	1214	G REPLC WINDOWS	1	83	83	0
2006	1335	G REPLC WINDOWS	1	27	28	-1
2006	1621	G REPLC WINDOWS	1	17	18	-1
2006	1787	G REPLC WINDOWS	1	13	13	0
2006	1813	G REPLC WINDOWS	1	60	60	0
2006	1869	G REPLC WINDOWS	1	27	28	-1
2006	1940	G REPLC WINDOWS	1	42	43	-1
2006	2118	G REPLC WINDOWS	2	12	---	---
2006	2173	G REPLC WINDOWS	1	92	92	0
2006	2232	G REPLC WINDOWS	1	15	15	0
2006	2271	G REPLC WINDOWS	1	12	12	0
2006	2373	G REPLC WINDOWS	3	53	43	10
2006	2441	G REPLC WINDOWS	1	17	17	0
2006	2588	G REPLC WINDOWS	1	37	37	0
2006	2745	G REPLC WINDOWS	2	71	---	---
2006	2959	G REPLC WINDOWS	1	36	36	0
2006	2975	G REPLC WINDOWS	2	59	---	---
2006	3161	G REPLC WINDOWS	1	32	32	0
2006	3248	G REPLC WINDOWS	1	76	76	0
STRATUM 2 (INSULATION)						
2008	523399	G INS - CEIL/ATTIC	1	69	92	0 ¹
2008	720435	G INS - CEIL/ATTIC	1	83	83	0
2008	1307535	G INS - CEIL/ATTIC	1	90	90	0
2008	1400618	G INS - CEIL/ATTIC	1	61	61	0
2008	1603972	G INS - CEIL/ATTIC	1	126	126	0
2008	1700346	G INS - CEIL/ATTIC	1	97	97	0
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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2008	2001884	G INS - CEIL/ATTIC	1	119	119	0
2008	2012853	G INS - CEIL/ATTIC	1	123	123	0
2008	2108083	G INS - CEIL/ATTIC	1	115	190	0
2008	2128788	G INS - CEIL/ATTIC	1	90	90	0
2008	2220479	G INS - CEIL/ATTIC	1	99	107	0
2008	50033708	G INS - CEIL/ATTIC	1	130	130	0
2008	130062327	G INS - CEIL/ATTIC	1	155	155	0
2008	170096640	G INS - CEIL/ATTIC	1	140	140	0
2008	210037823	G INS - CEIL/ATTIC	1	81	81	0
2008	250037865	G INS - CEIL/ATTIC	1	98	98	0
2008	250050319	G INS - CEIL/ATTIC	1	5	86	0
2008	250109879	G INS - CEIL/ATTIC	1	0	32	0
2008	290090682	G INS - CEIL/ATTIC	1	126	126	0
2008	330036984	G INS - CEIL/ATTIC	1	137	137	0
2008	330063510	G INS - CEIL/ATTIC	1	111	111	0
2008	490040898	G INS - CEIL/ATTIC	1	10	105	0
2008	530010428	G INS - CEIL/ATTIC	1	83	83	0
2008	530099927	G INS - CEIL/ATTIC	1	65	140	0
2008	570038040	G INS - CEIL/ATTIC	1	113	113	0
2008	650097867	G INS - CEIL/ATTIC	1	32	69	0
2008	650103914	G INS - CEIL/ATTIC	1	73	73	0
2008	650108560	G INS - CEIL/ATTIC	1	74	74	0
2008	690093398	G INS - CEIL/ATTIC	1	144	144	0
2008	730091467	G INS - CEIL/ATTIC	1	72	72	0
2008	1810351	G INS - FLOOR	1	69	69	0
2008	2517736	G INS - FLOOR	1	62	62	0
2008	170068210	G INS - FLOOR	1	304	304	0
2008	530004884	G INS - FLOOR	1	118	118	0
2008	570104078	G INS - FLOOR	1	156	264	0
2008	690105496	G INS - FLOOR	1	214	214	0
2008	1708836	G INS - WALL	1	227	227	0

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2008	1713377	G INS - WALL	1	264	579	0
2008	2305625	G INS - WALL	1	231	231	0
2008	2517736	G INS - WALL	1	164	164	0
2008	10027146	G INS - WALL	1	136	136	0
2008	90072816	G INS - WALL	1	186	186	0
2008	170106674	G INS - WALL	2	109	---	---
2008	330074670	G INS - WALL	1	62	62	0
2008	410067679	G INS - WALL	3	527	338	189
2008	650113988	G INS - WALL	1	43	43	0
2008	730044284	G INS - WALL	1	318	318	0
2008	730107653	G INS - WALL	1	203	379	0
2008	770075490	G INS - WALL	1	167	372	0
2007	818909	G INS - CEIL/ATTIC	1	40	40	0
2007	1120809	G INS - CEIL/ATTIC	1	71	71	0
2007	1611797	G INS - CEIL/ATTIC	1	50	50	0
2007	1618060	G INS - CEIL/ATTIC	1	40	40	0
2007	1819186	G INS - CEIL/ATTIC	1	48	48	0
2007	2012487	G INS - CEIL/ATTIC	5	76	0	76
2007	2401897	G INS - CEIL/ATTIC	1	49	49	0
2007	50098623	G INS - CEIL/ATTIC	1	36	36	0
2007	90063925	G INS - CEIL/ATTIC	1	28	28	0
2007	90082345	G INS - CEIL/ATTIC	1	50	50	0
2007	170102792	G INS - CEIL/ATTIC	1	48	48	0
2007	290098926	G INS - CEIL/ATTIC	1	46	46	0
2007	290100491	G INS - CEIL/ATTIC	1	45	45	0
2007	330039815	G INS - CEIL/ATTIC	1	63	63	0
2007	330103865	G INS - CEIL/ATTIC	1	32	32	0
2007	410093226	G INS - CEIL/ATTIC	2	66	---	---
2007	450051398	G INS - CEIL/ATTIC	1	122	122	0
2007	450073257	G INS - CEIL/ATTIC	1	38	38	0
2007	450101648	G INS - CEIL/ATTIC	1	98	98	0

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2007	490099973	G INS - CEIL/ATTIC	1	50	50	0
2007	570068423	G INS - CEIL/ATTIC	1	71	71	0
2007	570070462	G INS - CEIL/ATTIC	1	47	47	0
2007	690043710	G INS - CEIL/ATTIC	2	32	---	---
2007	690083912	G INS - CEIL/ATTIC	1	84	84	0
2007	690088948	G INS - CEIL/ATTIC	1	67	67	0
2007	730087620	G INS - CEIL/ATTIC	1	45	45	0
2007	770098626	G INS - CEIL/ATTIC	3	28	26	2
2007	1304539	G INS - FLOOR	1	75	75	0
2007	210094205	G INS - FLOOR	1	255	255	0
2007	250109186	G INS - FLOOR	1	223	223	0
2007	690012320	G INS - FLOOR	1	151	151	0
2007	826687	G INS - WALL	1	25	25	0
2007	90053146	G INS - WALL	3	282	71	211
2007	90096656	G INS - WALL	1	346	346	0
2007	210086578	G INS - WALL	1	191	191	0
2007	290104103	G INS - WALL	1	374	374	0
2007	450093242	G INS - WALL	1	217	217	0
2007	570046914	G INS - WALL	1	203	82	121
2007	570102581	G INS - WALL	1	492	492	0
2007	690096414	G INS - WALL	1	84	84	0
2006	93	G FIREPLACE DAMPER	4	616	336	280
2006	570	G INS - CEIL/ATTIC	1	42	42	0
2006	722	G INS - CEIL/ATTIC	1	4	4	0
2006	1444	G INS - CEIL/ATTIC	1	50	50	0
2006	1674	G INS - CEIL/ATTIC	1	32	32	0
2006	1874	G INS - CEIL/ATTIC	1	102	102	0
2006	2076	G INS - CEIL/ATTIC	1	50	50	0
2006	2277	G INS - CEIL/ATTIC	1	54	54	0
2006	2793	G INS - CEIL/ATTIC	1	59	59	0
2006	2795	G INS - CEIL/ATTIC	1	83	83	0
						continued



YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2006	3048	G INS - CEIL/ATTIC	1	33	33	0
2006	1357	G INS - FLOOR	1	332	332	0
2006	3002	G INS - FLOOR	2	233	---	---
2006	1680	G INS - WALL	1	334	334	0
STRATUM 3 (FURNACES/BOILERS)						
2008	2425504	G HE FURNACE	1	123	123	0
2008	50110983	G HE FURNACE	1	123	123	0
2008	90113852	G HE FURNACE	1	123	123	0
2008	570084344	G HE FURNACE	1	123	123	0
2008	610104014	G HE FURNACE	1	123	123	0
2007	130070564	G HE BOILER	5	72	0	72
2007	170026002	G HE BOILER	1	72	72	0
2007	570092576	G HE BOILER	1	72	72	0
2007	827101	G HE FURNACE	1	72	72	0
2007	250050451	G HE FURNACE	1	72	72	0
2007	450097090	G HE FURNACE	1	72	72	0
2007	610033739	G HE FURNACE	1	72	72	0
2006	326	G HE FURNACE	1	72	72	0
2006	404	G HE FURNACE	1	72	72	0
2006	470	G HE FURNACE	1	72	72	0
2006	475	G HE FURNACE	1	72	72	0
2006	548	G HE FURNACE	1	72	72	0
2006	589	G HE FURNACE	1	72	72	0
2006	688	G HE FURNACE	1	72	72	0
2006	869	G HE FURNACE	1	72	72	0
2006	877	G HE FURNACE	1	72	72	0
2006	879	G HE FURNACE	1	72	72	0
2006	959	G HE FURNACE	1	72	72	0
2006	1024	G HE FURNACE	1	72	72	0
2006	1113	G HE FURNACE	1	72	72	0
2006	1251	G HE FURNACE	1	72	72	0

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2006	1310	G HE FURNACE	1	72	72	0
2006	1590	G HE FURNACE	1	72	72	0
2006	1709	G HE FURNACE	1	72	72	0
2006	1744	G HE FURNACE	1	72	72	0
2006	2313	G HE FURNACE	1	72	72	0
2006	2375	G HE FURNACE	1	72	72	0
2006	2816	G HE FURNACE	1	72	72	0
2006	2884	G HE FURNACE	1	72	72	0
2006	3091	G HE FURNACE	1	72	72	0
2006	3204	G HE FURNACE	1	72	72	0
STRATUM 4 (OTHER)						
2008	250109943	E ESTAR HOME ELEC/GAS	1	197	197	0
2008	1003123	G ES CLOTHES WASHER	1	9	9	0
2008	2538861	G ES CLOTHES WASHER	1	9	9	0
2008	2566027	G ES CLOTHES WASHER	1	9	9	0
2008	210052002	G ES CLOTHES WASHER	1	9	9	0
2008	450112230	G ES CLOTHES WASHER	1	9	9	0
2008	730036067	G ES CLOTHES WASHER	1	9	9	0
2008	1310695	G ES DISHWASHER	1	5	5	0
2008	2119383	G ES DISHWASHER	1	5	5	0
2008	10042919	G ES DISHWASHER	1	5	5	0
2008	290070765	G ES DISHWASHER	1	5	5	0
2008	370110028	G ES DISHWASHER	1	5	5	0
2008	570052854	G ES DISHWASHER	1	5	5	0
2008	730117983	G ES DISHWASHER	4	5	9	-4
2008	1302215	G HE WH 50G	1	11	11	0
2008	10113078	G HE WH 50G	1	11	11	0
2007	90110207	E STAR HOMES	1	197	197	0
2007	1002154	G HE WH 40G	1	11	11	0
2007	1611094	G HE WH 40G	1	11	11	0
2007	210104187	G HE WH 40G	1	11	11	0
						continued



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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2007	1112720	G HE WH 50G	5	8	0	8
2007	2400928	G HE WH 50G	1	8	8	0
2007	130047730	G HE WH 50G	5	8	0	8
2007	210103749	G HE WH 50G	5	8	0	8
2007	250108153	G HE WH 50G	1	8	8	0
2007	450006577	G HE WH 50G	1	8	8	0
2006	1497	E STAR HOMES	4	197	0	197
2006	110	G HE WH 40G	4	11	8	3
2006	861	G HE WH 40G	5	11	0	11
2006	2288	G HE WH 40G	1	11	11	0
2006	121	G HE WH 50G	1	8	8	0
2006	1083	G HE WH 50G	1	8	8	0
2006	1811	G HE WH 50G	1	8	8	0

¹ It is common practice to purchase more insulation than needed, and then later return the excess insulation to the vendor. Therefore, when receipts and invoices documented more insulation than the rebate form, we assumed the difference was excess insulation that was unused and accepted the value recorded on the rebate form.



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LIMITED INCOME PROGRAM

Table A.2: Case-by-Case Results for Limited-Income Program, 2006-2008

YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
STRATUM 1 (INSULATION)						
2008	737907	G INS - CEIL/ATTIC	1	52	54	-2
2008	1806968	G INS - CEIL/ATTIC	1	438	95	343
2008	290074666	G INS - CEIL/ATTIC	1	184	25	159
2008	290104977	G INS - CEIL/ATTIC	1	54	102	-48
2008	530103226	G INS - CEIL/ATTIC	1	294	193	101
2008	770005654	G INS - DUCT	1	50	23	27
2008	1608742	G INS - FLOOR	1	168	121	47
2008	2000620	G INS - FLOOR	1	64	55	9
2008	170073090	G INS - FLOOR	1	129	51	78
2008	410102770	G INS - FLOOR	1	327	194	133
2008	490094768	G INS - FLOOR	1	61	140	-79
2008	619613	G INS - WALL	1	139	152	-13
2008	1309461	G INS - WALL	1	81	89	-8
2008	2000620	G INS - WALL	1	155	169	-14
2008	410031001	G INS - WALL	1	198	217	-19
2008	570065039	G INS - WALL	1	209	229	-20
2008	650096884	G INS - WALL	1	129	170	-41
2007	826887	G INS - CEIL/ATTIC	1	75	119	-44
2007	2545868	G INS - CEIL/ATTIC	1	244	39	205
2007	370047443	G INS - CEIL/ATTIC	1	466	236	230
2007	370065566	G INS - CEIL/ATTIC	1	197	236	-39
2007	490080502	G INS - CEIL/ATTIC	1	390	197	193
2007	690093567	G INS - CEIL/ATTIC	1	168	20	148
2007	730060565	G INS - CEIL/ATTIC	1	372	75	297
2007	770080472	G INS - CEIL/ATTIC	1	0	62	-62
2007	290078749	G INS - DUCT	1	2	168	-166

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2007	1224570	G INS - FLOOR	1	73	212	-139
2007	10078121	G INS - FLOOR	1	83	74	9
2007	10095781	G INS - FLOOR	1	7	20	-13
2007	450079399	G INS - WALL	1	164	179	-15
2007	690078482	G INS - WALL	1	191	209	-18
2007	690095215	G INS - WALL	1	135	148	-13
2006	8	G INS - CEIL/ATTIC	1	41	33	8
2006	17	G INS - CEIL/ATTIC	1	187	188	-1
2006	101	G INS - CEIL/ATTIC	1	308	68	240
2006	168	G INS - CEIL/ATTIC	1	137	30	107
2006	171	G INS - CEIL/ATTIC	1	271	240	31
2006	274	G INS - CEIL/ATTIC	1	354	435	-81
2006	301	G INS - CEIL/ATTIC	1	395	484	-89
2006	349	G INS - CEIL/ATTIC	1	302	141	161
2006	350	G INS - CEIL/ATTIC	1	319	58	261
2006	392	G INS - CEIL/ATTIC	1	299	79	220
2006	418	G INS - CEIL/ATTIC	1	375	108	267
2006	72	G INS - FLOOR	1	54	99	-45
2006	80	G INS - FLOOR	1	203	287	-84
2006	83	G INS - FLOOR	1	215	183	32
2006	175	G INS - FLOOR	1	80	91	-11
2006	315	G INS - FLOOR	1	86	82	4
2006	319	G INS - FLOOR	1	74	101	-27
2006	372	G INS - FLOOR	1	92	134	-42
2006	32	G INS - WALL	1	146	213	-67
2006	117	G INS - WALL	1	19	22	-3
2006	172	G INS - WALL	1	164	239	-75
2006	305	G INS - WALL	1	218	287	-69
2006	415	G INS - WALL	1	146	213	-67
STRATUM 2 (AIR INFILTRATION)						
2008	705022	G AIR INFILTRATION	1	188	100	88

