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Refining Building Energy Modeling through Aggregate Analysis and Probabilistic Methods Associated with Occupant Presence

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Refining Building Energy Modeling through Aggregate Analysis and Probabilistic Methods Associated with Occupant Presence

by

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Refining Building Energy Modeling through Aggregate Analysis and Probabilistic Methods Associated with Occupant Presence

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Abstract

The building sector represents the largest energy consumer among the United States' end use sectors. As a result, the public and private sector will continue to place great emphasis on designing energy efficient buildings that minimize operating costs while maintaining a healthy environment for its occupants. Creating design-phase building energy models can facilitate the process of selecting life-cycle appropriate design strategies aimed at maximizing building energy efficiency.

The primary objective of this research study is to gain greater insight into likely causes of variation between energy predictions derived from building energy models and building energy performance during post-occupancy. Identifying sources of error can be used to improve future modeling efforts that can potentially lead to greater accuracy and better decisions made during the building's design phase.

My research approach is to develop a method for conducting retrospective analysis of building energy models in the areas that affect the building's predicted and actual energy consumption. This entails collecting pre-construction and post-occupancy related data from various entities that exhibit influence on the building's energy performance. The method is then applied to recently-constructed military dormitory

buildings that utilized building energy modeling and now have actual, metered building energy consumption data. The study also examines how building occupancy impacts energy performance.

The value of this work will provide additional insight to future building energy modeling efforts.

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Chapter 1 Introduction

1.1 Background and Research Questions

Today, the building sector represents the largest energy consumer among United States (U.S.) end use sectors. The U.S. Department of Energy (DoE) reported buildings in the U.S. consumed nearly 40% of the nation's total energy in 2011 as compared to nearly 31% and 27% for the industrial and transportation industries, respectively [1]. As buildings continue to consume significant amounts of energy, building owners will continue to place high importance on identifying effective building energy solutions through building energy models. It is therefore important that energy models not only aid design teams in selecting building systems that optimize performance, but also provide reliable estimates of actual energy consumption.

Constructing sustainable and energy efficient buildings is especially important among Federal agencies required by the Energy Policy Act of 2005 to design life-cycle cost-effective buildings that are 30% below energy performance standards established by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) [2]. The reliance on building energy model accuracy, whether to attain compliance with federal mandates or maintain building operational costs within budget, underscores the importance of conducting retrospective analysis on past energy models. By comparing building energy models to actual building and building performance data to identify potential sources of model error, future modeling efforts can be improved.

According to the U.S. DoE, commercial and residential buildings consumed nearly 40% of the nation's 99.5 quads of total energy in 2008 [3]. In that same year, the building sector's share of the nation's electricity consumption was 73% [3]. To put the building sector's energy consumption into perspective, the next most energy-intensive sectors were industrial and transportation consuming approximately 32% and 28%, respectively [3].

In a report based on inputs from 30 Federal agencies, DoE cited the U.S. Federal Government as the nation's single largest energy consumer [4]. In Fiscal Year (FY) 2006, DoE estimated that Federal buildings accounted for approximately 2.2% of all building energy consumption [3]. Within the Federal Government, the Department of Defense (DoD) not only the largest consumer of energy, it also maintains the greatest amount of building space. Based on FY 2006 energy consumption data, DoD consumed approximately 57% of all Federal building energy consumption, while maintaining 63% of all Federal building space [3]. Figure 1 illustrates DoD's share of FY 2006 Federal building energy consumption and floor space with the next 5 largest Federal agencies, with respect to building energy consumption and floor space.

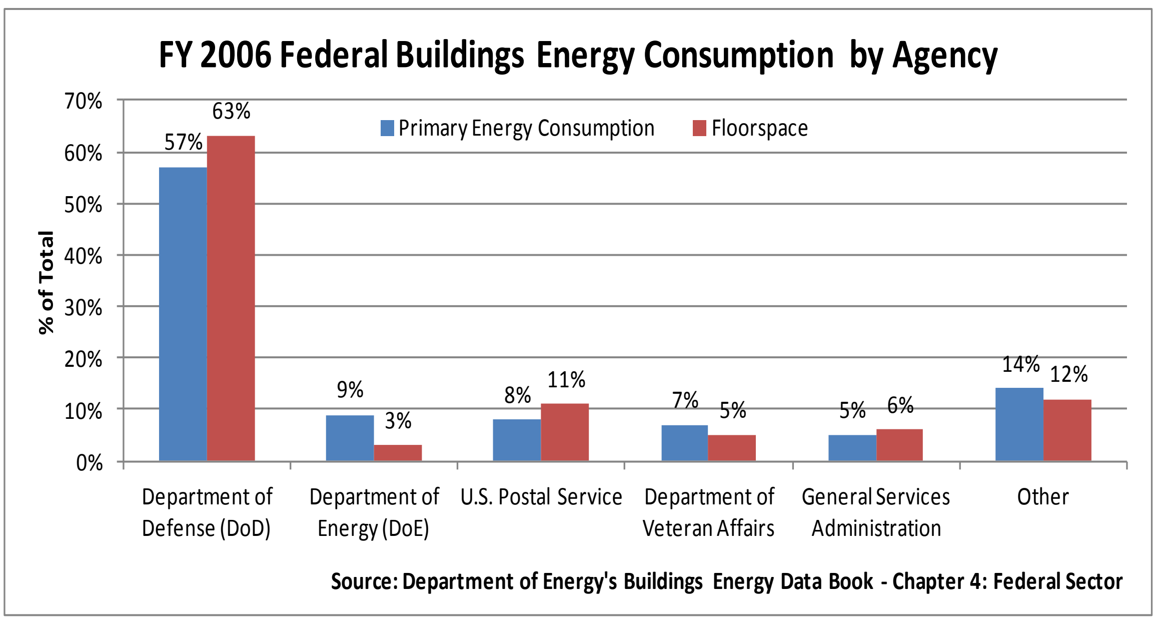

Figure 1: Federal Buildings Energy Consumption by Agency (FY 2006)

As a federal agency, incorporating sustainability into its facility portfolio continues to be an important topic within the DoD. Military services face significant challenges in meeting energy and water savings requirements codified in various executive orders and recent congressional legislation. Executive Orders (EO's) 13423 and 13514, along with the Energy Policy Act of 2005, the Energy and Independence Security Act of 2007, and the National Defense Authorization Act of 2007 all contain significant language regarding facility energy consumption[2, 5-7]. As a result of these mandates, as well as additional sustainability policies within the DoD, designing and constructing sustainable and energy efficient buildings is a vital component within any Military Construction (MILCON) project.

Until the Energy Policy Act of 2005, most Air Force and Army facilities were not metered for utilities consumption. This largely inhibited the services' ability to quantify energy consumption at the individual building level. Without this data, building and/or building equipment age would usually become a primary factor in determining which buildings were in greater need of energy efficiency improvements. The Energy Policy Act of 2005 requires all federal facilities to be metered by 2012 where practicable.

Federal and DoD policy also require DoD construction projects to be LEED-certified at the silver level with additional emphasis on energy and water efficiency [8]. Specifically, LEED's Energy and Atmosphere Credit 1 requires project owners to submit a whole building energy simulation that essentially predicts the building's annual site energy consumption during operation. This requirement, coupled with facility utility metering makes comparing predicted to actual energy consumption possible.

In the summer of 2011, we conducted a case study retrospective analysis of the building energy model developed for the Biomedical Engineering (BME) Building, located on the University of Texas (UT) at Austin main campus. The purpose of the case study was to evaluate the energy model's accuracy as compared to the as-built facility now in operation. The study revealed the building energy model significantly under predicted the building's actual annual energy consumption, but it was also apparent that the as-built building was much larger than the one reflected in the building energy model.

The results of the case study served as a motivating case for this dissertation study. The research questions for this dissertation study are presented below:

Research Question 1: What are the potential causes of variation between predicted and actual building energy consumption?

Research Question 2: How can current building energy modeling techniques be improved to account for occupant presence patterns associated with long vacancies?

Research Question 3: How can a greater in-depth retrospective analysis of building energy models be accomplished beyond the traditional comparison of predicted/actual Energy Use Intensity (EUI) metric?

In order to answer the research questions crafted for this study, we identified three, LEED-certified buildings, owned and operated by the DoD that met the following criteria:

- Dormitory building type
- Contained at least 12-months of post-occupancy energy consumption data.
- Building has been in operation and occupied for at least 12 months prior to the collection of energy data

We obtained permission from the DoD and the military installation's respective public works and military housing functions to collect the data necessary for completing this study. The DoD also authorized access to the LEED-submittal documents maintained by the U.S. Green Building Council (USGBC), as well as the actual building energy models used for each building.

The dissertation study resulted in three main contributions. First it demonstrates a method for conducting retrospective analysis on building energy models that may be applied to any building type. Second, it illustrates the use of buildings' indoor water consumption patterns to provide greater insight to a building's actual occupancy. Third, it presents a method for integrating building occupants' long vacancies, as observed from studying the building's water consumption patterns, into the building energy model.

1.2 Document Organization

This dissertation is organized into five chapters. Chapter 1 presents the introduction as well as the BME Case Study. Chapters 2 – 4 address Research Questions 1 – 3, respectively, with each of these chapters written as stand-alone documents that contain an introduction, literature review, research method, results, and conclusion section. Chapter 5 summarizes the dissertation's conclusions and findings as well as suggestions for future research.

1.3 Research Study Scope, Assumptions, and Definitions

This research study focused on the retrospective analysis of building energy models developed for recently-constructed LEED-certified buildings in the U.S. Department of Defense. The following criteria were used in determining which buildings would be included in this study:

- Dormitory building type

- The building must contain at least 12-months of post-occupancy energy consumption data.
- The building must be in operation and occupied for at least 12 months prior to collection of energy data.

Based on the review of 24 identified LEED-certified dormitories in the DoD, three buildings met the final two criteria regarding actual energy consumption data and sufficient time after the building's startup to ensure properly functioning building systems. The three buildings were all certified as LEED-Gold facilities under the LEED version 2.2 certification system for New Construction.

Conducting retrospective analysis of building energy models requires reflecting on the original intent of these models. Two viewpoints exist on this topic. The predominant view of building energy models revolves around the model's original purpose of conducting trade-off analysis among competing design strategies that influence building energy performance. By testing different design strategies, an optimal design strategy could be identified and implemented. The other viewpoint stems from an implicit expectation, particularly from an owner's perspective, that the energy model should be capable of producing results that reflect reality. Even if a new building incorporates new or unproven technologies where performance characteristics are relatively unknown, this perspective argues that as a minimum, the baseline model should be more reflective of reality.

This research study proposes two distinct methods for refining efforts in building energy modeling. The first method consists of retrospective analysis of building energy models by comparing the model to actual data in the areas of building systems, weather, energy consumption, occupancy and utilization, and building operation. The analysis of modeled and actual energy consumption is limited to site energy only. We applied this proposed method for retrospective analysis in Chapter 2 on a dormitory complex consisting of two, identically-constructed buildings, and later in Chapter 4 on two other complexes to demonstrate the method's utility with various amounts of actual building performance data.

The second method, explained and demonstrated in Chapter 3, focuses on integrating a probabilistic-based occupancy model that focuses on known long-vacancy periods (greater than 1 week) with the building energy model. The long-vacancy periods were determined based on interviews with occupants and military leadership as well as analyzing the building's respective daily water consumption data as a proxy for actual building occupancy.

1.4 Motivation Case: UT Biomedical Engineering Building Case Study

The purpose of the Biomedical Engineering (BME) Building case study was to explore the relationship between the building's design intent and post-occupancy with respect to the building's site energy consumption. This case study only considered site energy consumption; source energy was not evaluated since the focus of this research study will be on buildings' site energy only. In order to compare predicted vs actual site energy consumption values, Energy Use Intensity (EUI) factors were calculated based on the Department of Energy's Energy Star Portfolio Manager Program [9]. The methodology essentially converts the various energy streams consumed by the building on an annual basis to a common unit (kBtu) in order to combine them into a single value. In order to compare buildings of all sizes, EUI values are normalized by the building's respective Gross Square Footage (GSF). This methodology was also utilized in a 2008

New Buildings Institute (NBI) Report that analyzed energy performance among 121 LEED-certified facilities (Turner, 2008).

Three data sources were necessary to calculate the predicted and actual EUI for the BME building. First, whole building energy simulation documented in the LEED submittal documents provided the data to calculate the predicted annual energy consumption. UT Utilities & Energy Management provided an electronic copy of the LEED submittal document containing the whole building energy simulation. Second, actual annual energy consumption data was provided by UT's "ENURGY" Utility Reporting System. ENURGY is a web-based utility reporting system that enables users to view utility data of UT at Austin facilities. Finally, BME's design and actual GSF values were provided by USGBC's Public LEED-Certified Project Directory and UT Facilities Maintenance Department, respectively.

The BME building was an ideal candidate for this case study for two reasons. First, since the building was registered and submitted for LEED-certification, documented whole building energy simulation results were available for converting the results to a predicted EUI value. Second, with occupancy of BME beginning in August 2008, metered energy data has been available since May 2009. In other words, two full years of energy consumption data are available for analysis in this case study.

1.4.1 Calculating BME's EUI

In this case study, three EUI values for BME are calculated: the budget building (i.e. base case), the proposed building, and actual operation. This section outlines the computation of these three values and then compares and discusses the differences observed between EUI values using predicted and actual energy consumption data.

When applying for Energy and Atmosphere Credit 1 under the LEED New Construction V2.2 certification program, applicants must provide a documented whole building energy simulation that estimates the building's annual energy usage for two cases: a base case building and a proposed building. Energy simulations of both cases are conducted and then compared in order to calculate an estimated savings. The base case is essentially the proposed building constructed to standards listed in ASHRAE Standard 90.1 [10]. The amount of estimated savings offered in the proposed building, relative to the base case, determines the potential point earnings under this LEED credit. The consultant responsible for submitting the BME project for LEED certification conducted whole building energy simulations using eQUEST (Quick Energy Simulation Tool), a commonly-used building energy simulation software program. Table 1 illustrates the consumption value estimates for the base case.

"Base Case" Model Output										
	Lights	Misc Equip	Space Heating	Space Cooling	Heat Reject	Pumps & Aux	Vent Fans	Domestic Hot Water	Ext Usage	Total
Electricity (MBTU)	2,050	3,485	0	7,159	272	1,524	4,570	0	293	19,355
Natural Gas (MBTU)	0	0	16,983	0	0	0	0	6,782	0	23,765
Total (MBTU)	2,050	3,485	16,983	7,159	272	1,524	4,570	6,782	293	43,120
Total Site Energy = 43,119,520 kBtu					EUI = 325 kBtu/ft^2					

Table 1: BME Whole Building Energy Model Output (Base Case)

The model output includes electricity and natural gas as the two energy streams supplied to BME. The model output displays the estimated consumption in similar units of MBtu's, so calculating the annual energy consumption is a simple matter of adding the predicted consumption values for electricity and natural gas, resulting in a predicted consumption value of 43,119,520 kBtu/yr. The model assumed a building GSF value of 132,692 ft^2, resulting in an EUI value of 325 kBtu/ft^2.