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2008	1807678	G AIR INFILTRATION	1	163	87	76
2008	1815747	G AIR INFILTRATION	1	18	10	8
2008	2207931	G AIR INFILTRATION	1	65	35	30
2008	10099184	G AIR INFILTRATION	1	82	43	39
2008	250100535	G AIR INFILTRATION	1	8	10	-2
2008	370064522	G AIR INFILTRATION	1	76	41	35
2008	370093616	G AIR INFILTRATION	1	31	35	-4
2008	450009013	G AIR INFILTRATION	1	53	28	25
2008	530036695	G AIR INFILTRATION	1	197	105	92
2008	530052564	G AIR INFILTRATION	1	14	17	-3
2008	570078060	G AIR INFILTRATION	1	104	68	36
2008	570087112	G AIR INFILTRATION	1	109	58	51
2008	610103136	G AIR INFILTRATION	1	13	7	6
2008	650087567	G AIR INFILTRATION	1	200	107	93
2008	650095327	G AIR INFILTRATION	1	24	28	-4
2008	770110190	G AIR INFILTRATION	1	46	61	-15
2007	827855	G AIR INFILTRATION	1	33	53	-20
2007	1716754	G AIR INFILTRATION	1	49	75	-26
2007	50040746	G AIR INFILTRATION	1	90	67	23
2007	210103112	G AIR INFILTRATION	1	113	196	-83
2007	290067981	G AIR INFILTRATION	1	90	67	23
2007	290078749	G AIR INFILTRATION	1	7	11	-4
2007	330063253	G AIR INFILTRATION	1	107	80	27
2007	330096551	G AIR INFILTRATION	1	175	131	44
2007	370088734	G AIR INFILTRATION	1	80	121	-41
2007	490069605	G AIR INFILTRATION	1	20	27	-7
2007	490075311	G AIR INFILTRATION	1	195	147	48
2007	570085190	G AIR INFILTRATION	1	72	53	19
2007	650021131	G AIR INFILTRATION	1	56	42	14
2007	650091938	G AIR INFILTRATION	1	162	121	41
2007	770097042	G AIR INFILTRATION	1	92	58	34

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2006	47	G AIR INFILTRATION	1	198	148	50
2006	54	G AIR INFILTRATION	1	122	132	-10
2006	113	G AIR INFILTRATION	1	168	125	43
2006	119	G AIR INFILTRATION	1	34	25	9
2006	136	G AIR INFILTRATION	1	57	42	15
2006	137	G AIR INFILTRATION	1	45	45	0
2006	159	G AIR INFILTRATION	1	37	34	3
2006	172	G AIR INFILTRATION	1	47	35	12
2006	173	G AIR INFILTRATION	1	72	54	18
2006	189	G AIR INFILTRATION	1	32	23	9
2006	190	G AIR INFILTRATION	1	86	65	21
2006	200	G AIR INFILTRATION	1	23	23	0
2006	250	G AIR INFILTRATION	1	158	118	40
2006	265	G AIR INFILTRATION	1	276	206	70
2006	271	G AIR INFILTRATION	1	332	327	5
2006	277	G AIR INFILTRATION	1	66	64	2
2006	314	G AIR INFILTRATION	1	41	45	-4
2006	351	G AIR INFILTRATION	1	63	47	16
2006	356	G AIR INFILTRATION	1	14	13	1
2006	369	G AIR INFILTRATION	1	115	86	29
2006	392	G AIR INFILTRATION	1	52	39	13
2006	427	G AIR INFILTRATION	1	14	13	1
STRATUM 3 (ENERGY STAR® WINDOWS AND DOORS)						
2008	1715727	G ENERGY STAR DOORS	1	14	14	0
2008	50103544	G ENERGY STAR DOORS	1	164	185	-21
2008	170107102	G ENERGY STAR DOORS	1	124	131	-7
2008	290085948	G ENERGY STAR DOORS	1	65	64	1
2008	330108201	G ENERGY STAR DOORS	1	94	99	-5
2008	410103913	G ENERGY STAR DOORS	1	124	129	-5
2008	570016928	G ENERGY STAR DOORS	1	329	78	251
2008	770041467	G ENERGY STAR DOORS	1	182	201	-19
continued						



YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2008	2217957	G ENERGY STAR WINDOWS	1	233	258	-25
2008	130012830	G ENERGY STAR WINDOWS	1	29	31	-2
2008	250105753	G ENERGY STAR WINDOWS	1	441	463	-22
2008	410089369	G ENERGY STAR WINDOWS	1	39	39	0
2008	570016928	G ENERGY STAR WINDOWS	1	5	25	-20
2007	827855	G ENERGY STAR DOORS	1	66	53	13
2007	1332240	G ENERGY STAR DOORS	1	24	92	-68
2007	10101669	G ENERGY STAR DOORS	1	22	89	-67
2007	90055315	G ENERGY STAR DOORS	1	66	89	-23
2007	690095537	G ENERGY STAR DOORS	1	55	80	-25
2007	740957	G ENERGY STAR WINDOWS	1	119	55	64
2007	1224570	G ENERGY STAR WINDOWS	1	287	212	75
2007	290064106	G ENERGY STAR WINDOWS	1	13	13	0
2007	410064696	G ENERGY STAR WINDOWS	1	44	39	5
2007	410084077	G ENERGY STAR WINDOWS	1	279	401	-122
2007	490099116	G ENERGY STAR WINDOWS	1	375	550	-175
2007	650036327	G ENERGY STAR WINDOWS	1	45	65	-20
2006	234	G ENERGY STAR WINDOWS	1	163	55	108
2006	289	G ENERGY STAR WINDOWS	1	111	65	46
2006	401	G ENERGY STAR WINDOWS	1	50	86	-36
STRATUM 4 (ALL OTHER MEASURES)						
2008	1715727	G HE FURNACE	1	73	64	9
2008	1917318	G HE FURNACE	1	230	250	-20
2008	10109658	G HE FURNACE	1	123	123	0
2008	90054359	G HE FURNACE	1	123	123	0
2008	410096429	G HE FURNACE	1	123	123	0
2008	570004563	G HE FURNACE	1	140	123	17
2008	570114369	G HE FURNACE	1	123	123	0
2008	650082824	G HE FURNACE	1	150	123	27
2008	690052738	G HE FURNACE	1	123	123	0
2008	770095216	G HE FURNACE	1	123	123	0

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2008	570114369	G HE WH 40G	1	8	8	0
2008	770005654	G HE WH 40G	1	8	8	0
2008	770112073	G HE WH 40G	1	8	8	0
2008	10099750	G HE WH 50G	1	11	11	0
2008	130084650	G HE WH 50G	1	11	11	0
2008	170081931	G HHS	1	12	12	0
2008	2127804	HEALTH & HUMAN SAFETY	1	5	5	0
2008	50096218	HEALTH & HUMAN SAFETY	1	4	4	0
2008	530109803	HEALTH & HUMAN SAFETY	1	1	2	-1
2008	570078060	HEALTH & HUMAN SAFETY	1	61	60	1
2008	610019574	HEALTH & HUMAN SAFETY	1	9	5	4
2007	826887	G HE FURNACE	1	184	119	65
2007	1128844	G HE FURNACE	1	348	105	243
2007	2119686	G HE FURNACE	1	72	105	-33
2007	50032298	G HE FURNACE	1	75	107	-32
2007	170088691	G HE FURNACE	1	50	119	-69
2007	330101145	G HE FURNACE	1	72	101	-29
2007	450100133	G HE FURNACE	1	72	105	-33
2007	450108853	G HE FURNACE	1	75	141	-66
2007	650075521	G HE FURNACE	1	298	105	193
2007	690074383	G HE FURNACE	1	72	141	-69
2007	1508613	G HE WH 40G	1	11	8	3
2007	90090201	G HE WH 40G	1	25	8	17
2007	290086632	G HE WH 40G	1	11	8	3
2007	1109368	G HE WH 50G	1	8	11	-3
2007	1609944	G HE WH 50G	1	8	11	-3
2007	1706937	G HE WH 50G	1	8	11	-3
2007	10092900	G HE WH 50G	1	8	11	-3
2007	330018934	G HE WH 50G	1	25	11	14
2007	370047443	G HE WH 50G	1	8	11	-3
2006	50	G HE FURNACE	1	72	72	0

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2006	243	G HE FURNACE	1	70	72	-2
2006	272	G HE FURNACE	4	72		
2006	344	G HE FURNACE	1	150	72	78
2006	421	G HE FURNACE	1	150	72	78
2006	229	G HE WH 40G	1	11	11	0
2006	237	G HE WH 40G	1	25	11	14
2006	369	G HE WH 40G	1	11	11	0
2006	1	G HE WH 50G	1	8	8	0
2006	15	G HE WH 50G	1	8	8	0
2006	76	G HE WH 50G	1	25	8	17
2006	135	G HE WH 50G	1	8	8	0
2006	214	G HE WH 50G	1	25	8	17
2006	236	G HE WH 50G	4	25	11	14
2006	279	G HE WH 50G	1	25	8	17
2006	424	G HE WH 50G	1	8	8	0