Likewise for the proposed building energy simulation, the model output displays the predicted annual energy consumption in MBtu's. Adding the annual predicted energy consumption for electricity and natural gas yields a value of 33,911,650 kBtu/yr, and an EUI value of 256 kBtu/ft^2. Table 2 illustrates the proposed building's model output and corresponding EUI value.

Proposed Building Model Output										
	Lights	Misc Equip	Space Heating	Space Cooling	Heat Reject	Pumps & Aux	Vent Fans	Domestic Hot Water	Ext Usage	Total
Electricity (MBTU)	2,050	3,485	0	4,874	188	999	3,653	0	293	15,543
Natural Gas (MBTU)	0	0	11,530	0	0	0	0	6,840	0	18,369
Total (MBTU)	2,050	3,485	11,530	4,874	188	999	3,653	6,840	293	33,912
Total Site Energy = 33,911,650 kBtu						EUI = 256 kBtu/ft^2				

Table 2: BME Whole Building Model Output (Proposed Building)

Calculating BME's actual site energy EUI is performed using energy consumption data from UT's web-based "ENURGY" Utility Reporting System and BME's actual GSF of 202,942 ft^2, as reported by UT Facilities Maintenance. Chilled water, electricity, and steam are the actual energy commodities supplying power to BME, reported in units of Ton Hours, kWh's, and MLBS of Steam, respectively. In order to calculate an EUI value based on actual annual energy consumption that combines these three energy types, conversion factors are applied. Consistent with the EPA's methodology for calculating combined site energy consumption among multiple energy types, the annual metered energy types are converted to kBtu's via thermal conversion factors from the Environmental Protection Agency's Portfolio Manager program. The actual metered data, along with the conversion factors and the converted energy type amount in kBtu's are illustrated in Table 3.

"ENURGY" Utilities Report for BME							
FY	Chilled Water (1 Ton Hr = 12.0 kBtu)		Electricity (1kWh = 3.41 kBtu)		Steam (1MLBS = 1,194 kBtu)		Total (kBtu)
	Ton Hrs	kBtu	kWh	kBtu	MLBS	kBtu	
2009 - 2010	2,458,595	29,503,152	3,226,986	11,010,476	11,412	13,625,928	54,139,556
2010 - 2011	2,822,350	33,868,195	3,829,119	13,047,296	10,267	12,258,583	59,184,074

Table 3: BME Actual Energy Consumption (FY 2009 - 2010 and FY 2010 - 2011)

Using the actual BME GSF amount of 202,942 ft^2 results in EUI values of 267 and 292 for FY 2009 – 2010 and FY 2010 – 2011, respectively. Table 4 summarizes the EUI values for the base case, proposed building, and actual case, and includes the annual consumption and building GSF values used in each of the EUI calculations.

	Base Case	Proposed	Actual
Annual Consumption (kBtu)	43,119,520	33,911,650	54,139,556 (FY10) 59,191,964 (FY11)
Building GSF (ft^2)	132,692	132,692	202,942
Site Energy EUI ($kBtu/ft^2$)	325	256	267 (FY10) 292 (FY11)

Table 4: Summary EUI, Annual Consumption (Predicted and Actual) and GSF Values

There are several takeaways from this case study of comparing predicted versus actual site energy consumption. First, BME appears to be consuming a significantly greater energy amount than the proposed building or even the base case building. However, part of that difference may be explained in the substantial difference observed in the GSF values used for calculating EUI values for the simulated (i.e. base case and proposed building) and actual scenarios. The difference between actual and simulated weather conditions may also explain the difference seen in actual and simulated energy amounts.

1.4.2 Challenges Identified

While the method for calculating a facility site EUI is relatively straight-forward, challenges existed in doing so for this case study. The primary challenges in conducting this case study were: acquiring the data necessary to calculate BME's site EUI, attributing confidence to the predicted EUI values as a result of the simulation model's sources of error, and relating BME's actual EUI values to a known standard to make an inference regarding its performance with respect to energy consumption. Each challenge is described in detail subsequently.

Data Acquisition

Identifying the data requirements to calculate the site EUI was relatively objective; obtaining the data itself proved slightly more challenging. UT Facilities Maintenance provided the LEED-certification submittal documents containing the results of the whole building energy simulations (base case and proposed building). Electronic copies of these submittals were obtained and stored by UT Facilities Maintenance as a result of previous requests for similar information on UT at Austin projects being rejected by the consultant. Had this information not been readily available, additional time spent preparing a formal consent for release of information from the UT System's Office of Facility Planning and Construction and a formal request for obtaining project-related information from the U.S. Green Building Council (USGBC) would have taken considerable extra time. Extracting similar information for DoD projects to be used in this research study will require a process for obtaining formal or written consent from authorized service representatives. Obtaining this data will also require knowledge of whom at USGBC to submit this formal request.

Validating Model Assumptions

Identifying sources of error within the predicted EUI values from energy simulation results also proved challenging, but represents an important step in understanding where improvements are needed and are possible to ultimately improve the validity of the energy consumption simulation results. The following paragraphs discuss four identified sources of error.

The first source of error relates to the model's Utility and Fuel Use Summary. The model lists electricity and natural gas in the output reports as the primary fuels providing energy to BME. But in reality, electricity, chilled water, and steam are the actual commodities as indicated by the utility meter data. BME is powered by the UT Power

Plant that essentially converts natural gas to electricity, steam, and chilled water that subsequently powers campus facilities. The lack of alignment between the model's energy stream types and actual energy streams used is a potential indicator of additional invalid model assumptions.

Discussions with UT Plant Engineering staff revealed two additional inaccurate model assumptions [11]. The first inaccuracy deals with providing chilled water to BME. The UT power plant provides chilled water to BME via service lines, but the model assumes BME contains its own chillers. In addition, the model assumed a minimum chiller efficiency value of 6.10 Coefficient of Performance (COP). Both a UT plant manager and UT CAEE faculty member in separate discussions declared this was an inflated COP value.

The last identified inaccuracy deals with the building's GSF which was ultimately used in calculating the baseline and predicted EUI values. The energy simulation used the lower than actual GSF value of 132,692 ft^2 to calculate the EUI when BME's actual GSF is 202,942 ft^2. It is likely that the 132,692 ft^2 value represents the modeled building's total conditioned space as indicated on other simulation summary reports. But the simulation output also clearly uses this value when calculating the EUI which causes some confusion. Regardless, the assumed total conditioned space of 132,692 ft^2 appears rather low compared to the actual GSF of an academic building. This disproportionate ratio between the assumed total conditioned space and the building's actual GSF causes speculation as to whether additional building modifications and/or additions were made to BME subsequent to the energy simulation performed on BME and included in the LEED-submittal documents.

Evaluating Actual EUI-Values as a Performance Metric

Finally, evaluating BME's energy consumption performance based on its actual EUI value proved to be somewhat incomplete without a reliable standard to compare against. The DoE's Energy Information Administration's Commercial Building Energy Consumption Survey (CBECS) Data for 2003 reports the average energy intensity (kBtu/sf) for education building types to be 83.1 [12]. At first glance, comparing BME's actual EUI value may lead to concluding the building is a low performer with respect to energy consumption. However, the CBECS' definition of the education building type incorporates a wide variety of sub-categories such as elementary and middle schools, vocational training, colleges and universities, and religious education facilities [12]. These sub-categories will likely have a varying range of EUI values as well because of differing energy requirements. Commenting on the attainment of a building's initial, actual EUI value requires knowledge of EUI values for similar buildings (i.e. type, sub-category, function, geographic location, etc.). The building's initial EUI value could also serve as a benchmark to evaluate future year consumption rates so that in the building's subsequent O&M years, its performance can be compared against a similar class of buildings and itself.

Chapter 2 Evaluating Building Energy Model Performance of LEED Buildings: Identifying Potential Sources of Error through Aggregate Analysis

This chapter presents a proposed framework for evaluating building energy model performance of LEED buildings through an aggregate analysis of comparing predicted to actual building energy consumption as well as evaluating how well the building energy model reflects the actual physical building. In this study, we seek to identify potential sources of energy model error by applying the framework to two, identically-constructed and co-located, LEED-certified military dormitories. The simulated and actual building energy data is segregated and analyzed by energy type, heating/cooling season, end use, and weekday/weekend to determine the relative extent to which these differences contribute to the total annual difference between predicted and actual consumption as well as examine the model's assumptions regarding occupancy. Overall, the model over-predicted energy consumption in Buildings A and B by 14% and 25%, respectively, as based on comparison between coinciding modeled and actual cooling and heating seasons. The larger model errors appeared in over-estimating natural gas consumption, particularly the heating season's boiler usage. Examining the buildings' daily water consumption data exhibited significant changes throughout the analysis period, suggesting similar changes in the buildings' actual occupancy which deviates from the model's assumption of 100% occupancy throughout the analysis period.

2.1 INTRODUCTION

According to the United States (U.S.) Department of Energy (DoE), commercial and residential buildings consumed nearly 40% of the nation's 99.5 quads of total energy in 2008 [3]. In that same year, the building sector's share of the nation's electricity consumption was 73% [3]. To put the building sector's energy consumption into perspective, the next most energy-intensive sectors were industrial and transportation consuming approximately 32% and 28%, respectively [3]. In a report based on inputs from 30 federal agencies, the DoE cited the U.S. federal government as the nation's single largest energy consumer [4]. Among federal agencies, the Department of Defense (DoD) owns and operates the largest building portfolio of over 300,000 buildings comprised of 2.2 billion square feet [4, 13]. This large facility footprint equates to an annual $4 billion annual energy bill, or approximately 20 – 25% of all DoD energy-related costs.

As a recognized substantial consumer of energy for buildings, sustainability has become a key element in the U.S. federal government's building construction program, as evidenced in part by the several legislative mandates passed into law over the past decade that target building energy efficiency. The Energy Policy Act (EPA) of 2005 established specific building energy metering requirements, required new building designs to achieve consumption levels 30% below current ASHRAE standards, and begins the framework for creating voluntary and consensus-based building performance standards [2]. The Energy Independence and Security Act of 2007 further targets energy efficiency in federal buildings by updating building energy reduction goals, reducing buildings' fossil fuel-generated energy consumption, and establishing the Office of Federal High-Performance Green Buildings (OFHPGB) [7]. One of the responsibilities of this office is selecting a building certification system that "encourages a comprehensive and environmentally-sound approach to certification of green buildings." Currently, OFHPGB prescribes the Leadership in Energy and Environmental Design (LEED) program as the third-party building certification system for federal agencies. Other mandates such as Presidential Executive Orders 13123 and 13514 emphasize life-cycle cost effective measures to improve building energy efficiency and well as ensuring all new federal building construction complies with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings [6, 14].

The DoD's current sustainability policy requires new building construction to achieve LEED-Silver certification. It further stipulates that projects in the planning stage beginning in fiscal year 2012 will derive at least 40% of the points necessary to achieve LEED-Silver from energy and water efficiency credits [8]. As this policy places more emphasis on energy efficiency, many project teams are conducting building energy simulation to test design initiatives and then submitting the energy model results as part of the certification submittal record.

As more DoD LEED buildings enter the operations and maintenance phase, additional studies like Menassa et al. (2012) will likely be conducted to determine the extent to which these buildings conform to federal energy reduction mandates [15]. But it also presents an opportunity to more closely examine and evaluate the energy model's ability to predict building performance. Past studies by Diamond et al. (2006), Turner and Frankel (2008) and Widener (2009) identified significant variation between predicted and actual building energy consumption among individual buildings. Further research is needed to identify the known sources of variation in order to improve future building energy modeling efforts.

In this chapter, we evaluate the building energy model created for two, LEED-certified and identically-constructed DoD dormitory buildings by comparing the predicted to actual energy consumption and comparing the model's parameter values to values documented in the buildings' as-built drawings. We present a method for evaluating the variance observed between the model's predicted and building's annual energy consumption beyond traditional metrics that only consider the building's aggregate annual consumption value. This approach coupled with comparing the energy model to the physical, as-built barracks represents a method for improving our understanding of where potential sources of error within the building energy model exist.

2.2 Literature Review

There are numerous published studies that evaluate LEED building performance and compare those buildings' predicted to actual building energy consumption [15-20]. The following paragraphs summarize the literature's key points of agreement, disagreement, and gaps requiring additional study.

The most common performance measure used in these studies is the Energy Use Intensity (EUI) factor (kBtu/ft^2). The EUI is calculated by summing a building's annual energy usage for all energy types and then normalizing by the building's gross square footage. The building's energy types are converted to kilo British Thermal Units (kBtu's) to enable summation and subsequent comparison with other buildings. While the literature appears to agree on the EUI as the choice metric when evaluating building performance and comparing actual to predicted energy consumption values, it does contain limitations. For example, the metric does not distinguish between buildings with differing occupant density, building usage patterns, or process loads. Fowler and Rauch (2008) and Fowler et al. (2011) addressed this metric's limitation in their post-occupancy study of U.S. General Services Administration (GSA) buildings by normalizing building energy consumption by gross square footage, number of building occupants, and number of occupancy hours in adjacent graphs to illustrate how occupancy may impact building performance [18, 20].

Most published studies evaluating LEED building performance and comparison to predicted energy consumption focus on buildings' site energy [16-20], that which is actually consumed by buildings, rather than source energy which accounts for on-site energy use as well as off-site production, transmission, and associated off-site losses. Using site energy data is appropriate especially when the focus is on the building's efficient use of energy, whereas source energy analysis can potentially mask the building's use of energy. Scofield [21] differed in this trend by focusing his analysis of LEED building performance on source energy in order to draw a greater understanding of greenhouse gas emission related to building energy consumption.

Identifying the standard of comparison is also an interesting topic. Most studies tend to use multiple comparisons, thereby adding additional perspective to studies' findings [17, 18, 20]. Past analyses of buildings' energy performance have involved comparisons to national and regional averages of the Commercial Buildings Energy Consumption Survey (CBECS) data set, managed by the DoE's Energy Information Agency; and the Energy Star Target Finder Program, managed by the U.S. Environmental Protection Agency. The U.S. General Services Administration published LEED building post-occupancy studies in 2008 and 2011 that included additional comparisons to agency-established national and regional goals [18, 20].