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NONRESIDENTIAL PROGRAM

Table A.3: Case-by-Case Results for Nonresidential Program, 2006-2008

YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
STRATUM 1 (LARGEST PROJECTS – CENSUS)						
2008	25006	HVAC Combined	1	40,753	47,400	-6,647
2008	26379	HVAC Combined	1	25,771	24,033	1,738
2008	25005	HVAC Combined	1	23,894	8,550	15,344
2008	25056	HVAC Combined	1	18,315	12,659	5,656
2008	22206	HVAC Combined	1	14,305	14,305	0
2008	25032	HVAC Combined	2	14,303	26,003	-11,700
2008	22842	HVAC Combined	1	65,953	68,039	-2,086
2008	25245	HVAC Combined	1	19,647	17,238	2,409
2008	27948	HVAC Combined	1	18,679	18,682	-3
2008	26700	HVAC Combined	1	14,703	14,171	532
2008	26751	HVAC Heating	1	31,300	24,900	6,400
2007	22479	LEED Certification	2	49,553	10,243	39,310
2007	21320	HVAC	1	39,297	43,728	-4,431
2007	24738	HVAC	1	36,059	50,775	-14,716
2007	24825	HVAC	1	31,723	80,915	-49,192
2007	23059	Shell	1	25,884	26,251	-367
2006	19719	HVAC	1	54,332	15,477	38,855
2006	20608	HVAC	2	19,096	---	---
2006	20933	HVAC	1	20,228	21,056	-828
2006	21202	Resource Management	1	71,731	71,731	0
2006	21310	HVAC	1	29,651	21,134	8,517
2006	21314	HVAC	1	27,193	21,754	5,439
STRATUM 2 (PRESCRIPTIVE MEASURES)						
2008	26825	Prescriptive Food Service	1	13	40.4	13
2008	25198	Prescript. Demand Cont. Vent.	1	1855	894	1855
2008	27343	Prescriptive Food Service	1	1463	1230.4	1463
						continued



YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2008	28143	Prescript. Steam Trap Repl.	1	827	265	827
2008	26989	Prescriptive Food Service	1	906	888	906
2008	27106	Prescript. Demand Cont. Vent.	1	7171	3467	7171
2007	25295	Pre-Rinse Sprayer	1	44	44	0
2007	24929	Pre-Rinse Sprayer	1	44	44	0
2007	25166	Pre-Rinse Sprayer	1	44	44	0
2007	24882	Pre-Rinse Sprayer	1	44	44	0
2007	24072	Pre-Rinse Sprayer	1	44	44	0
2006	23016	Pre-Rinse Sprayer	1	176	176	0
2006	23218	Pre-Rinse Sprayer	1	176	176	0
2006	23222	Pre-Rinse Sprayer	1	176	176	0
2006	23265	Pre-Rinse Sprayer	1	352	352	0
2006	23288	Pre-Rinse Sprayer	1	176	176	0
2006	23323	Pre-Rinse Sprayer	1	352	352	0
2006	23345	Pre-Rinse Sprayer	1	176	176	0
2006	23356	Pre-Rinse Sprayer	1	176	176	0
2006	23400	Pre-Rinse Sprayer	1	704	704	0
2006	23436	Pre-Rinse Sprayer	1	176	176	0
2006	23444	Pre-Rinse Sprayer	1	704	704	0
2006	23450	Pre-Rinse Sprayer	1	528	528	0
2006	23453	Pre-Rinse Sprayer	1	176	176	0
2006	23464	Pre-Rinse Sprayer	1	176	176	0
2006	23488	Pre-Rinse Sprayer	1	176	176	0
2006	23732	Pre-Rinse Sprayer	1	528	528	0
2006	23801	Pre-Rinse Sprayer	1	176	176	0
2006	23806	Pre-Rinse Sprayer	1	880	880	0
2006	23818	Pre-Rinse Sprayer	1	176	176	0
2006	23828	Pre-Rinse Sprayer	1	176	176	0
2006	23865	Pre-Rinse Sprayer	1	704	704	0
2006	23868	Pre-Rinse Sprayer	1	528	528	0
2006	23887	Pre-Rinse Sprayer	1	352	352	0
						continued



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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
STRATUM 3 (ALL OTHER MEASURES)						
2008	27262	Appliances	1	700	1031	-331
2008	25927	Appliances	1	1578	1716	-138
2008	25031	HVAC Combined	2	5696	100	5596
2008	25958	HVAC Combined	1	8125	5779.9	2345.1
2008	26366	HVAC Combined	1	259	263	-4
2008	25952	HVAC Combined	1	587	586	1
2008	25881	HVAC Combined	1	611	666	-55
2008	27919	HVAC Combined	1	955	306	649
2008	27229	HVAC Heating	1	397	370.5	26.5
2008	28066	Rooftop Service	2	358	46	312
2008	28065	Rooftop Service	2	12011	3430	8581
2008	27593	Rooftop Service	2	326	275	51
2008	27501	Shell	1	31	24	7
2008	26621	Shell	1	1302	1074	228
2008	25899	Shell	1	80	85	-5
2008	26617	Shell	1	648	534	114
2008	28571	HVAC Heating	1	362	399.8	-37.8
2008	18249	HVAC Combined	1	1051	146.5	904.5
2008	28130	HVAC Heating	1	210	188.5	21.5
2008	27910	HVAC Combined	1	164	205.8	-41.8
2008	28868	Rooftop Service	2	2214	2098	116
2008	28878	Rooftop Service	2	1928	1535	393
2008	28290	Rooftop Service	2	584	459	125
2008	27506	Shell	1	392	394	-2
2008	27533	Shell	1	1614	1614	0
2008	28611	UCON MF Shell	1	648	535.68	112.32
2007	23959	Appliances	2	124	205	-81
2007	22920	HVAC	2	3,755	3,866	-111
2007	22003	HVAC	1	1,427	11,794	-10,367
2007	25628	HVAC	1	2,439	3,235	-796

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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2007	21824	HVAC	2	966	2,742	-1,776
2007	22939	HVAC	1	273	124	149
2007	24106	HVAC	1	203	163	40
2007	22796	HVAC	1	12,524	9,883	2,641
2007	24422	HVAC	1	6,337	6,337	0
2007	24150	HVAC	1	11,494	11,494	0
2007	26030	Rooftop Service	2	1,814	544	1,270
2007	26144	Rooftop Service	2	390	242	148
2007	26283	Rooftop Service	2	103	103	0
2007	25477	Rooftop Service	2	573	231	342
2007	25496	Rooftop Service	2	87	149	-62
2007	26255	Rooftop Service	2	1,220	7	1,213
2007	25254	Rooftop Service	2	777	14	763
2007	25250	Rooftop Service	2	37	74	-37
2007	26011	Rooftop Service	2	93	157	-64
2007	25480	Rooftop Service	2	556	58	498
2007	26226	Rooftop Service	2	751	838	-87
2007	26238	Rooftop Service	2	389	444	-55
2007	26237	Rooftop Service	2	1,895	433	1,462
2007	25269	Rooftop Service	2	6,403	1,174	5,229
2007	24867	Shell	1	905	735	170
2007	22457	Shell	1	235	239	-4
2006	22514	Appliances	1	769	669	100
2006	19629	HVAC	1	319	297	22
2006	20873	HVAC	1	8,159	8,986	-827
2006	21282	HVAC	1	6,798	6,298	500
2006	22019	HVAC	1	3,651	4,170	-519
2006	22417	HVAC	1	1,588	1,574	14
2006	22425	HVAC	1	162	226	-64
2006	23092	Rooftop Service	2	518	1,081	-563
2006	23120	Rooftop Service	2	1,359	327	1,032

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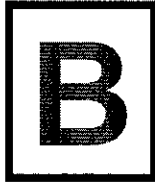


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YEAR	ID #	MEASURE	FINAL DISPOSITION CODE	THERMS		AVISTA MINUS AUDIT
				AVISTA	AUDIT	
2006	23237	Rooftop Service	2	1,428	1,041	387
2006	23549	Rooftop Service	2	145	106	39
2006	23592	Rooftop Service	2	736	1,666	-930
2006	23594	Rooftop Service	2	29	510	-481
2006	7082	Shell	1	4,600	4,600	0
2006	21238	Shell	1	1,028	917	111
2006	21674	Shell	1	93	97	-4
2006	22257	Shell	2	797	---	---
2006	22308	Shell	1	216	247	-31
2006	22492	Shell	1	1,280	1,189	91
2006	22595	Shell	1	220	249	-29
2006	22597	Shell	1	134	125	9
2006	22601	Shell	1	166	154	12
2006	22604	Shell	1	258	351	-93



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SUMMARY DATA BY YEAR AND STRATUM

RESIDENTIAL PROGRAM

Table B.6: Final Disposition of Sampled Residential Cases

YEAR	DISPOSITION	2008 DATA		
		NUMBER OF CASES ¹	PERCENT	90% CONFIDENCE INTERVAL (CI)
2008	1 = Documentation supports input data	106	96.1	95.8 – 96.4
	2 = Insufficient documentation	1	0.2	0.2 – 0.3
	3 = Documentation contradicts input data	3	1.5	1.3 – 1.7
	4 = Measure was incorrectly coded	1	2.1	1.9 – 2.3
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	111	100.0	
2007	1 = Documentation supports input data	81	83.5	82.7 – 84.2
	2 = Insufficient documentation	3	1.9	1.7 – 2.2
	3 = Documentation contradicts input data	7	7.2	6.7 – 7.7
	4 = Measure was incorrectly coded	0	0.0	0.0 – 0.0
	5 = Measure does not qualify for rebate	6	7.4	6.9 – 8.0
	TOTAL	97	100.0	
2006	1 = Documentation supports input data	60	82.0	80.9 – 83.0
	2 = Insufficient documentation	7	12.1	11.2 – 13.0
	3 = Documentation contradicts input data	2	2.9	2.4 – 3.3
	4 = Measure was incorrectly coded	3	2.4	2.0 – 2.8
	5 = Measure does not qualify for rebate	1	0.7	0.4 – 0.9
	TOTAL	73		
2006-2008 Stratum 1	1 = Documentation supports input data	92	84.8	84.6 – 85.1
	2 = Insufficient documentation	7	7.5	7.3 – 7.7
	3 = Documentation contradicts input data	8	6.9	6.7 – 7.0
	4 = Measure was incorrectly coded	0	0.0	0.0 – 0.0
	5 = Measure does not qualify for rebate	1	0.8	0.7 – 0.8
	TOTAL	108		

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YEAR	DISPOSITION	2008 DATA		
		NUMBER OF CASES ¹	PERCENT	90% CONFIDENCE INTERVAL (CI)
2006-2008 Stratum 2	1 = Documentation supports input data	94	88.1	87.9 – 88.4
	2 = Insufficient documentation	4	4.5	4.4 – 4.6
	3 = Documentation contradicts input data	4	4.5	4.4 – 4.6
	4 = Measure was incorrectly coded	1	1.9	1.8 – 2.0
	5 = Measure does not qualify for rebate	1	0.9	0.9 – 1.0
	TOTAL	104		
2006-2008 Stratum 3	1 = Documentation supports input data	35	91.6	91.4 – 91.7
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	3 = Documentation contradicts input data	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	0	0.0	0.0 – 0.0
	5 = Measure does not qualify for rebate	1	8.4	8.3 – 8.6
	TOTAL	36		
2006-2008 Stratum 4	1 = Documentation supports input data	26	72.9	72.6 – 73.2
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	3 = Documentation contradicts input data	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	3	3.4	3.3 – 3.5
	5 = Measure does not qualify for rebate	4	23.7	23.5 – 24.0
	TOTAL	33		
2006-2008 Total (Weighted)	1 = Documentation supports input data	247	88.2	87.9 – 88.4
	2 = Insufficient documentation	11	3.0	2.9 – 3.1
	3 = Documentation contradicts input data	12	3.4	3.3 – 3.5
	4 = Measure was incorrectly coded	4	1.8	1.8 – 1.9
	5 = Measure does not qualify for rebate	7	3.6	3.5 – 3.7
	TOTAL	280 ²	100.0	

¹ For readability, raw (unweighted) counts are shown in the table. However, percentages were based on counts that were weighted to account for differences in the sampling ratios across strata and across program years.

² The number of cases of each disposition sum to 280, not 281, because one case represented both disposition '3' and disposition '4'. If that case had been counted twice, the total would be 281.



Table B.2: Stratum-by-Stratum and Year-by-Year Comparisons of Avista's Reported Residential Therm Savings and the Audit's Values

YEAR/STRATUM	AVISTA MEAN	AUDIT MEAN	MEAN DIFFERENCE		90% CONFIDENCE INTERVAL	RANGE
			VALUE	PERCENT		
2008 PROGRAM YEAR						
Stratum 1	103.4	105.5	-2.2	-2.1	-6.4 – 2.1	-55 – 68
Stratum 2	128.2	150.3	3.9	3.1	-2.5 – 10.3	0 – 189
Stratum 3	123.0	123.0	0.0	0.0	0 – 0	0 – 0
Stratum 4	19.3	19.3	0.0	0.0	-0.5 – 0.5	-4 – 2
Total	83.3	86.9	-0.1	-0.1	-1.4 – 1.3	-55 – 189
2007 PROGRAM YEAR						
Stratum 1	81.1	74.5	1.4	1.7	-4.8 – 7.5	-63 – 100
Stratum 2	109.7	102.1	10.8	9.8	0.3 – 21.3	0 – 211
Stratum 3	72.0	61.7	10.3	14.3	-6.6 – 27.2	0 – 72
Stratum 4	27.8	25.4	2.4	8.6	0.4 – 4.4	0 – 8
Total	79.2	72.2	5.4	6.8	-0.8 – 11.5	-63 – 211
2006 PROGRAM YEAR						
Stratum 1	46.9	47.0	2.7	5.8	-0.8 – 6.3	-1 – 51
Stratum 2	144.6	116.2	21.5	14.9	-12.5 – 55.6	0 – 280
Stratum 3	72.0	72.0	0.0	0.0	0 – 0	0 – 0
Stratum 4	36.3	6.1	30.1	83.1	-15.5 – 75.8	0 – 197
Total	68.3	62.4	6.0	8.8	0.3 – 11.8	-1 – 280
COMBINED 2006-2008 PROGRAM YEARS						
Stratum 1	81.0	81.4	0.2	0.3	-2.5 – 3	-63 – 100
Stratum 2	123.2	127.3	10.9	8.9	0.9 – 20.9	0 – 280
Stratum 3	79.1	77.1	6.7	8.5	-4.3 – 17.7	0 – 72
Stratum 4	25.5	18.3	3.1	12.1	0.2 – 6	-4 – 197
Total	75.3	74.3	3.2	4.3	0.7 – 5.8	-63 – 280



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LIMITED-INCOME PROGRAM

Table B.3: Final Disposition of Sampled Limited-Income Cases

YEAR	DISPOSITION	2008 DATA		
		NUMBER OF CASES ¹	PERCENT	90% CONFIDENCE INTERVAL (CI)
2008	1 = Documentation supports input data	68	100.0	100.0 – 100.0
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	0	0.0	0.0 – 0.0
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	68		
2007	1 = Documentation supports input data	61	100.0	100.0 – 100.0
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	0	0.0	0.0 – 0.0
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	61		
2006	1 = Documentation supports input data	62	98.0	97.6 – 98.4
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	2	2.0	1.6 – 2.4
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	64		
2006-2008 Stratum 1	1 = Documentation supports input data	55	100.0	100.0 – 100.0
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	0	0.0	0.0 – 0.0
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	55		
2006-2008 Stratum 2	1 = Documentation supports input data	54	100.0	100.0 – 100.0
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	0	0.0	0.0 – 0.0
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	54		

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YEAR	DISPOSITION	2008 DATA		
		NUMBER OF CASES ¹	PERCENT	90% CONFIDENCE INTERVAL (CI)
2006-2008 Stratum 3	1 = Documentation supports input data	28	100.0	100.0 – 100.0
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	0	0.0	0.0 – 0.0
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	28		
2006-2008 Stratum 4	1 = Documentation supports input data	54	93.7	93.5 – 93.9
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	2	6.3	6.1 – 6.5
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	56		
2006-2008 Total (Weighted)	1 = Documentation supports input data	191	99.6	99.5 – 99.6
	2 = Insufficient documentation	0	0.0	0.0 – 0.0
	4 = Measure was incorrectly coded	2	0.4	0.4 – 0.5
	5 = Measure does not qualify for rebate	0	0.0	0.0 – 0.0
	TOTAL	193		

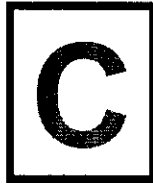
¹ For readability, raw (unweighted) counts are shown in the table. However, percentages were based on counts that were weighted to account for differences in the sampling ratios across strata and across program years.