The literature also tends to agrees that when comparing predicted to actual building energy consumption, significant variation among individual buildings may exist [16, 17, 19, 22] . The National Buildings Institute's 2008 study of 121 LEED-certified buildings suggested that from a program standpoint, the modeling effort appeared to be a good predictor of average building performance with respect to energy consumption [19]. According to the study, the average predicted annual savings (compared to the building's baseline) of 25% was very close to the actual measured savings of 28%. However the report also reported significant variation among individual buildings. Among the study's building sample size, over half differed from their respective design predictions by over 25%, with 30% performing significantly better and 25% performing significantly worse [19]. Diamond et al. cited a similar finding among their study of 21 buildings in which the difference between the average predicted and actual savings was 1%, but exhibited wide variation around the mean [16].

Contemplating the merits of comparing predicted to actual energy consumption presents an interesting topic and suggests two common themes throughout the literature. On one hand, most research cautions readers to temper expectations with remembering two important points. The variation in operational factors such as occupancy schedules, plug loads, and weather can likely limit the model's accuracy [19]. The second point goes back to remembering one of the intended uses of these building energy models which is to compare design alternatives to a base case building, as is required for projects submitting for LEED certification [23]. From this perspective, the models were only intended to primarily express relative performance. However, there still remains a strong show of support to continue the analysis of predicted to actual energy consumption in order to improve our understanding of building energy consumption to further improve future modeling efforts. Newsham et al. (2009) points out that modeling building energy use does in fact create a performance expectation with building owners [24]. Turner and Frankel (2008) also support this notion by pointing out that energy models are also used as the basis for many life-cycle cost decisions regarding alternative designs and construction methods. In this regard, retrospective analysis provides a continual means of evaluating to incrementally improve the practice of building energy modeling.

While the research community widely acknowledges significant variation between predicted and actual energy consumption can and often does exist among individual LEED buildings [16, 17, 19, 22] , there is noticeably less research in further exploring the verifiable sources of observed variation. Diamond listed potential reasons for variance such as differences between the model and the actually-constructed building, differences in assumed occupancy behavior patterns, and different number and types of equipment used in the building, but did not pursue further verification of these claims [16]. Turner and Frankel also acknowledged exploring reasons for variation as beyond the scope of their 2008 LEED building study, but recommended that future research in this area could be very valuable to the building industry.

This research seeks to further explore the verifiable sources of model error through the collection and subsequent comparison between the building energy model simulation results and actual utility consumption data, based on comparing the model to as-built drawings, and interviews conducted with the building's operations and maintenance staff.

2.3 Research Method

In order to be considered for this study, the selected DoD LEED building had to meet the following criteria:

- Dormitory building type
- Contained at least 12-months of post-occupancy energy consumption data, and
- Building has been in operation and occupied for at least 12 months prior to the collection of energy data

The dormitory building type was selected in order to reduce the analysis to a single building type and to eventually compare multiple DoD LEED-certified dormitories using the same method as the one presented in this chapter. This building type was also selected because we assumed the space designation among individual buildings would vary to a lesser extent, and would therefore further enable subsequent analysis between more similar buildings. Also requiring the building to be in post-occupancy for an extended duration prior to collecting energy data aids to ensure properly functioning building systems and is a similar criteria used in other post-occupancy evaluation studies [18, 20].

Upon identifying a suitable candidate meeting the criteria listed above, data collection began. We collected a copy of the actual building energy model created during the building's design and used during the LEED certification processes. The consultant used the building energy modeling software TRACE 700 (version 6.1.1), which is a common system containing four separate calculation phases: design, systems, equipment, and economics [25]. The military installation's public works organization provided the building's actual energy consumption data as well as access to building maintenance records, and communications with operations and maintenance personnel. The U.S. Army Corps of Engineers supplied the building's as-built drawings to compare against the values used in the energy model as well as values documented in the project's LEED submittal documentation acquired from the U.S. Green Building Council. In order to determine that the energy model adequately reflected the constructed building, we compared the model to the building's as-built drawings. Parameter values such as gross square footage, number of rooms and their respective designation, and chiller and boiler unit specifications were compared and found to be largely in accordance with the building's as-built drawings.

The analysis began by selecting the most-recent twelve month period containing the most complete data set of daily energy consumption values. We collected 17 consecutive months of daily building energy and water consumption beginning July 2011 through November 2012. The energy data did contain gaps and inconsistencies that required a data cleansing step prior to analyzing the data. In some cases, the missing data were irretrievable. In other instances however, periods of presumed missing data were followed by a significantly large value. This scenario represented instances where the energy meter failed to record the daily consumption value and did not automatically reset. The installation's utility meter manager identified these occurrences in the data and in such instances, the large data reading was averaged over the time period of missing data. Based on this criterion, we used the energy data from October 1, 2011 through September 30, 2012.

In order to compute predicted daily energy consumption values, building designers use TMY (typical meteorological year) data that typify meteorological conditions over an extended time period (e.g. 30 years) and are not intended to represent weather extremes [26]. In order to determine if the TMY3 weather data set corresponding to the subject building location was appropriate for this study, we first compared the monthly Heating and Cooling Degree Days (HDD, CDD) between the TMY3 weather data and actual weather data collected from the U.S. Air Force's 14th Weather Squadron [27] to determine if it was necessary to conduct a separate building energy simulation using actual weather data. The base temperatures used for calculating HDD and CDD values were 65°F and 50°F, respectively, as seen in Equations 1 and 2.

Equation 1: $HDD_{65} = \sum_{i=1}^{n}(65 - T_i)$

Equation 2: $CDD_{50} = \sum_{i=1}^{n}(T_i - 50)$

In Equations 1 and 2, T_i represents daily average temperature values and was calculated as the average among each day's hourly dry-bulb temperature readings. Prior to comparing the two datasets, the actual weather data was screened for extraneous data (e.g. multiple readings taken in the same hour) to ensure consistency. We calculated monthly HDD_{65} values for the heating season months (October – April) and monthly CDD_{50} values pertaining to the cooling season (May – September) for each weather dataset.

Figure 2 illustrates the comparison between monthly HDD_{65} and CDD_{50} values for the TMY3 and actual weather data sets. Overall, the TMY3 HDDs and CDDs correspond fairly well with the equivalent values calculated from the actual weather data. During the heating period, the TMY3 data overestimate actual HDDs by approximately 11% and underestimate the actual CDDs by 27%. Based on this simple comparative analysis, we did not construct an additional weather file comprised of actual data. However, the analysis does provide the reader with additional perspective to temper judgment regarding the building energy model's accuracy.

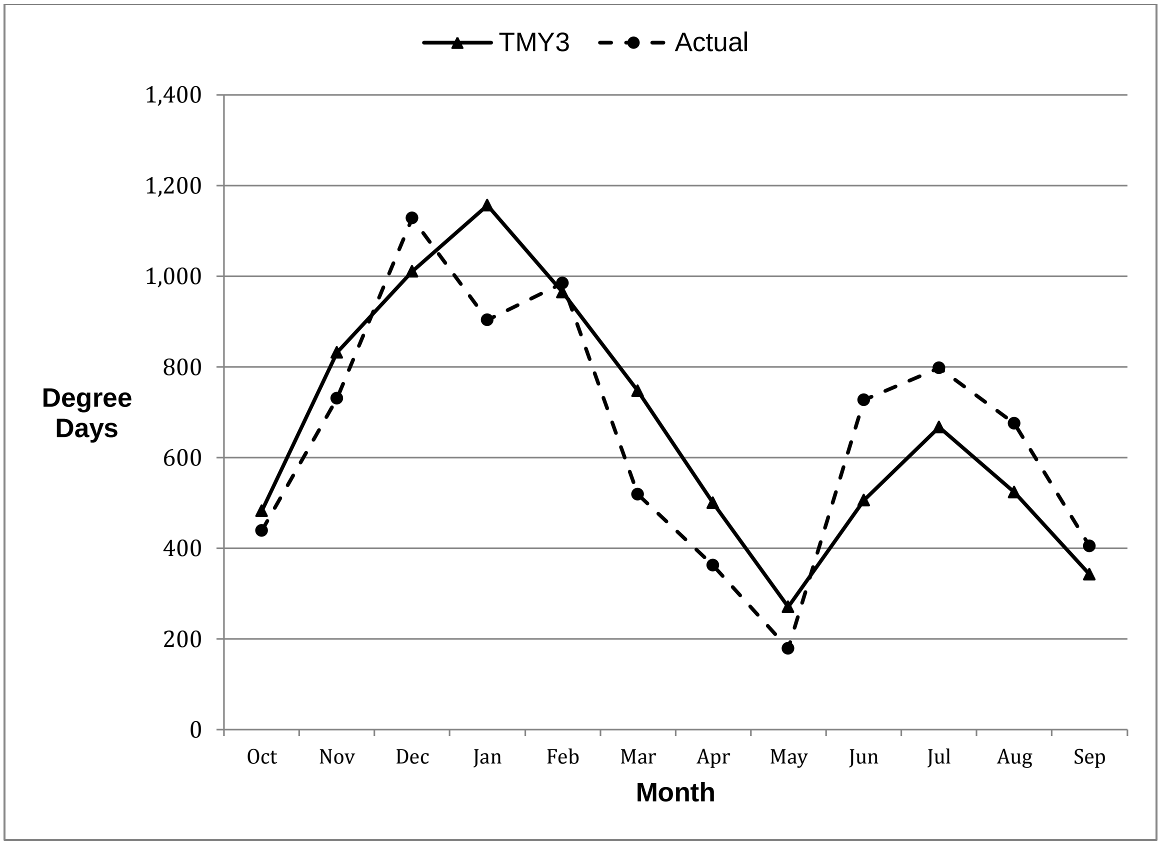

Figure 2: Monthly CDD and HDD Comparisons between TMY3 and Actual Weather Data

Following the selection of the appropriate weather data, the energy data were further segregated by fuel type, heating and cooling season, end use, and weekday/weekend consumption and subsequently compared to the model's corresponding segregated data. In order to further segregate the actual energy consumption data into electricity usage during the heating and cooling seasons, the installation's public works department provided the dates of the building mechanical systems' actual changeover dates from cooling-to-heating and heating-to-cooling. According to the building service records, the buildings heating systems were activated on 5 Oct 2011 and then switched back to cooling on 30 Apr 2012. Table 5 lists the respective heating and cooling dates used by the model as well as the actual dates. Overall, the model overestimated the actual heating season and underestimated the cooling season, both by approximately 1 month. The number of total days between the model and actual differs by one due to the 2012 leap year and the model's built-in assumption of a 365-day year based on the 1978 calendar year [28].

	Model		Actual	
	Dates	# days	Dates	# days
Heating	Oct 11 – May 12	243	5 Oct 11 – 30 Apr 12	209
Cooling	Jun – Sep 12	122	1 – 4 Oct 11; May – Sep 12	157

Table 5: Comparison between Model and Actual Heating and Cooling Seasons

Segregating the energy data serves two purposes. First, it allows better comparison between predicted and actual energy consumption under similar circumstances and provides a greater relative sense of where model error may exist. For this building, segregating the data also allowed a direct comparison between the predicted and actual natural gas consumption for the boiler and domestic hot water end uses. Second, it enabled further examination of the model's assumption regarding occupancy. The model assumes greater occupancy periods during the weekends and holidays than weekdays. In order to test the model's assumptions regarding occupancy, we conducted a series of paired t-tests consisting of paired, weekday and weekend/holiday average consumption values to test whether a statistically significant difference in energy consumption existed between weekdays and weekends for the respective segregated data pools of simulated and actual energy data. For all paired t-tests comparing weekday and weekend/holiday consumption, the null hypothesis (H_0) represented equal average consumption between weekdays and weekend/holidays. The alternative hypothesis (H_a) represented the mean difference (weekday average – weekend/holiday average) < 0.

2.3.1 Building Description

The dormitories selected for this study are two LEED-Gold dormitories, owned, operated, and maintained by the DoD. The entire project consisted of five identical dormitories constructed on the same site. The buildings were constructed in 2009 and earned their LEED-Gold certification the same year. Each building has a Gross Square Feet (GSF) value of 152,684 square feet (14,184 square meters) and design occupancy of 368 persons. Only two of the five buildings were adequately metered and hence included in this study.

The buildings operate on electricity and natural gas. The buildings' primary electricity end uses include interior/exterior lighting, space heating, interior fans, and receptacle equipment, while natural gas provides the buildings' space heating and domestic hot water needs. Each building contains one electricity meter and two natural gas meters. The natural gas meters measure gas flow to its respective north and south mechanical rooms. Both mechanical rooms contain two, 250-gallon water heaters as well as a 2,500-gallon storage tank. The building's boiler is situated in the north mechanical room, so during the heating season, the north natural gas meter records natural gas used for heating as well as domestic hot water.

2.3.2 Statistics Analysis

As mentioned in the previous Research Method section, we used the paired t-test to determine statistical significance between weekday and weekend/holiday energy consumption. The results of these tests determined the validity of the energy models' use of separate schedules for weekdays and weekends/holidays.

We did not include multiple linear regression into this research method based on the results of scatter plots depicting the relationship between independent and dependent variables. In this analysis, occupancy data, actual weather, and indoor water consumption represented independent variables. Dependent variables consisted of daily electricity and natural gas consumption. We created scatterplots of the various combinations of independent and dependent variables for Buildings A and B for both heating and cooling seasons to determine what, if any, causal relationships existed between the variables.

The strongest correlations existed between the buildings' natural gas consumption and actual HDD_{65} (0.8071 and 0.8024 for Building A and B, respectively) during the heating season and electricity consumption and actual CDD_{50} (0.6595, 0.8510) during the cooling season. Figure 3 illustrates the scatter plots for Building A and B's daily natural gas consumption during the heating season as it relates to actual $HDD_{65.}$

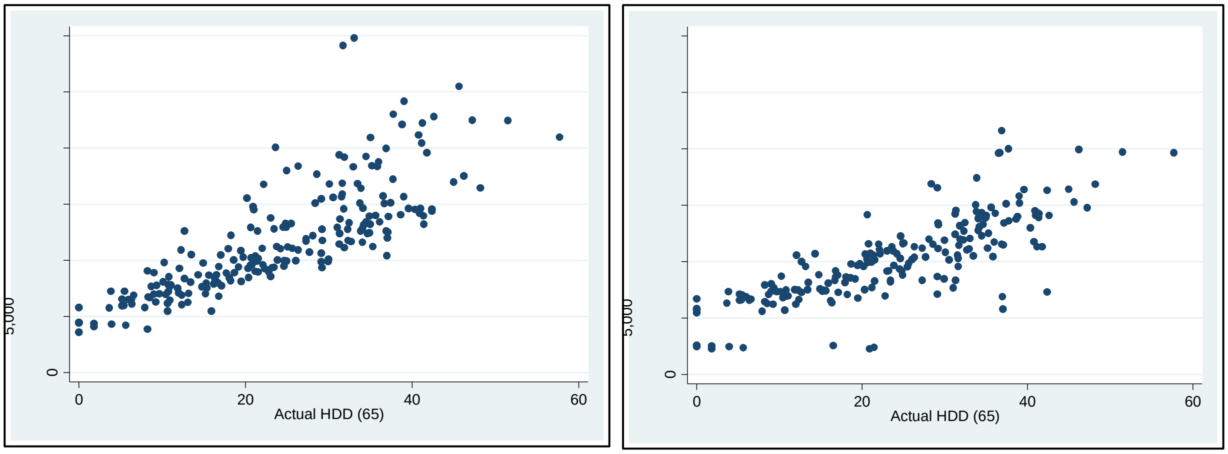

Figure 3: Scatter Plot of Building A (left) and B (right) Daily Natural Gas Consumption and Actual HDD (65)

consumption indicated a wide scattering of data points. As an example of this general observation, Figure 4 illustrates the combined scatter plots of Buildings A and B that relate daily electricity consumption to the corresponding reported occupancy value.

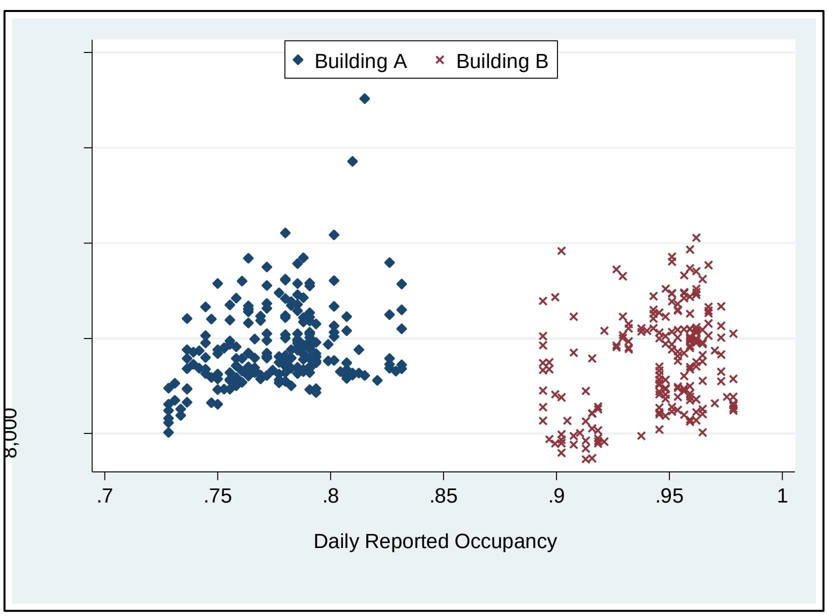

Figure 4: Building A (left) and B (right) Scatter Plot of Daily Electricity Consumption and Reported Occupancy during the Heating Season

The remaining scatter plots displayed similar results of no apparent causal relationship. As a result, we did not pursue multiple linear regression as a method of statistical analysis in this study.

2.4 Results

Analysis begins by segregating the buildings' daily energy data using the process discussed in the previous section. Figure 5 illustrates the data segregation pathways of the subject buildings and identifies four distinct data paths consisting of electricity and natural gas consumed during the heating and cooling seasons. Electricity usage during the heating and cooling seasons could not be further segregated by end use as the buildings' electricity end uses greatly outnumber the buildings' single meter. In this case, electricity consumption was further divided into weekday (WD) and weekend (WE) consumption. However, segregating the natural gas data by end use was attainable and is further described in the natural gas analysis section.

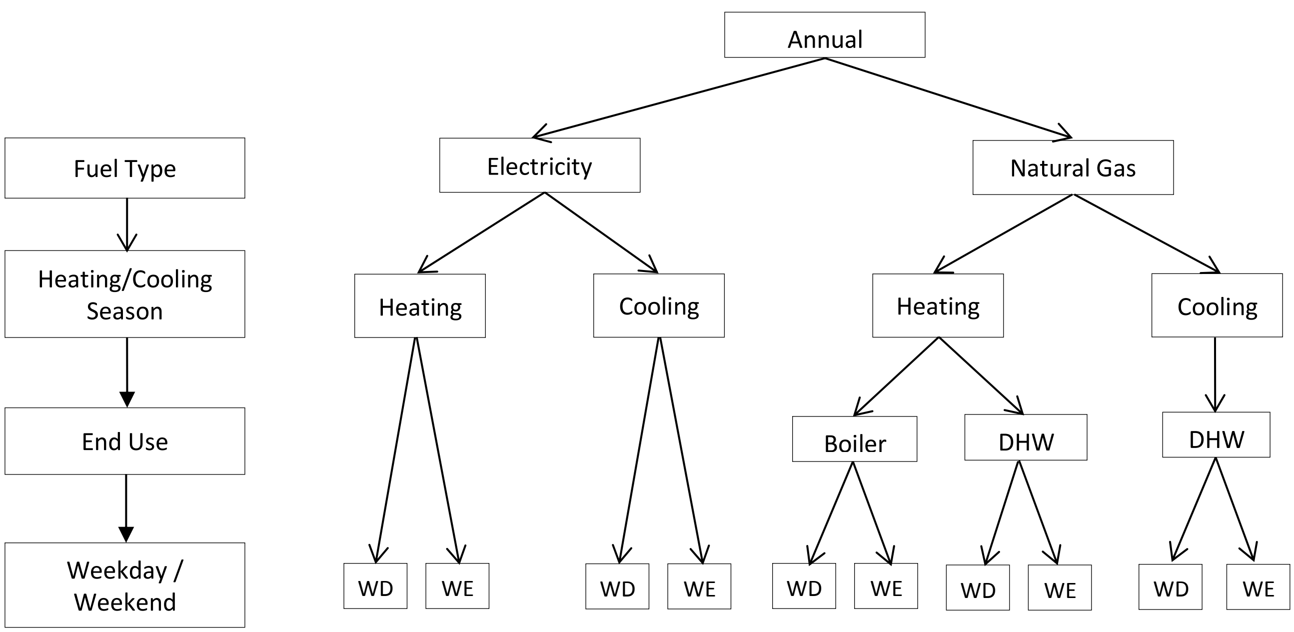

Figure 5: Dormitory Energy Data Segregation Pathways

Figure 6 illustrates the daily total energy consumption values for Buildings A and B, as well as the building energy model. Daily electricity and natural gas values were converted to kBtu's and subsequently combined using the thermal conversion factors presented in the Environmental Protection Agency's Portfolio Manager program [9]. The simulation data were accrued using the consultant's energy model and the TMY3 weather data set of the closest city to the military installation containing the dormitory buildings. The observed low points in Building B's data (early-mid October, sudden downward spike in early December, and early-mid March) reflect either missing natural gas or electricity data. Building A contained a complete set of daily electricity and natural gas data.

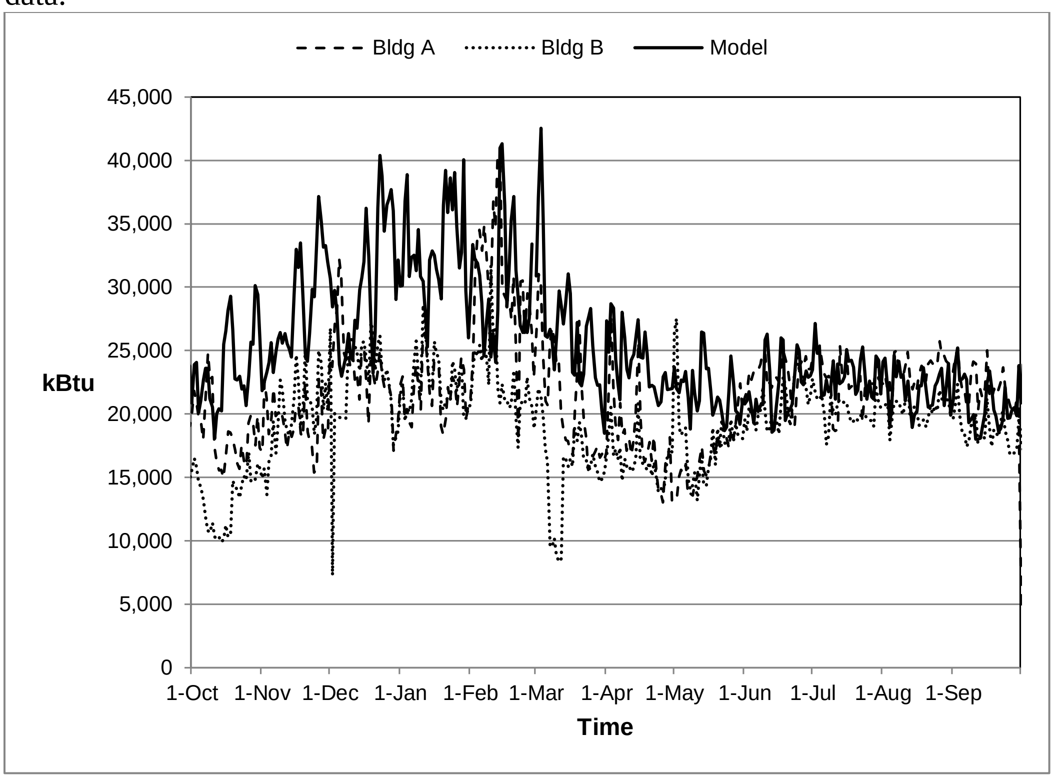

Figure 6: Total Daily Building Energy Consumption (Actual vs Simulated)

Upon visual inspection of the data, the model appears to overestimate building energy consumption during the heating season months (October – May), but more closely predicts energy usage during the cooling season (June – September). Using this dataset, we calculated the EUI values for the model and Buildings A and B as 60.8, 51.9, and 46.1, respectively. Overall, both buildings consumed significantly less energy on an annual basis as compared to the model, with Building A consuming approximately 15% less than the model prediction and Building B consuming 25% less. It's also interesting to note the nearly 10% difference in consumption between the two buildings, relative to the model, since the buildings are co-located and thus operate under the same weather conditions and were constructed using the same design and by the same construction contractor.

2.4.1 Data Segregation Analysis Summary

Table 6 and Table 7 summarize the predicted and actual energy consumption values of Buildings A and B, segregated by heating and cooling seasons based on the date ranges listed in Table 5. The % Difference (% Diff) and % Total Error rows are calculated as follows:

$$\text{Equation 1: \% Diff} = \frac{\boldsymbol{Predicted - Actual}}{\boldsymbol{Predicted}}$$

$$\text{Equation 2: \% Total Difference} = \frac{\boldsymbol{Predicted - Actual}}{(\boldsymbol{Predicted - Actual})_{\boldsymbol{Total}}}$$

While the model over predicted Building A's annual energy consumption by 15%, it over predicted electricity consumption by 4% and natural gas consumption by 27%.

The relative small over prediction of total electricity however, masks the model's larger errors during the heating and cooling seasons (32% and -40%, respectively). With respect to natural gas, the model over predicted consumption by 27%, consisting of 31% and 12% differences in the heating and cooling seasons, respectively. While the largest magnitude of %-differences among commodities consumed electricity consumed in the cooling season, the error observed during natural gas consumption for the heating season contributed the greatest proportion (79%) to the total observed difference between predicted and actual energy consumption.

	Total (kBtu)	Electricity (kBtu)			Natural Gas (kBtu)		
		Commodity Subtotal	Heating	Cooling	Commodity Subtotal	Heating	Cooling
Predicted	9,330,521	4,938,019	3,025,060	1,912,960	4,392,502	3,599,014	793,488
Actual (A)	7,924,562	4,736,146	2,055,583	2,680,563	3,188,416	2,487,086	701,330
% Diff	15.1%	4.1%	32.0%	-40.1%	27.4%	30.9%	11.6%
% Total Difference	NA	14.4%	69.0%	-54.6%	85.6%	79.1%	6.6%

Table 6: Predicted/Actual Energy Usage for Cooling/Heating Seasons (Building A)

	Total (kBtu)	Electricity (kBtu)			Natural Gas (kBtu)		
		Commodity Subtotal	Heating	Cooling	Commodity Subtotal	Heating	Cooling
Predicted	9,330,521	4,938,019	3,025,060	1,912,960	4,392,502	3,599,014	793,488
Actual	7,009,474	4,156,348	1,864,614	2,291,735	2,853,126	2,089,328	763,798
% Diff	24.9%	15.8%	38.4%	-19.8%	35.0%	41.9%	3.7%
% Total Difference	NA	33.7%	50.0%	-16.3%	66.3%	65.0%	1.3%

Table 7: Predicted/Actual Energy Usage for Cooling and Heating Seasons (Building B)

In evaluating the model based on Building B's energy performance, the model over predicted electricity and natural gas consumption by approximately 16% and 35%, respectively. Building B's electricity consumption during the cooling season was only slightly greater than the model prediction (2.4% difference). Similar to Building A, we also observe a significant range of error when comparing commodity consumption during the heating and cooling seasons.

At least one reason for the observed trend of greater over predictions during the heating seasons and under predictions of electricity consumption during the cooling season stem from the difference in actual and simulated heating and cooling days (reference Table 5). In order to factor out this model inaccuracy and to draw more accurate conclusions regarding the model's performance during heating and cooling seasons, we conducted the same analysis for the time periods of coinciding heating/cooling seasons between the model and buildings' actual operation. Table 8 and Table 9 summarize the result of this analysis. Based on this analysis, we observed only a slight increase in the total electricity consumption %-difference and a slight decrease in total natural gas consumption %-difference for both buildings. However, the reduced analysis resulted in a dampening of the magnitudes of all %-difference values, thereby reflecting a more accurate representation of model performance during these seasons.

In addition to comparing the model to the actual buildings' performance, we also compared the energy performance between buildings. Overall, Building A consumed approximately 10% less energy than Building B, relative to the model's estimate for annual consumption. Within this difference, Building A consumed 14.5% more electricity during the cooling season as well as a 16% more natural gas during the heating season.