Table B.4: Stratum-by-Stratum and Year-by-Year Comparisons of Avista's Reported Limited-Income Therm Savings and the Audit's Values

YEAR/STRATUM	AVISTA MEAN	AUDIT MEAN	MEAN DIFFERENCE		90% CONFIDENCE INTERVAL	RANGE
			VALUE	PERCENT		
2008 PROGRAM YEAR						
Stratum 1	160.7	122.3	38.4	31.4	-0.8 – 77.6	-79 – 343
Stratum 2	81.8	49.4	32.4	65.6	18.8 – 46	-15 – 93
Stratum 3	141.8	132.1	9.7	7.3	-19.6 – 39	-25 – 251
Stratum 4	70.0	68.2	1.8	2.6	-0.2 – 3.7	-20 – 27
Total	129.5	98.8	30.7	31.1	9.8 – 51.7	-79 – 343
2007 PROGRAM YEAR						
Stratum 1	171.1	133.0	38.1	28.6	-19.7 – 95.9	-166 – 296.8
Stratum 2	89.4	83.2	6.2	7.4	-8.5 – 20.9	-83.4 – 48.5
Stratum 3	116.3	144.8	-28.5	-19.7	-58.7 – 1.7	-175 – 75.1
Stratum 4	75.3	65.2	10.1	15.5	-14.4 – 34.6	-68.8 – 243.1
Total	133.4	113.8	19.6	17.3	-10.2 – 49.5	-175 – 296.8
2006 PROGRAM YEAR						
Stratum 1	195.0	165.9	29.1	17.6	-9.9 – 68.2	-89.4 – 266.7
Stratum 2	93.3	77.7	15.6	20.1	9.1 – 22	-10 – 69.9
Stratum 3	108.0	68.5	39.5	57.8	-26.5 – 105.5	-35.7 – 108.4
Stratum 4	43.3	25.9	15.5	60.1	5.6 – 25.5	-2 – 78
Total	136.2	113.9	23.7	20.8	4.4 – 43.1	-89.4 – 266.7
COMBINED 2006-2008 PROGRAM YEARS						
Stratum 1	177.9	143.4	35.4	24.7	10.1 – 60.7	-166 – 343
Stratum 2	88.6	70.3	19.2	27.4	12.1 – 26.3	-83.4 – 93
Stratum 3	127.2	130.7	2.2	1.7	-19.4 – 23.8	-175 – 251
Stratum 4	64.1	55.6	10.0	17.9	3.4 – 16.6	-68.8 – 243.1
Total	135.0	112.0	23.6	21.1	10.5 – 36.8	-175 – 343





RESIDENTIAL AND LIMITED-INCOME DOCUMENTATION PROBLEMS

Table C.1: Residential Sample Cases with Documentation Problems, 2006-2008

YEAR	CASE ID	MEASURE TYPE	EXCEPTION
DISPOSITION = 2, "INSUFFICIENT DETAIL"			
2006	115	Replacement Windows	The invoice does not provide any detail on window dimensions or size.
2006	2118	Replacement Windows	The invoice does not provide any detail on window dimensions or size.
2006	2745	Replacement Windows	The invoice does not provide any detail on window dimensions or size.
2006	2975	Replacement Windows	The invoice does not provide any detail on window dimensions or size.
2006	1269	New Windows	No invoice was provided. No other documentation provides detail on window dimensions or size.
2006	3002	Insulation – Wall/Floor	The invoice does not provide any detail on amount of insulation installed.
2006	3298	New Windows	No invoice was provided. No other documentation provides detail on window dimensions or size.
2007	450082177	New Windows	No invoice was provided. Unable to obtain invoice from vendor.
2007	410093226	Insulation - Ceiling/Attic	Invoice does not specify number of square feet covered. Vendor did not return repeat calls.
2007	690043710	Insulation - Ceiling/Attic	Invoice does not specify number of square feet covered. Vendor was not able to provide the data.
2008	170106674	Insulation – Wall/Floor	The invoice did not provide sufficient detail. When contacted, the vendor stated that they installed no insulation at this site.
DISPOSITION = 3, "INVOICE CONTRADICTS REBATE FORM"			
2006	2373	Replacement Windows	Therm savings in Avista data file exceed that calculated from documented window square footage by 19%.
2006	93	Insulation – Duct	The rebate form counts water pipe insulation, in addition to duct insulation, documented on the invoice. As a result, savings in the Avista data file exceeded that calculated from documented insulation linear footage by 46%.
			continued



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YEAR	CASE ID	MEASURE TYPE	EXCEPTION
2007	902365	New Windows	Therm savings in Avista data file exceed that calculated from documented window square footage by 40%.
2007	1010248	New Windows	Therm savings in Avista data file exceed that calculated from documented window square footage by 9%.
DISPOSITION = 3, "INVOICE CONTRADICTS REBATE FORM" (CONTINUED)			
2007	210039444	New Windows	Therm savings in Avista data file exceed that calculated from documented window square footage by 10%.
2007	1809816	New Windows	Therm savings in Avista data file exceed that calculated from documented window square footage by 26%.
2007	1010427	New Windows	Therm savings in Avista data file exceed that calculated from documented window square footage by 58%.
2007	770098626	Insulation - Ceiling/Attic	Therm savings in Avista data file exceed that calculated from documented insulation square footage by 7%.
2007	90053146	Insulation - Wall/Floor	Therm savings in Avista data file exceed that calculated from documented insulation square footage by 75%.
2008	130105627	New Windows	Therm savings in Avista data file exceed that calculated from documented window square footage by 7%.
2008	490099788	Replacement Windows	Therm savings in Avista data file exceed that calculated from documented window square footage by 40%.
2008	410067679	Insulation - Wall/Floor	Therm savings in Avista data file exceed that calculated from documented insulation square footage by 36%.
DISPOSITION = 4, "INCORRECTLY CLASSIFIED"²			
2006	93	Fireplace Damper	The measure was duct insulation, not a fireplace damper.
2006	110	High-Efficiency 40-Gallon Water Heater	Model number on rebate form is for 50-G, not 40-G.
2006	1497	ENERGY STAR [®] Home	The measure was electric, not gas.
2008	730117983	ENERGY STAR [®] Dishwasher	The measure was an ENERGY STAR [®] clothes washer, not dishwasher.
DISPOSITION = 5, "DOES NOT QUALIFY"			
2006	861	High-Efficiency 40-Gallon Water Heater	EF < .60, does not meet standard for rebate.
			continued



YEAR	CASE ID	MEASURE TYPE	EXCEPTION
2007	250109418	Replacement Windows	The invoice indicated U-factors all exceed .35.
2007	2012487	Insulation - Ceiling/Attic	The measure was insulation under siding; does not qualify.
2007	130070564	High-Efficiency Boiler	AFUE < 85%, does not meet standard for rebate
2007	210103749	High-Efficiency 50-Gallon Water Heater	EF < .60, does not meet standard for rebate.
2007	1112720	High-Efficiency 50-Gallon Water Heater	EF < .60, does not meet standard for rebate.
2007	130047730	High-Efficiency 50-Gallon Water Heater	Electric to gas conversion

- 1 In the 2006 report, three additional cases were reported as having documentation that contradicted the rebate form. These were ID 1214, 1787, and 2173. All were cases of replacement windows. A review of all records indicating documentation errors, carried out for this final report, found that all three should have been classified as confirmed because the square footage of windows on the invoice, although differing somewhat from that shown on the rebate form, was within 5%.
- 2 In the 2006 report, two additional cases were reported as having been incorrectly classified. These were ID 121 and ID 1083. In both cases, the rebate form indicated the measure was "High-Efficiency Water Heater 50-gallon" but the invoice stated that they were tankless water heaters. Subsequent discussion with Avista clarified that Avista used the same measure code for both measures, since they both had the same level of prescribed savings. Our engineering review accepted Avista's prescribed savings for both the measures (but recommended a higher level of savings for the tankless water heaters), so there is no reason to consider these as misclassified.