	Total (kBtu)	Electricity (kBtu)			Natural Gas (kBtu)		
		Commodity Subtotal	Heating	Cooling	Commodity Subtotal	Heating	Cooling
Predicted	8,561,982	4,501,873	2,588,913	1,912,960	4,060,109	3,266,621	793,488
Actual	7,326,121	4,290,467	2,055,583	2,234,884	3,035,654	2,487,086	548,568
% Diff	14.4%	4.7%	20.6%	-16.8%	25.2%	23.9%	30.9%
% Total Difference	NA	17.1%	43.2%	-26.0%	82.9%	63.1%	19.8%

Table 8: Predicted/Actual Energy Usage for Coinciding Heating/Cooling Seasons (Building A)

	Total (kBtu)	Electricity (kBtu)			Natural Gas (kBtu)		
		Commodity Subtotal	Heating	Cooling	Commodity Subtotal	Heating	Cooling
Predicted	8,561,982	4,501,873	2,588,913	1,912,960	4,060,109	3,266,621	793,488
Actual	6,398,505	3,731,633	1,864,614	1,867,019	2,666,873	2,089,328	577,545
% Diff	25.3%	17.1%	28.0%	2.4%	34.3%	36.0%	27.2%
% Total Difference	NA	35.6%	33.5%	2.1%	64.4%	54.4%	10.0%

Table 9: Predicted/Actual Energy Usage for Coinciding Heating/Cooling Seasons (Building B)

2.4.2 Electricity Consumption Analysis

Figure 7 illustrates the daily electricity consumption for the buildings and the energy model. Overall, the model over predicts Building A's annual electricity consumption by only 4% while over predicting Building B's annual consumption by approximately 16%.

There are three general observations to be made from Figure 7. First, the actual data appear to confirm the reported buildings' mechanical system switchover dates as the end of April and October for segregating the data for further analysis. Note however that the model assumes the heating period lasts until June. Second, the model appears to more greatly overestimate electricity consumption during the heating season than the cooling season. Third, the model and actual data exhibit periodic spikes with noticeably lesser variance during the heating season than the cooling season.

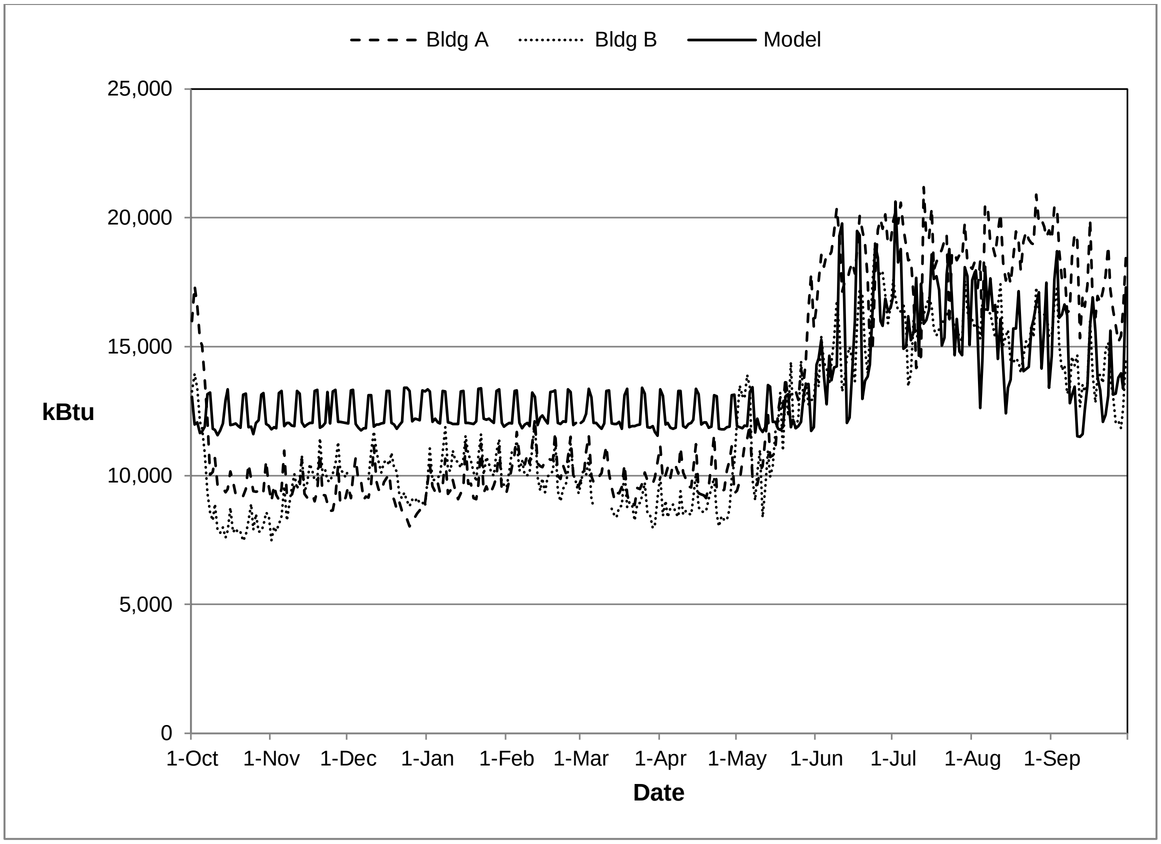

Figure 7: Daily Electricity Consumption (Actual vs Simulated)

Electricity Consumption - Heating Season

Figure 8 illustrates model and actual daily electricity consumption values during the heating season (Oct 2011 – Apr 2012) with holidays and weekend days specifically marked. In addition, the installation's days of non-scheduled activity for military personnel are also highlighted in the actual energy plots for Buildings A and B. The figure includes the data through May 2012 to highlight the visible rise in electricity usage as more occupants use the cooling system to maintain comfortable room temperatures as well as illustrate the model's assumption of heating through May and cooling beginning in

June. During the heating season (Oct – Apr), the model over predicts electricity consumption by approximately 19% and 26% for Buildings A and B, respectively. The actual consumption difference between the two buildings is approximately 10%, relative to Building A's consumption. Note the observed variance in actual consumption between buildings themselves, particularly from October through December, which may suggest varying occupancy levels among the buildings. During this period, Building B begins by consuming nearly 20% less than Building A, but ends the period consuming more than Building A by just over 10%. The noticeable dip in actual energy consumption for both buildings in late December is likely due to tenants traveling during the holiday season.

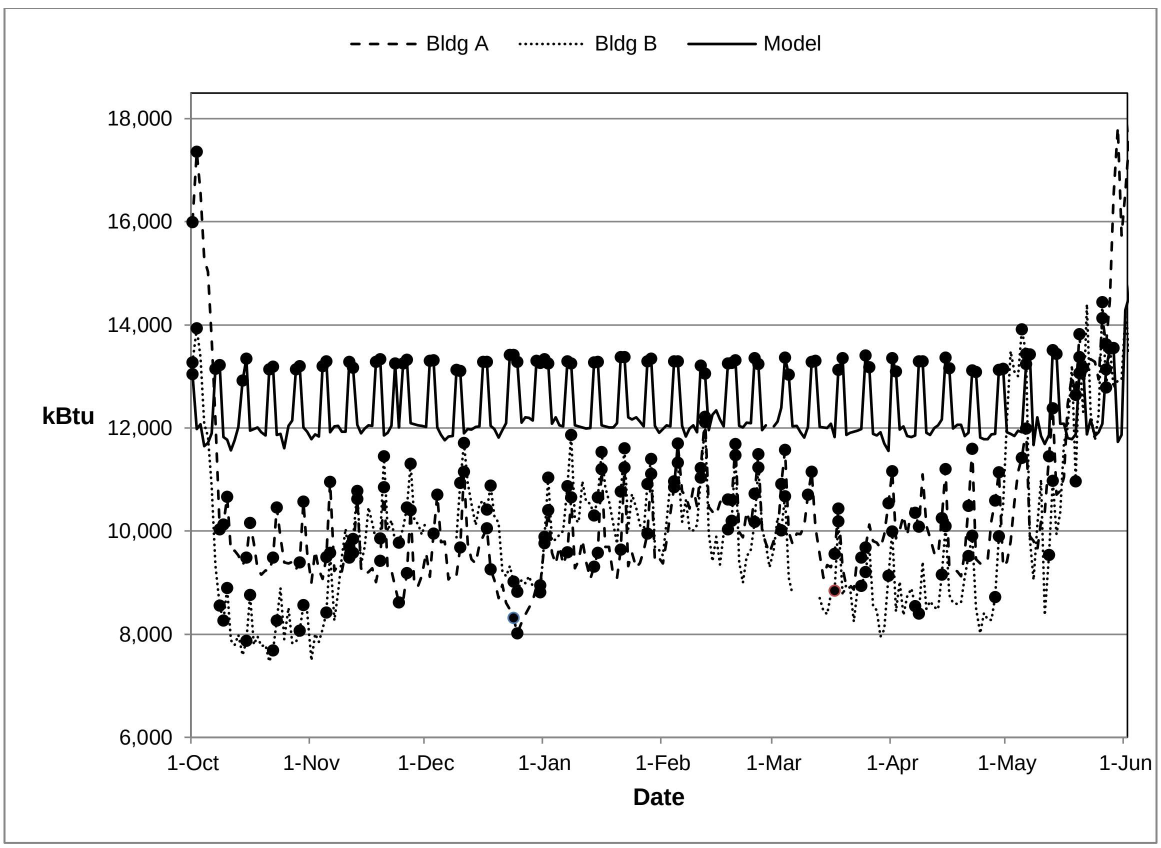

Figure 8: Daily Electricity Consumption - Heating Season (• denotes holiday or weekend)

Upon closer inspection of the observed spikes in the simulated data, we noticed they occurred on only weekends and days classified as holidays in the energy model. It's also interesting to note the noticeably small range of variance among the model's weekend and holiday energy consumption values as well as the range of simulated values from week to week. To evaluate the model's projection of significantly greater electricity consumption on weekends and holidays, relative to weekdays, we first highlighted all weekend and designated holidays energy values in Figure 8 to provide an illustrative comparison. With very few exceptions, nearly all periodic spikes in electricity consumption (for both buildings) fall on a weekend day or holidays. Figure 9 illustrates Building A's actual consumption relative to the model to more clearly observe the weekly energy consumption spikes occurring on weekends. There also appears to be a distinct trend of greater electricity consumption on Sundays than Saturdays which contradicts the model's simulated outputs of nearly even consumption on Saturday's, Sunday's, and holidays. However, we only tested statistical significance between average weekly weekday and weekend/holiday consumption.

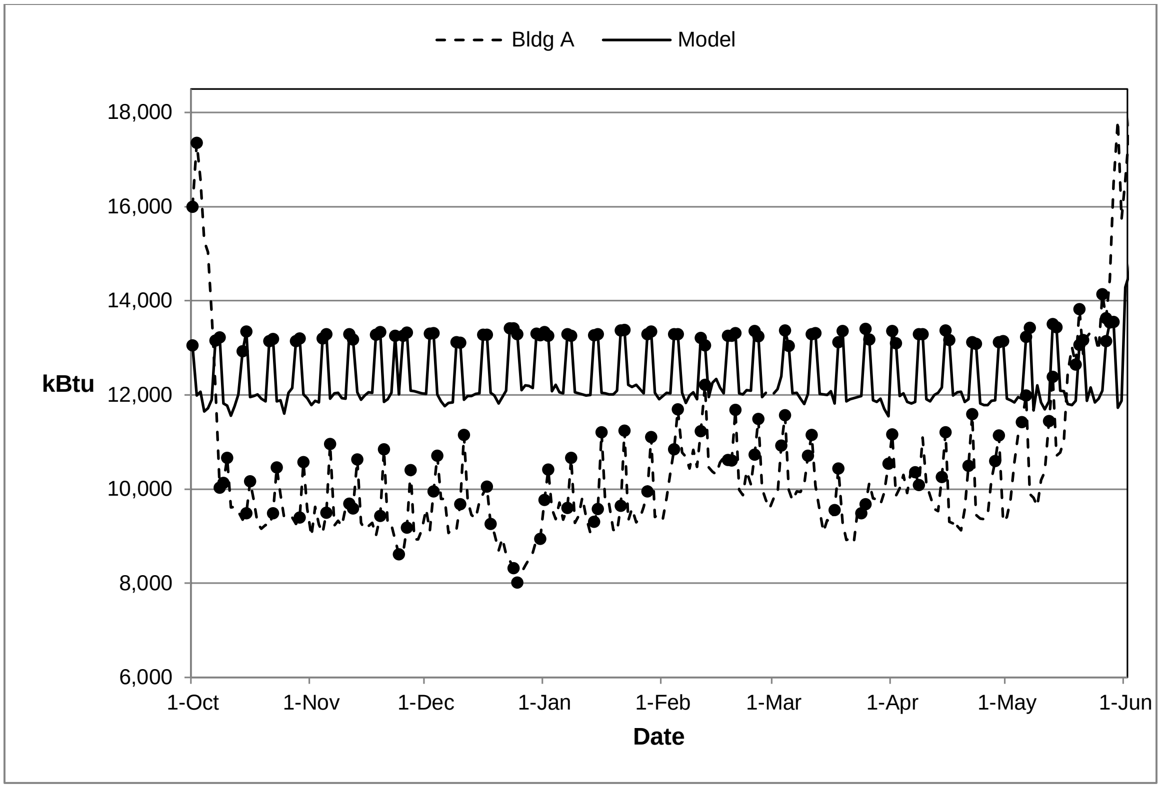

Figure 9: Building A and Model Electricity Consumption (Heating Season)

To further test the model's assumption of increased electricity usage on weekends (presumably due to increased occupancy levels), we conducted a paired t-test using the buildings' actual energy consumption data. The daily energy data were first converted to weekly paired, weekday and weekend/holiday averages and then tested for normality and independence to satisfy the assumptions of the paired t-test. We tested these assumptions by creating normal quantile plots to evaluate normality and time series plot for independence. In order to be considered a valid data point, the weekly weekday average had to consist of at least 3 weekday consumption values, while the weekend average values had to contain at least Saturday and Sunday values. Holidays occurring on a Friday or Monday were included in calculating weekly weekend values while holidays falling on Tuesday through Thursday were excluded from the weekly weekday calculation. Figure 10and Figure 11 illustrate the normal quantile plots for Building A and B’s respective electricity consumption during the heating season. In addition, Figure 12 illustrates the buildings’ time series plot.

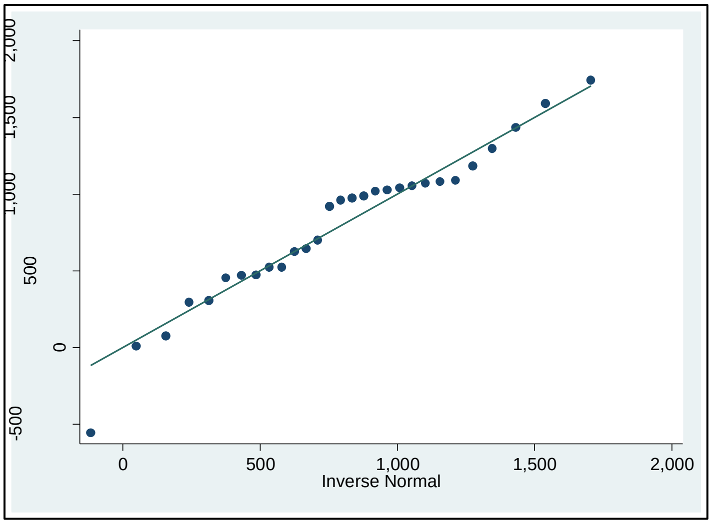

Figure 10: Normal Quantile Plot of Building A's Weekly Difference between Average Weekend and Weekday Electricity Consumption (Heating Season)

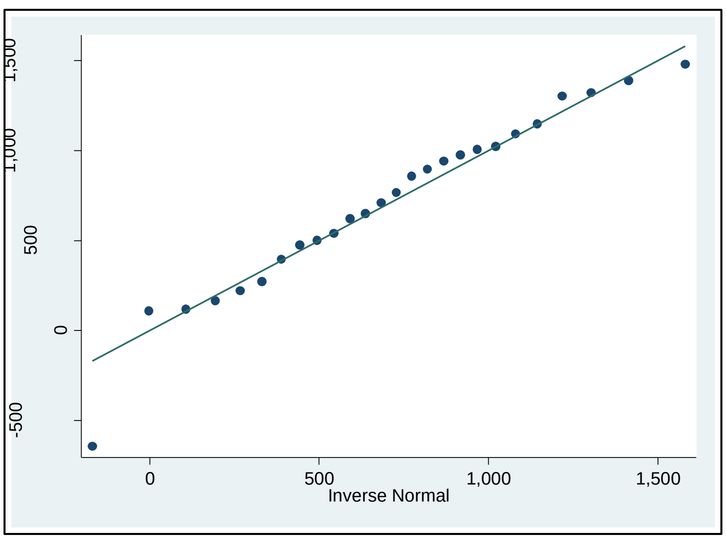

Figure 11: Normal Quantile Plot of Building B's Weekly Difference between Average Weekend and Weekday Electricity Consumption (Heating Season)

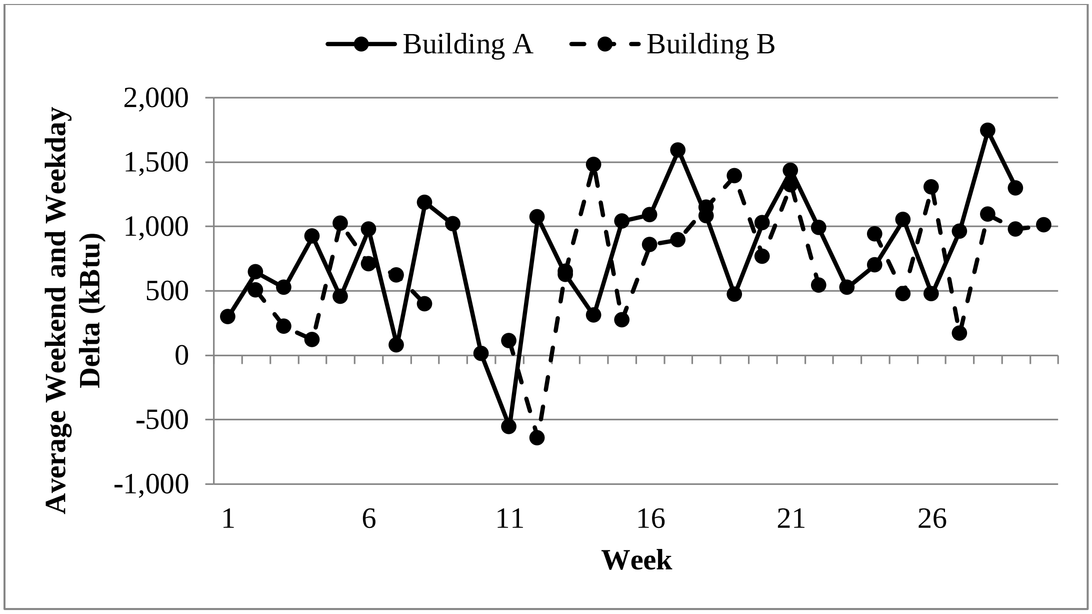

Figure 12: Time Series Plot of Average Weekend and Weekday Delta Electricity Consumption

A visual inspection of these figures was conducted to determine the appropriate statistical test. Building A's quantile plot (Figure 10) revealed skewness and therefore non-normality while Building B's quantile plot (Figure 11) comprised of a data set that satisfies the normality assumption. In Figure 12, we did not detect a visual, cyclical pattern in the time series data and therefore was satisfied with the assumption of independence. To account for the non-normality exhibited in Building A's data, we utilized the Wilcoxon matched-pairs signed rank test. For each subsequent segregated dataset, we applied this same approach to determine the appropriate statistical test

Applying the appropriate statistical test to each building's respective data resulted in p-values of <0.00001 for both buildings, a strong indicator of the model accurately predicting significantly greater electricity weekday consumption over weekend/holiday usage during the heating season.

Electricity Consumption - Cooling Season

Figure 13 illustrates modeled and actual electricity consumption of Buildings A and B for the cooling season (May – Sep 2012). Overall, the model under predicts Building A's consumption by approximately 16% while only over predicting Building B's consumption by only 1%. The figure also marks weekend and holiday periods, but there is noticeably more variation in daily consumption values as compared to the heating season. This is likely due to the additional cooling load as indicated by the relatively high correlation values calculated between Building A and B's electricity consumption and actual CDD_{50} as 0.6595 and 0.8510, respectively. Conducting the paired t-tests again for Buildings A and B resulted in p-values of 0.0000, 0.0038, respectively, again indicating the model correctly predicted significantly greater electricity consumption during the weekends during the cooling season.

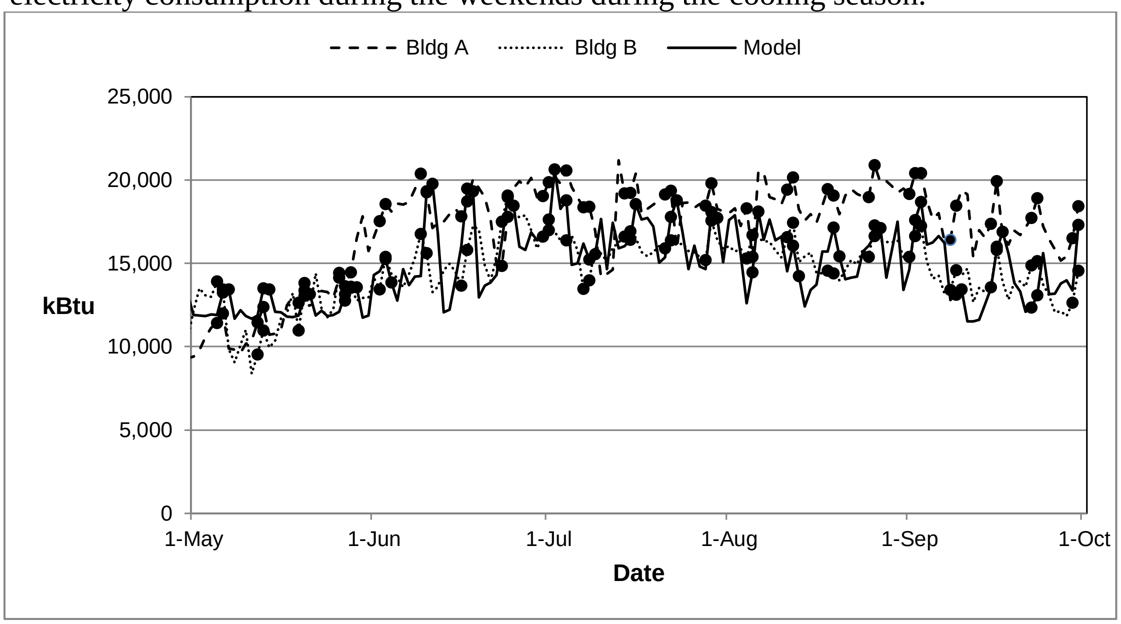

Figure 13: Daily Electricity Consumption (Cooling Season)

2.4.3 Natural Gas Consumption Analysis

Figure 14 illustrates the predicted and actual daily natural gas consumption for the same time period covered in the previous section. Overall, the model over predicts natural gas consumption by approximately 27% and 35% for Buildings A and B, respectively. The figure also shows a stark difference in consumption during the transition from the heating to cooling season as the model predicts a constant consumption value during cooling. This is likely due to no boiler usage during the cooling season as well as the model's assumption of the buildings being consistently 100%-occupied throughout the year.

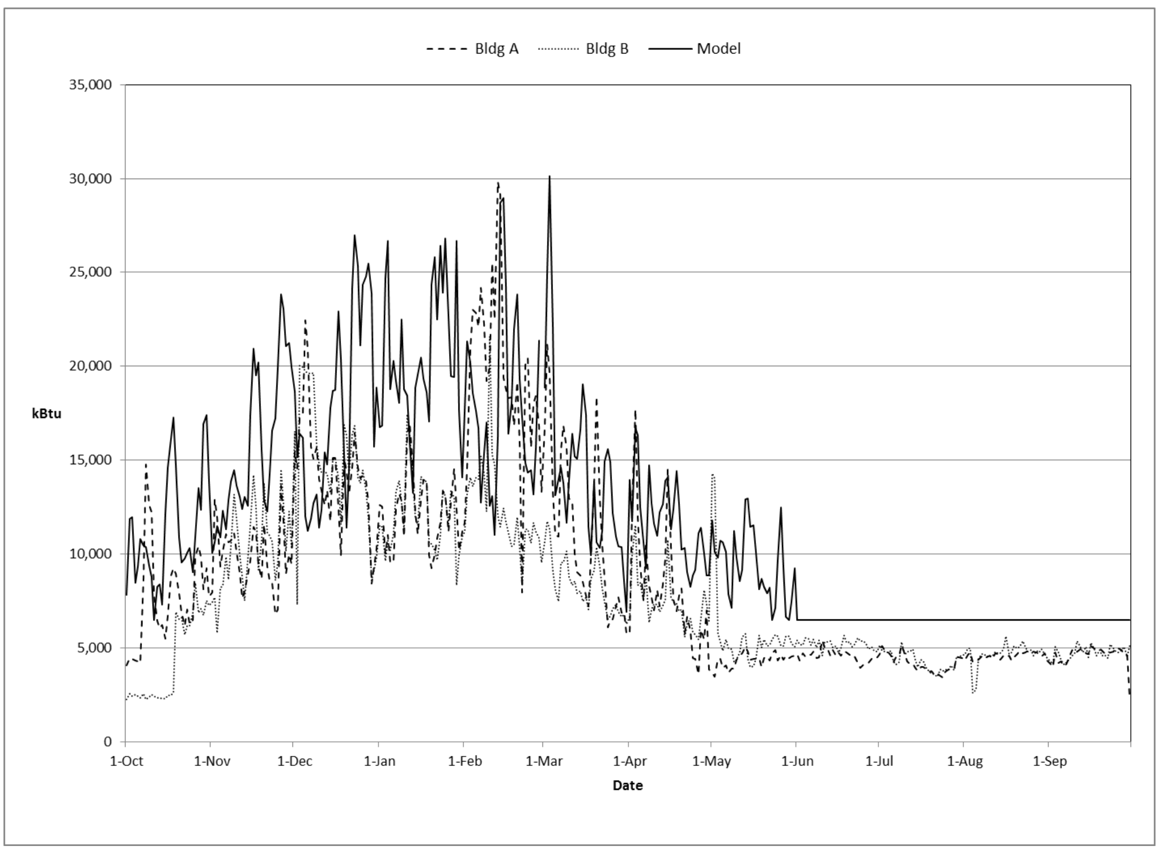

Figure 14: Total Daily Natural Gas Consumption (Actual vs Simulated)

Figure 15 illustrates the buildings' segregated natural gas consumption values as measured from each building's north and south meter as well as the buildings' reported daily occupancy rates. Weekends and holidays are highlighted during the heating season, but do not visibly appear to correlate as well to periodic spikes in consumption, as compared to electricity consumption during the same season. The buildings' north meters measure natural gas consumption for boiler and domestic hot water (DHW) end uses in the buildings' respective north mechanical room, while the buildings' south meters stay relatively more constant throughout the year as the meters measure consumption for only DHW in the buildings' respective south mechanical room. Utilizing data from both meters enables us to further approximate natural gas consumption for boiler end use by segregating natural gas consumption used for DHW. The following section explains the method used for further segregating natural gas consumption into boiler and DHW end uses.