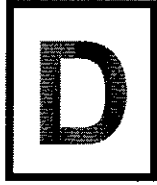
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Table C.2: Limited-Income Sample Cases with Documentation Problems, 2006-2008

YEAR	CASE ID	MEASURE TYPE	EXCEPTION
2006	319	Health & Human Safety	The Avista database recorded 3 therms for <i>Health & Human Safety</i> measures for this case. We received only invoice form screen captures with output data, and no input data. The form indicates that <i>Health & Safety</i> was "N/A", with 0 therms, but a cost of \$154.67.
2006	399	Health & Human Safety	The Avista database recorded 2 therms for <i>Health & Human Safety</i> measures for this case. The invoice form documents <i>Health & Safety</i> expenses, but does not document the measures installed and indicates 0 therm savings.
2006	236	High-Efficiency 50-Gallon Water Heater	The invoice documents a 40-gallon water heater, not a 50-gallon heater.
2006	272	High-Efficiency Furnace	The invoice documents electric to gas conversion, not a high-efficiency gas furnace.
2007	50040746	Air Infiltration	Pre- and post-CFM measurements from the fandoor test do not match the CFM listed on the input forms
2007	570085190	Air Infiltration	Pre- and post-CFM measurements from the fandoor test do not match the CFM listed on the input forms
2007	1128844	High-Efficiency Furnace	Baseline and retrofit efficiencies had to be assumed, and were assumed using AVISTA assumptions for baseline equipment and residential program requirements for retrofit equipment
2007	650075521	High-Efficiency Furnace	Baseline and retrofit efficiencies had to be assumed, and were assumed using AVISTA assumptions for baseline equipment and residential program requirements for retrofit equipment
2007	90090201	High-Efficiency 40-Gallon Water Heater	Available documentation did not provide sufficient input to support the claimed savings, which exceeded the prescriptive amount
2007	330018934	High-Efficiency 50-Gallon Water Heater	Available documentation did not provide sufficient input to support the claimed savings, which exceeded the prescriptive amount



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LARGEST NONRESIDENTIAL PROJECTS

2008 PROGRAM (SIX OF ELEVEN LARGEST PROGRAMS)

As explained in detail in the report body, we initially drew projects to verify from the first three quarters of 2008 so that we could begin the verification audit before the end of the year to meet the strict deadline for completion. When we drew the sample from the first three quarters, we also selected the six largest projects for verification.

Later, when other large projects were provided from the fourth quarter, we identified five projects for which the claimed savings were greater than at least one of the six drawn from the first three quarters. Combined, there were 11 large project candidates. We performed verification analyses on all 11 projects, and we include the results of all 11 analyses in the report body. Below, we describe the 6 largest of those 11 projects.

22842 – Hecla Mining

This project involved several measures such as insulation of steam lines, installation of new hot water boilers, replacement of steam heat exchangers, removal of steam lines, hot water outdoor reset, and insulation of new hot water lines. The savings for the first measure (1F) were recalculated as 8,510 therms, an increase of 2,086 therms. Due to a change in the pipe R-value, the baseline heat loss for the 130-foot steam pipe was recalculated as 608 Btu/hr, higher than the Avista value of 469 Btu/hr. The modified (post verification) savings from the 2nd measure (1G) were accepted as 59,529.

25006 – Kellogg High School

This application involved several upgrades to the HVAC system at the high school, including new high-efficiency boilers, a new chiller, outdoor reset for the hot water and the chilled water. In several areas of the school, fan-coil units and unit ventilators using HW and CHW were installed to replace RTUs using gas furnaces and D/X cooling. In other areas, existing RTUs were replaced with newer, high-efficiency RTUs.

Replicating the savings for this project was difficult, as it involved a very large facility (90,500 sf) with many HVAC systems of varying type and size. For example, the audit report from the ESCO indicated that the school had 10 RTUs, but did not identify the zones served by the RTUs.

Nonetheless, an eQUEST model calibrated to the previous (2003 – 2004 year) energy consumption of was provided and used as a baseline. A new proposed model was supplied and



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compared to the retrofits as documented by the ESCO and Avista. The results show savings of 47,400 therms, a slight increase of the reported value by Avista.

It is worth mentioning that the ESCO project involved several EEMs, of which this application was only one. For large projects like this, it should be recognized that the estimated savings are greatly affected by the order in which the measures are evaluated, due to interactive effects. It is generally recommended that measures be evaluated in the following order—loads (as affected by the envelope), systems, and then plant. This is in accordance with the strategy suggested in the *California Energy Commission's Guide to Preparing Feasibility Studies for Energy Efficiency Projects*. Because the ESCO evaluated the measures in a different order, the savings can vary drastically from one measure to the next.

26751 – Washington Mutual Tower

This project involved the replacement of the existing gas-fired hot water boilers with high-efficiency boilers. The building is a 3-story 75,000 sf office building in Spokane. It was not entirely clear from the documentation what the baseline boiler efficiency should be; Nexant did not change the boiler efficiency in the baseline model. Nexant determined that the savings were 24,900 therms, about 20% less than what was reported by Avista.

26379 – Sandpoint Financial and Technical Center

This project consisted of evaluating different HVAC types compared to the baseline “code-level” system for a new 3-story, 87,000 sf office. The proposed system is a ground-source heat pump. Nexant determined that the savings were 24,033 therms, slightly less than that reported by Avista.

The eQUEST models were generally sound--the largest source of discrepancy comes from the determination of the proper baseline HVAC system. The baseline system selected by Avista was a large multi-zone AHU, which is inherently less efficient than separate packaged single zone RTUs. Selection of packaged single zone equipment shows less consumption in the baseline.

Nexant recommends that in the future, either WESC Appendix RS-29 or ASHRAE 90.1-2004 Appendix G be used to determine the baseline system. Per RS-29, the baseline system would be central VAV with reheat, fan-powered terminals and HW boiler; per Appendix G, the baseline system would be packaged VAV with reheat and HW boiler. Selection of either of these systems as the baseline would yield less therm savings for the proposed system. It is also suggested that the actual internal loads (e.g. lighting, equipment) of the facility be used, as these strongly affect energy consumption; these could not be verified from the documentation.



25005 – Kellogg High School

This project is directly related to Application #25006 described above. The measure investigated is Demand Controlled Ventilation (DCM), which adjusts the outside air (OA) to match the occupancy of the conditioned space. The occupancy of the space is monitored by CO₂ sensors, which are placed in the return air ducts. It should be noted that the savings originally reported by Avista (23,894 therms) were mis-transcribed and did not correspond to the value reported by the ESCO in its report (10,392). Nexant determined that the savings for this measure were 8,550 therms, about 18% less than what was reported by the ESCO.

The eQUEST models seemed basically sound; however it is suggested that the OA cfm requirement per person in the models be reduced to the values published in ASHRAE 62.1—for example, 10 cfm/person (classrooms), 7.5 cfm/person (gymnasium, cafeteria).

25056 – Post Falls City Hall

This application involved a new 3-story, 42,000 sf office building, to be occupied by the City of Post Falls, Idaho. Several different HVAC system types were considered for the facility, as improvements over the baseline system.

As in the case of application #26379 above, the largest source of discrepancy comes from the determination of the proper baseline HVAC system. The baseline system selected by Avista was a large multi-zone AHU, which is inherently less efficient than separate packaged single zone RTUs. Selection of packaged single zone equipment shows less consumption in the baseline.

Nexant recommends that in the future, either WESC Appendix RS-29 or ASHRAE 90.1-2004 Appendix G be used to determine the baseline system. Per RS-29, the baseline system would be packaged rooftop VAV with reheat, fan-powered terminals and HW boiler; per Appendix G, the baseline system would be packaged single zone with D/X cooling and natural gas furnace. Selection of either of these systems as the baseline would yield less therm savings for the proposed system. It is also suggested that the actual internal loads (e.g. lighting, equipment) of the facility be used, as these strongly affect energy consumption; these could not be verified from the documentation.

2007 PROGRAM (FIVE LARGEST PROGRAMS)

24825 – Spokane Valley Mall

This is an extremely large facility, comprising approximately 738,000 square feet. The eQUEST analysis seems generally sound, but it appears that many default settings were used within eQUEST, which could be problematic for a facility of this size.



The default skylight settings caused a warning in eQUEST, as the number of skylights exceeds the maximum allowed. The internal loads seem extremely low. There was no external documentation of many critical components, such as the actual HVAC systems, zoning and internal loads. It is acceptable to go with eQUEST defaults on many construction parameters, but strongly suggest that actual operating schedule and temperature setpoints for the facility be used, as these strongly affect energy consumption.

The baseline eQUEST model (as supplied) over-predicts the actual energy consumption. Consequently, scaling factors (less than 0.2) must be applied to the output to get results close to the actual consumption. Nexant made minor revisions to the model, and reanalyzed this project using a more recent version of eQUEST. Nexant calculated the savings to be significantly larger than that reported by Avista. Because of the large deviation in estimated savings, and because there were a large number of unknown parameters, Nexant recommends that the Avista value be used.

24738 – Saranac Building

This is a new construction project which was seeking LEED certification. The project was analyzed using eQUEST by an ESCO. There are several energy savings features in the proposed design which result in savings over the baseline model. The main source of gas savings was the use of a ground source heat pump system instead of the baseline HVAC system.

The existing eQUEST analysis seems generally sound, but baseline model indicates electric heating, which doesn't seem to correspond with other documentation. The largest source of error comes from the determination of the baseline HVAC system. Per ASHRAE 90.1-2004, the baseline system should be PVAV with hot water gas fired boiler (not electric reheat or furnace as analyzed by the ESCO). Also, the building shell had a few problems (e.g. exterior walls are missing on a portion of roof) and efficiency ratings of heat pumps seem overly optimistic. It is also suggested that actual operating schedule and temperature setpoints for the facility be used, as these strongly affect energy consumption; these could not be verified from the documentation.

Nexant made modifications to the models and recalculated the savings to be 50,775 therms (compared to 36,059 as reported by Avista).

23059 – (Name Withheld, No Release Signed)

The analysis was originally performed using a customized spreadsheet developed by Avista for shell measures. The project consisted of upgraded wall and ceiling insulation for a manufacturing facility.

Nexant re-analyzed the project using its own customized spreadsheet, which entailed an hourly bin analysis using the UA method. Nexant calculated gas therm savings very close to Avista's reported gas savings (about 1% higher than Avista's value).



21320 – Odessa Memorial Hospital

This project was originally evaluated by an ESCO using eQUEST version 3.54. In ECM 1, several changes to the envelope were made, consisting of wall and window upgrades. In ECM 2, several mechanical upgrades were evaluated, including a high efficiency condensing gas boiler, new air handlers, a new DDC control system, and a high efficiency hot water heater.

Nexant reviewed the eQUEST input files and found the models to be solid and consistent with the documentation. However, because Nexant used a more current version of eQUEST (version 3.61e) than originally used, the results are slightly different. It should be noted that the savings are based on the difference between the design and the current Washington *code* requirements, not the *actual* use. Nexant estimates the savings to be 43,728 therms over the modified baseline, compared to 39,297 therms, as reported by Avista.

22479 – Spokane Convention Center

This is a new construction project which was seeking LEED certification. The project was analyzed using Carrier's HAP model by an ESCO. There are several gas and electric energy savings features in the proposed design, which result in kWh and therms savings over the baseline model.

Several HAP model output reports were provided, showing energy consumption before and after various measures. In addition, many of the input parameters were summarized in the LEED documentation. Curiously, the baseline model was based upon ASHRAE 90.1-1999 prescriptive requirements, while it seems as if the 2004 version would have been more applicable.

The key measures evaluated are demand controlled ventilation, domestic hot water reduction (low flow faucets), higher efficiency hot water heaters, a higher efficiency boiler, along with other measures.

For the review, Nexant created an eQUEST model and calibrated the annual gas usage to match the base case gas usage provided by Avista's HAP model. However, because we did not have many of the details of the model (such as the geometry, layout, occupancy, and zoning), our calibration procedure is partially incomplete. Using our eQUEST model, we ran an 8760 hourly analysis to compute the annual gas savings. The results indicated that the savings would be substantially less than that predicted by the HAP tool. This seems to be partly due to the heating hours and occupancy periods used in HAP, which appear too high and not consistent with the documentation. Nexant estimates that the savings would be 10,243 therms, as opposed to 49,553 therms reported by Avista.



2006 PROGRAM (SEVEN LARGEST PROGRAMS)

19719 – Spokane Public Facilities

This is a new construction project. The customer is claiming therms savings for a proposed central heating system in lieu of packaged rooftop units. A Carrier HAP model output summary and the equipment schedule showing the boiler rated heating capacity and efficiency were provided. We also were provided with information pertaining to the DHW heating upgrade, which accounts for 2,033 therms of the 54,332 therms reported.

For the review, we created an *EZ Sim* model and calibrated the annual gas usage to match the base case gas usage provided by Avista's HAP model. However, because we did not have many of the details of the HAP model, our calibration procedure is partially incomplete. Using the estimated boiler heating capacity from our *EZ Sim* model, we ran an hourly temperature bin analysis to compute the annual gas savings.

The energy savings calculated from our analysis are significantly less than Avista's reported value (13,444 therms vs. a reported value of 52,299 therms). We were able to verify the reported energy savings from the DHW heating upgrade and confirmed Avista's reported savings of 2,033 therms. Therefore, our overall calculated savings came to 15,477, approximately 28% of Avista's reported savings.

20608 – Kootenai Medical Center

During our review, we found no documentation or M&V (measurement and verification) conducted to show that the air flow rate is at 12,485 CFM, as reported. Also, there was no documentation to show that at 65% effectiveness, the heat exchanger is able to achieve a 45° F temperature rise, without knowing what the hot and cold fluid streams temperatures are going in and out of the heat exchanger. We deemed an 80% AFUE or thermal efficiency for the gas heater to be a reasonable assumption.

Because of the lack of documentation to validate the stated assumptions for this project, we were unable to verify the project savings.

20933 – Huntwood Industries

During our review, we found no documentation on the size of the heating equipment and no indication that the DDC on/off occupied/unoccupied time schedule has been programmed into the EMCS. We were not able to verify whether the *EZ Sim* model had accurately estimated the required heating load of the building. However, while using the *EZ Sim* estimated heating equipment size, we recalculated the energy savings from the given occupied/unoccupied set points. The results of our analysis were approximately 4% higher than the *EZ Sim* results.



21202 – Spokane Public Schools

This is a special partnership program between Avista and the Spokane Public School District (SPSD), called the *Resource Management Partnership Program* (RMPP), which aims to “promote resource savings and demonstrate the cost effectiveness of improved operations and maintenance within existing facilities... to reduce user-oriented inefficiencies in fuel source consumption...”

We received historical utility data and irrigation reports for all the facilities in the Spokane Public School District. We checked the analysis and found no errors, and therefore we have approved the reported energy savings as submitted.

21310 – East Valley School District

During our review, we found no documentation to support the assumed base case boiler efficiency of 60%. A 60% boiler efficiency was deemed too low and, in the absence of proper documentation, we increased the baseline efficiency. There was also no identifiable reason as to why the W/SF for the DHW heater decreased after reducing the storage tank volume, therefore we revised the proposed 0.25 W/SF back to the base case value of 0.29 W/SF. We used the original *EZ Sim* model with slight modifications to the input parameters, as described above, to obtain our savings value of 21,134 therms, which was about 29% less than Avista’s reported savings of 29,651.

21314 – Triple Play Park (HVAC)

For this measure, we calculated savings using a catalogue-sizing approach – that is, using the manufacturer’s method for unit sizing. We checked this approach against ASHRAE and found it to be reasonably conservative. However, the calculation further divided the recovered energy by heater efficiency of 80%. This is an unnecessary step because this heat did not originate from the pool heater, but rather is the latent heat of vaporization from the dehumidifier. We accepted the assumption of 80% recoverable heat, and our calculated results were about 20% lower than Avista’s reported value.

21542 – Spokane Athletic Club

Avista used *EZ Sim* to model the gas savings from the installation of the new high efficiency burners for two existing boilers. The burners on the existing boilers were being replaced because they were found to be malfunctioning. The facility contacted Avista when they noticed a large increase in utility usage and stated that the boilers were barely able to maintain the space heating and water heating load for the facility. The original energy savings for this project were reported at 17,260 therms, based on the *EZ Sim* model. Avista revised this energy savings amount after reviewing and comparing the customer’s gas usage for the period 10/2005 through 6/2006



against gas usage from one year before (10/2004 through 6/2005). Based on the utility bill data (adjusted for heating degree-days), the energy savings were increased to 110,558 therms.

We have determined that the baseline energy usage must not be based solely on the 10/2004-6/2005 gas billing data, because we believe that during this period the boilers were malfunctioning and operating at an unusually high gas usage rate. Therefore, we evaluated the energy savings based on 2002 and 2003 utility history and calculated energy savings to be approximately 66% lower than Avista's reported savings estimate of 110,558 therms.



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