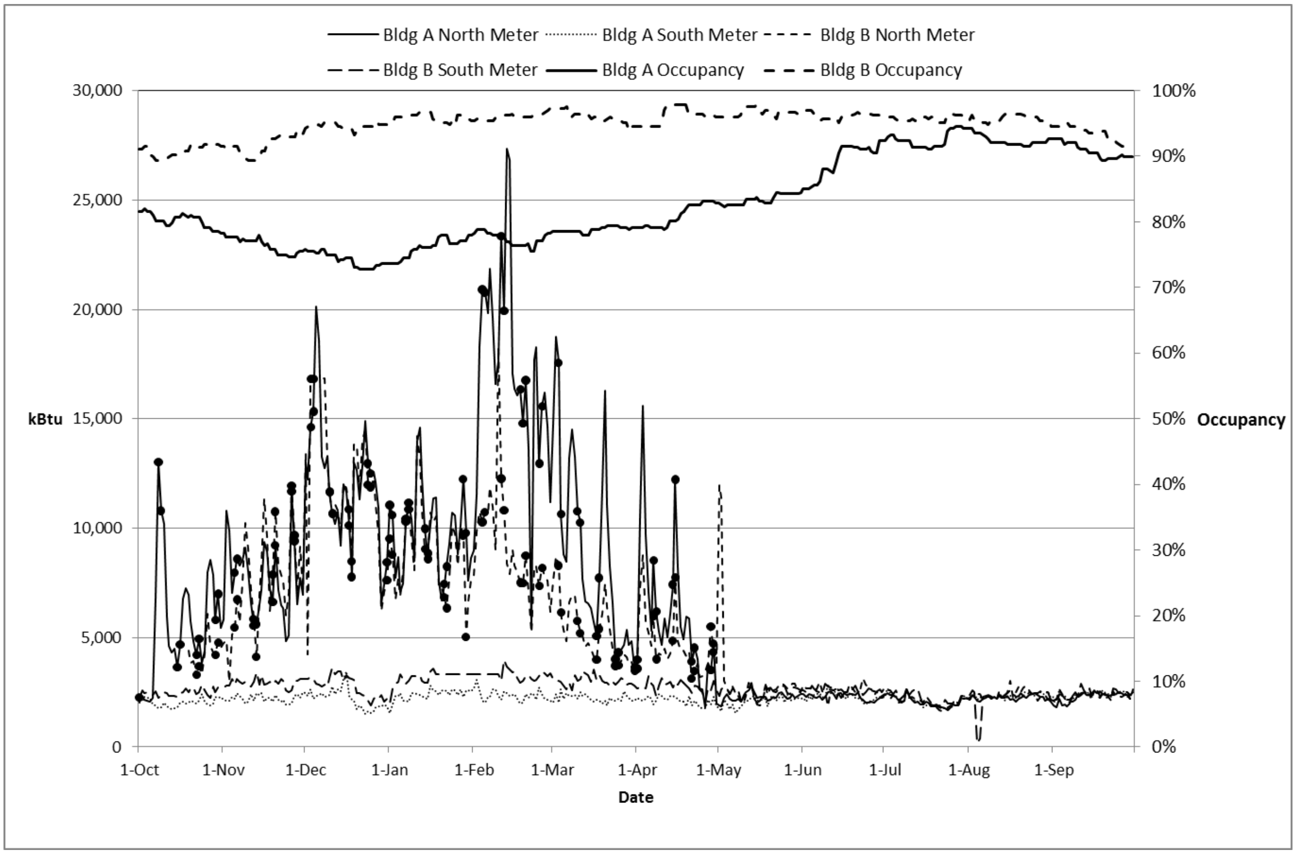

Figure 15: Daily Natural Gas Consumption (North and South Meters) and Daily Occupancy

Natural Gas Consumption - Cooling Season

During the cooling season, DHW represents the only natural gas-supplied end use. The model assumes constant consumption throughout this season and the actual energy data appear to follow that pattern as well. Conducting the paired t-test to compare weekday and weekend/holiday consumption resulted in p-values of 0.8085 (Building A) and 0.9165 (Building B), thereby further supporting the model's assumption of uniform consumption throughout the season. Since the model assumes a constant value for natural gas usage for DHW, we can compare predicted and actual consumption beyond the period of coinciding cooling seasons (refer to Table 8 and Table 9) to the actual cooling season of May – October. Under these circumstances, the calculated %-difference values of 31.3% and 25.2%, respectively for Building A and B, are similar to the values listed in Table 8 and Table 9.

During the heating season however, the buildings' boilers utilize natural gas as well. In order to distinguish the natural gas supplied to the boiler from natural gas used for generating DHW, we first assumed the natural gas used for supplying DHW in the north and south mechanical rooms were equal. Under this assumption, the natural gas used for space heating (e.g. boiler) may be approximated by subtracting the south natural gas meter reading from the north natural gas meter reading (Equation 3).

Equation 3: Daily Boiler Natural Gas Consumption $\approx$ North Meter $_{\text{Natural Gas}}$ – South Meter $_{\text{Natural Gas}}$

Figure 16 illustrates the north and south natural gas meters for both buildings during the cooling season. Visibly inspecting the data indicate the north and south meters are very close in value. To further test this assumption, we performed a paired t-test that compared the north and south natural gas meter readings during non-heating periods for both buildings to determine if a statistically significant difference in the weekly meter readings existed.

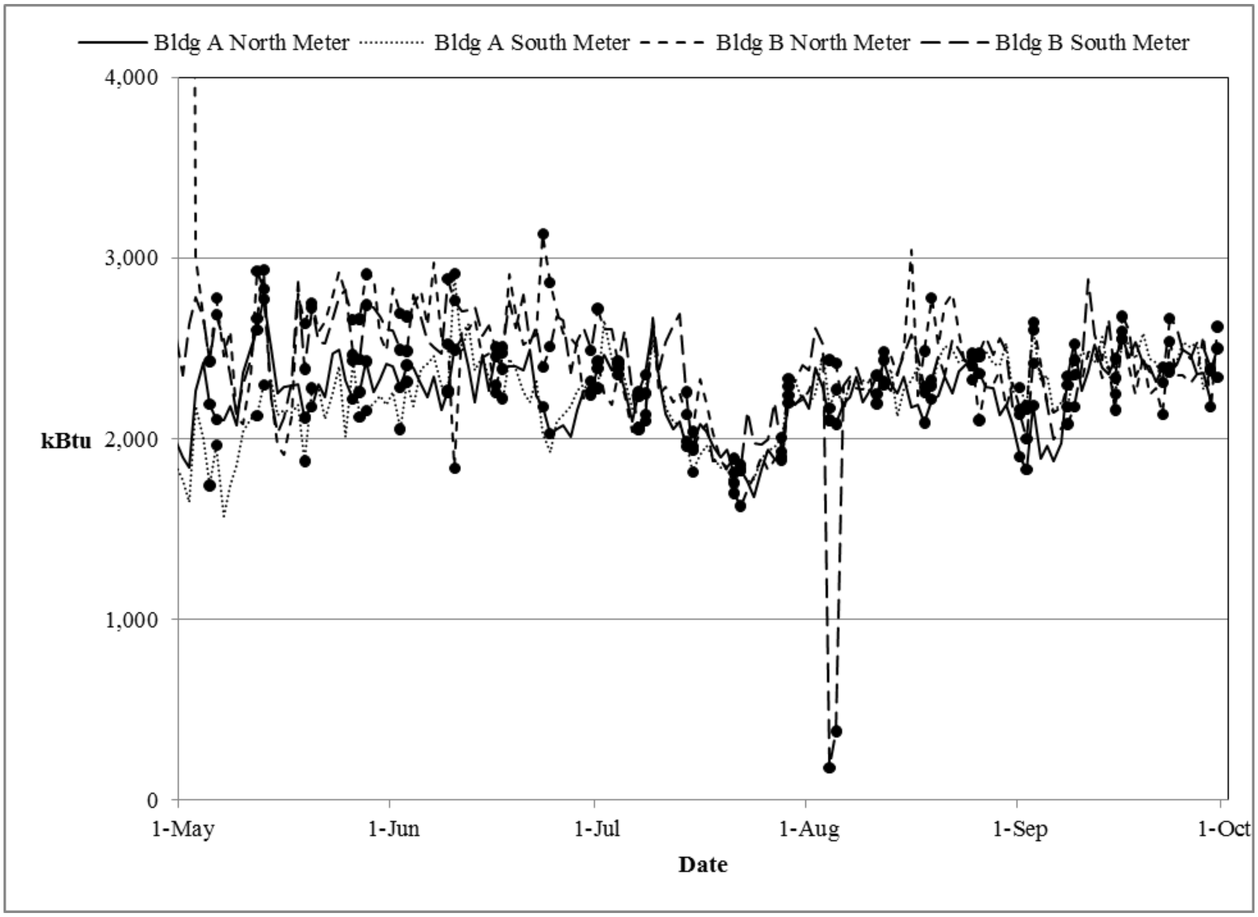

Figure 16: Daily Natural Gas Consumption (Cooling Season)

The resulting p-values for Buildings A and B of 0.7585 and 0.8616, respectively, indicate failure to reject the statistical test's null hypothesis of equal means. This results in two outcomes. First, it lends further support in approximating the boiler's natural gas usage described in Equation 3. Second, it allows us to approximate natural gas consumption, given in Equation 4:

Equation 4: Daily DHW Natural Gas Consumption ≈ 2(South Meter$_{\text{Natural Gas}}$)

Natural Gas Consumption - Heating Season

Figure 17 illustrates natural gas consumption during the heating season. Despite significant differences in reported daily building occupancy rates throughout the season, building consumption is nearly identical from October – February and then exhibits a larger difference from February - April. Note from Figure 15 that the building consuming the greater natural gas during this time period also exhibits the lesser reported occupancy.

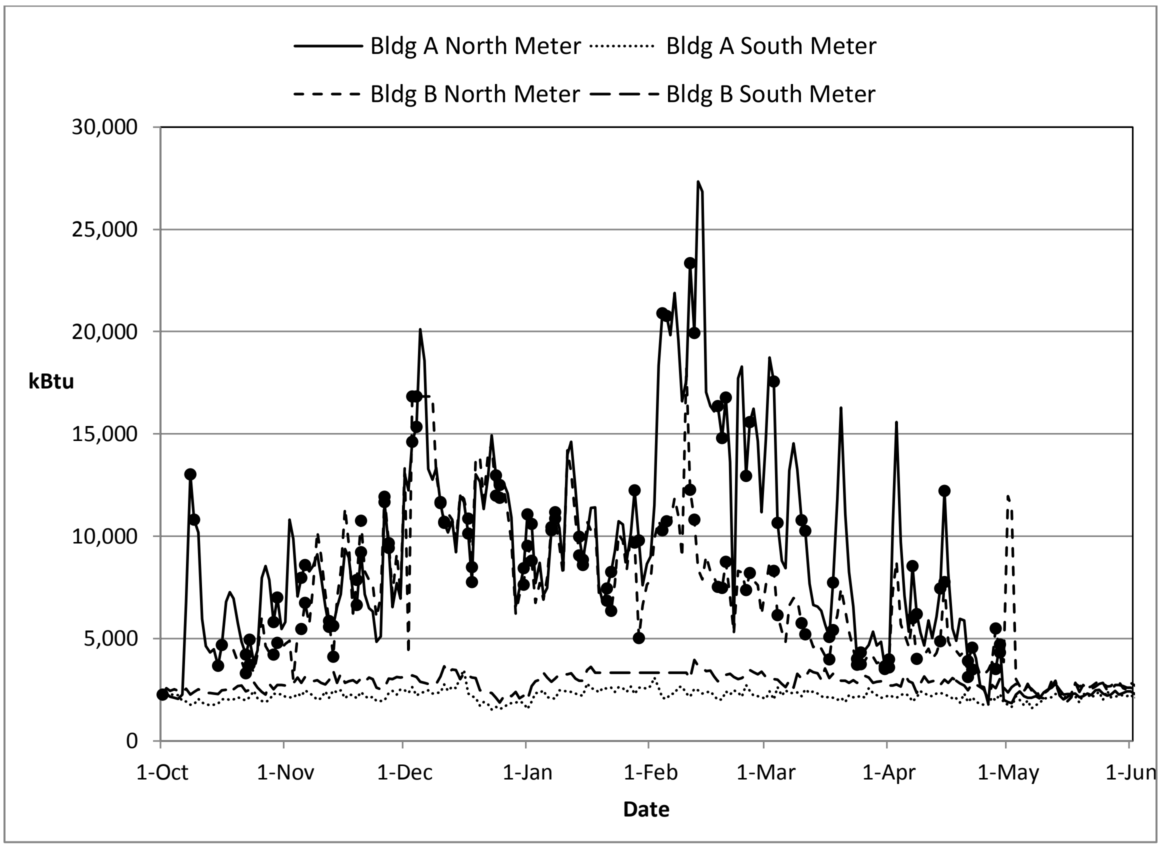

Figure 17: Building Daily Natural Gas Consumption (Heating Season)

A visual inspection of Figure 17's periodic consumption spikes and corresponding weekends and holidays did not indicate a clear correlation between peak consumption times and weekend/holiday time periods. This observation was also supported by the paired t-test's p-values for Buildings A and B of 0.5157 and 0.8785 indicating no significant difference between weekday and weekend/holiday consumption. Unlike electricity consumption that showed a strong tendency for greater non-workday use, periodic spikes in natural gas usage appear more weather-related. The correlation coefficient between Building A and B's natural gas consumption and HDD_{65} was 0.8071 and 0.7953, respectively.

Weekday and Weekend/Holiday Energy Consumption Summary

The previous sections discussed paired t-tests conducted on Building A and B's electricity and natural gas weekly average consumption during the heating and cooling seasons. We next conducted the same paired t-tests on the building energy model's simulated energy data and compared the results. Table 10 lists the p-values of all t-tests performed for the model and Buildings A and B. We didn't perform a paired t-test on the model's natural gas data during the cooling season since the model assumed constant consumption. Overall, the model's p-values correspond very well with the building's p-values. The t-tests performed on electricity data for both seasons all indicated significantly greater consumption on weekend/holiday periods, and therefore lend support to the model's assumption regarding greater occupancy during the weekend and holiday periods. The t-tests conducted on natural gas however, indicated different results, all showing high p-values resulting in the failure to reject the test's null hypothesis of equal consumption between weekday and weekend/holiday averages. The higher p-values observed for the heating season's natural gas data may be due in part to outdoor temperature exerting a greater influence on natural gas consumption, as indicated by the correlation coefficient values. The higher p-values seen for the cooling season's natural gas data actually correspond well with the model's original assumption regarding constant natural gas usage during the cooling season.

	Electricity		Natural Gas	
	Heating Season	Cooling Season	Heating Season	Cooling Season
Model	<0.0001	0.0011	0.6535	NA
Building A	<0.0001	0.0038	0.5157	0.8085
Building B	0.0036	0.0015	0.8785	0.9165

Table 10: Summary of paired t-tests comparing weekday to weekend energy consumption

Natural Gas Consumption – End Uses

Unlike electricity, where segregating the energy data by end use was unattainable due to numerous end uses and insufficient sub-metering, segregating the natural gas data into boiler and DHW usage was attainable. Table 11 summarizes the approximated %-differences between model and actual natural gas end uses for Buildings A and B based on coinciding season dates. Using Equation 3, we estimated the %-difference in natural gas consumption dedicated to boiler operations between October – April for the energy model and the buildings actual consumption to be 22.9% and 52.0%, respectively, for Buildings A and B.

	DHW			Boiler
	Total	Cooling	Heating	Total
Bldg A	31.5%	31.7%	31.3%	22.9%
Bldg B	16.2%	10.3%	24.2%	52.0%

Table 11: Approximated % Differences Between Model and Actual Natural Gas End Uses

Likewise, the annual natural gas consumption for DHW was estimated using Equation 4 during the heating season and the combined north and south meter readings during the cooling months. Performing this calculation yielded % differences of 31.5% and 16.2%, respectively or Buildings A and B. While Building A's DHW %-difference by season was very similar, Building B's DHW %-difference exhibited a greater range of difference between cooling and heating season.

Occupancy

The model assumes 100% occupancy throughout the year and uses a weekday and weekend/holiday schedule to simulate daily use. While this assumption stands as reasonable during the modeling effort during the building's design phase, the data somewhat contradict this assumption.

Figure 18 illustrates Building A and B's daily reported occupancy rates (maintained by the installation's housing division) from October 2011 – November 2012. During this time period, Building A's occupancy rates spanned 22% from 73% – 95%, while Building B's occupancy showed higher and more stable occupancy, ranging from 89% - 98%.

While the occupancy rates clearly indicate less than a continuously, fully-occupied building, the rates only account for when a room has been assigned to a tenant. The rates do not account for tenants' prolonged absences for training, vacation, or other activities. In order to gain better insight regarding the buildings' actual occupancy that accounts for tenant absence, we superimposed the buildings' daily water consumption values collected from the buildings' south water meters onto the daily occupancy rates, as a proxy or indirect measure of the buildings' actual occupancy, also illustrated in Figure 18. We selected the buildings' south water meters as they measure water consumption strictly for indoor building usage. The buildings' north water meters measure water usage not only for indoor consumption, but also water used during the irrigation season, as well as to supplement the boiler/chiller operation. We were unable to further segregate the north water meter data into these activities, and hence did not include in this portion of the analysis.

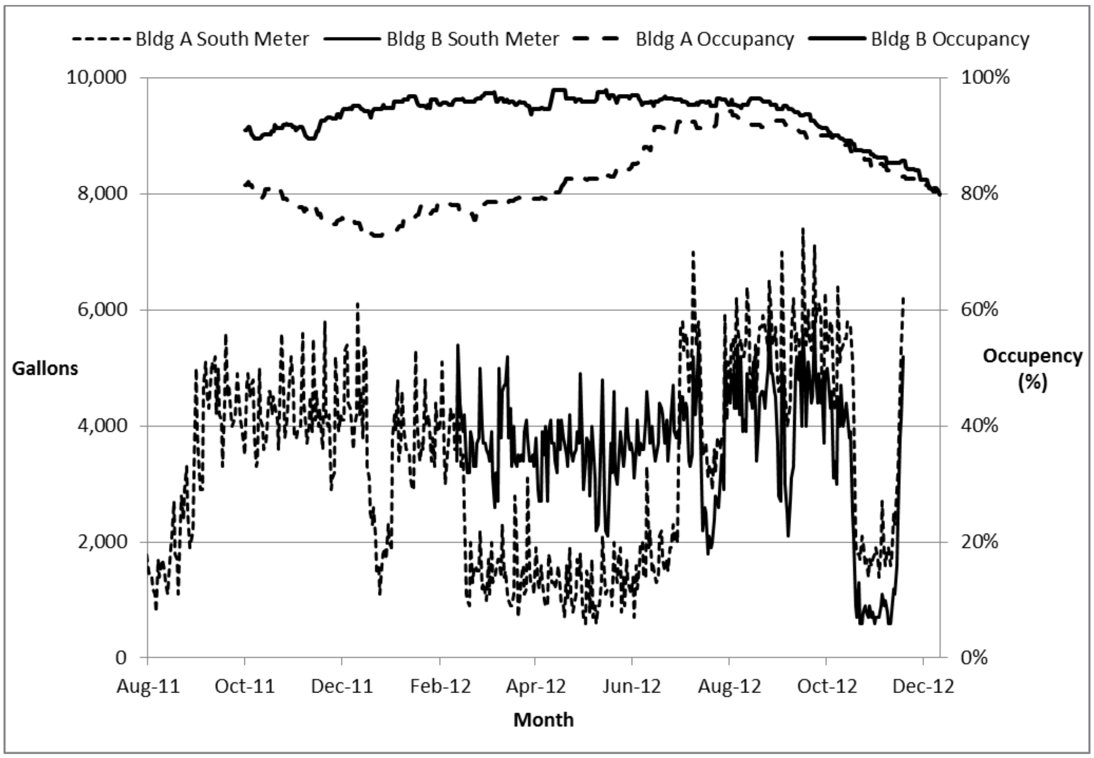

Figure 18: Daily Building Water Consumption (South Meter) and Occupancy Rates

Observing the south meter water data reveals significant changes in consumption, and therefore conceivably actual occupancy as well. Building A's water data contains significant changes during August 2011, late December 2011 (presumably for tenant holiday travel), February – July 2012, and mid-October – mid-November 2012. Building B's water data tends to be relatively more stable with a noticeable two-week dip during late July 2012 (similar to Building A) as well as the much larger decrease observed coinciding with Building A's decrease in mid-October – mid-November 2012. Note the greatest significant difference in water consumption between the two buildings (February - June 2012) corresponds with the aforementioned difference in building natural gas consumption of the same timeframe. The periodic peak in weekly water consumption also exhibited a strong tendency for peaking on Sunday's or the last day of an extended, 3-4 day weekend.

2.5 CONCLUSIONS

The purpose of this analysis was to identify potential sources of model error through the comparative analysis method presented in this chapter. While the model appeared to accurately reflect the as-built building based on review of as-built drawings, the model incorrectly assumed the mechanical system changeover date from heating to cooling by a month. This resulted in greater over-estimated heating season %-differences and higher under-estimated cooling season %-differences that required re-analysis by considering only the coinciding time periods within seasons. To prevent this type of modeling error in future efforts, we suggest close coordination with the building maintainers during the energy model's design phase to ensure actual building operation and maintenance activities that influence energy consumption are reflected in the model.

Building occupancy was an additional factor that appeared to differ from the model's assumptions. We evaluated two aspects of occupancy in this chapter. First, the model's assumption of greater occupancy during the weekends and holidays compared to weekdays appeared as a valid assumption. The paired t-tests performed on electricity consumption indicated significantly different consumption values between these time periods. In addition, the buildings' daily water consumption patterns also indicated higher usage during the weekends, and especially during the day prior to the beginning of the following work week. Future work in this area could further explore weekend and holiday consumption patterns to determine whether the model's assumption of equal occupancy levels throughout the weekend and holiday period are still valid.

The model also assumed 100% occupancy throughout the simulation period. While valid for simulation purposes when comparing alternative designs, the buildings occupancy rates exhibited significantly differing values throughout the analysis period, as evidenced by the housing management division's recorded occupancy rates as well as the buildings' daily water usage data. Further research should examine methods for quantifying the relationship between building water consumption and actual occupancy and methods for integrating the use of probabilistic methods for modeling occupancy within building energy models.

The comparative analysis performed through data segregation provided more perspective with regard to identifying relative sources of error in the model. One disadvantage of evaluating model performance based solely on EUI values is the inability to detect modeling errors canceling out one another.

Chapter 3 Integrating Probabilistic Methods for Describing Occupant Presence with Building Energy Simulation Models

This chapter presents a method for developing and integrating a probabilistic-based occupancy model that focuses on occupants' long vacancy activities (greater than 1 week) and other potential building underutilization into a building energy simulation model. The combined model is then applied toward an existing Leadership in Energy and Environmental Design (LEED) certified military dormitory and later compared with corresponding values from the energy model's original prediction as well as actual building energy data. The occupancy model simulates annual building occupancy rates comprised of weekly values based on the frequency, duration, and seasonality of occupants' long vacancy activities. The energy model then converts the simulated occupancy rates to yield the building's predicted range of energy performance. Applying the combined model to the existing LEED building resulted in an improved, predicted Energy Use Intensity mean value of 53.8 kBtu/gsf as compared to the original model and actual energy usage values of 60.8 and 51.9, respectively. While the model also demonstrated its utility in describing the change in predicted performance over a range of probabilities associated with certain long vacancy activities, efforts to incorporate other occupant behavior-related aspects such occupant schedules and thermal set points could further improve modeling efforts.

3.1 Introduction

Building energy modeling remains a key element in the design of energy efficient and sustainable buildings. The United States (U.S.) Department of Energy's (DoE) Office of Energy Efficiency and Renewable Energy cites nearly 400 building energy simulation software tools available for use in simulating various building design alternatives' impact on energy consumption [29]. Buildings consume a significant amount of energy as compared to other sectors, such as transportation and industrial. According to the DoE, the residential and commercial building sector accounted for approximately 41% of the nation's total energy consumption in 2010 [30]. As buildings continue to use a significant portion of the total energy consumed, building energy models will continue to play an intricate role in the design of new buildings and renovation of existing ones for both the private and public building sectors.

The literature contains numerous studies that evaluate the effectiveness of energy modeling efforts by comparing predicted to actual energy consumption, particularly buildings certified through the Leadership in Energy and Environmental Design (LEED) program [17-21, 24, 31]. Turner and Frankel's [19] large study of 121 LEED buildings cited that from a programmatic standpoint, the energy models predict building energy consumption rather well. However, they also concluded that significant variance existed between predicted and actual energy consumption values among individual buildings and that further research was necessary to further explain these sources of model error.

Sources for building energy model error can normally be attributed to one of four different areas: differences between the energy model parameter values and the as-built building, its mechanical systems, or presumed activities within designated spaces within the building not accounted for in the model; building systems operating at suboptimal performance levels, perhaps due to insufficient commissioning or maintenance activities; differences in climate conditions affecting building performance; and occupant influence. Torcellini's [31] study of six high-performance buildings revealed inadequate building controls to enable efficient integration of building systems, less than expected savings from daylighting and photovoltaic (PV) systems, higher than expected plug loads, over estimating the building's effective insulation values, and an overly optimistic estimation of occupant acceptance of building systems as actual sources of model error.

The latter of these actual sources of model error fall under the broader category of occupant influence. As building energy models become more sophisticated in predicting energy consumption, future models will seek to incorporate the vast variation that lie within building occupant influence. Occupant influence on building performance can be further divided into occupant behavior and presence. Most energy modeling efforts describe occupant behavior and presence through predetermined occupant schedules and assumed plug load factors that deterministically describe occupant influence in the building's energy consumption. For example, building energy models typically use weekday and weekend schedules to model occupant presence throughout the week. However, while these model assumptions may hold under certain circumstances, they do not describe the explicit variation normally observed among building occupants. They do not account for variation within individual work schedules, energy consumption related behavior, or periods of intermediate and long vacancy. Past research studies have tried various methods for describing occupant behavior and to a lesser extent, occupant presence, and will be described in greater detail in the literature review section.

Figure 19 illustrates the reported, actual occupancy for two, identically-constructed, and co-located LEED-certified military dormitory buildings and their associated water usage. The primary vertical axis represents the building's daily reported occupancy as reported by the military installation's housing management office. The secondary vertical axis represents the building's daily water intake (gallons) which is used as an indirect measure of the building's actual occupancy within the building. The illustration serves two purposes. First, it illustrates that unlike the respective building energy model's assumption of fully-utilized dorm rooms throughout the year, the number of unassigned rooms varies not only with time, but also among buildings.

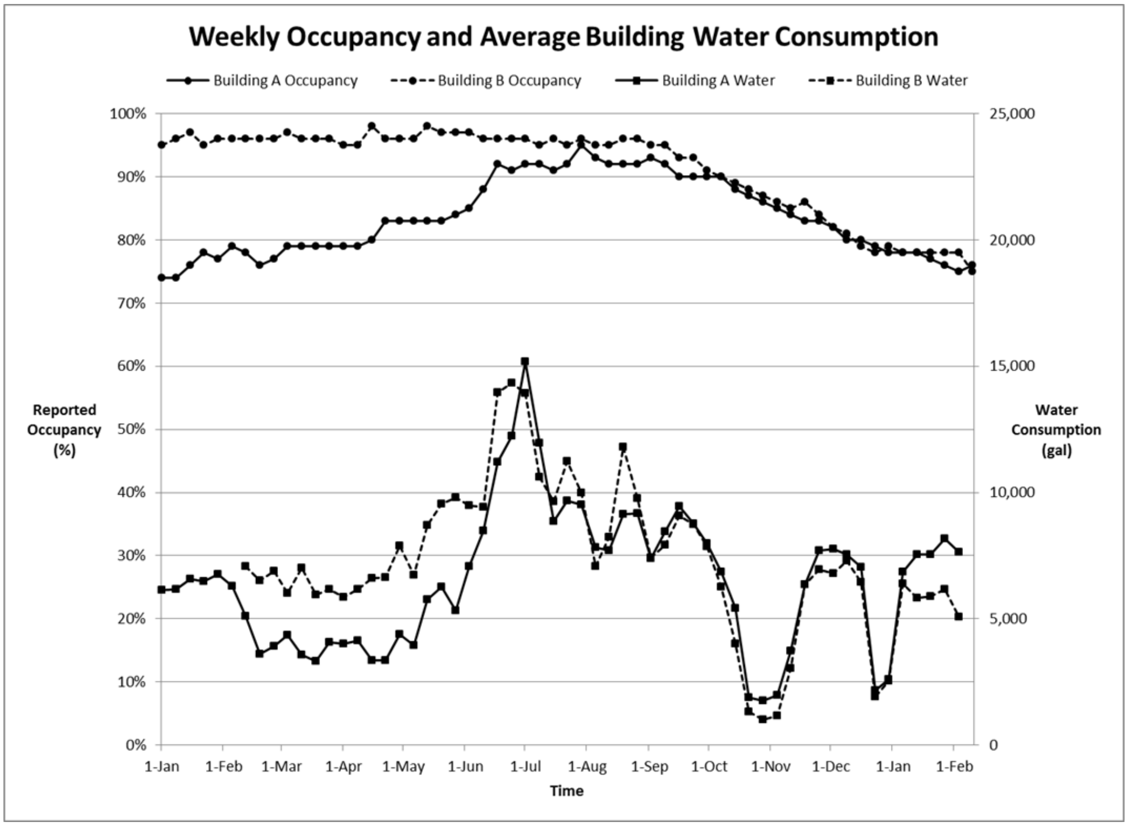

Figure 19: Reported Daily Occupancy Rates and Average Weekly Building Water Consumption

Second, the noticeable spikes and troughs in building water consumption illustrate that the reported occupancy data does not account for tenants' long vacancies, but do in fact occur. The increase in water consumption observed in both buildings from May through September may partly be explained by the building's usage of additional water for outdoor irrigation purposes. But it does not account for other occurrences, such as the larger troughs observed in November and December, and Building A's noticeable decrease from February to May. These observed variations in reported occupancy as well as presumed actual occupancy obtained from the buildings water usage data ultimately contribute to lowering the building's actual annual energy consumption, an effect not accounted for in the original building energy model. Further research is therefore necessary to integrate building occupant presence and more specifically, long periods of vacancy, to better describe building energy consumption.

The purpose of this study is to propose a method that accounts for the potential variance in occupant presence, specifically long vacancies, through probabilistic methods that are in turn integrated with the building energy model. For demonstrative and validation purposes, we then applied this method toward the aforementioned military dormitory building and compared these results with the original model's prediction and actual energy consumption results.

3.2 LITERATURE REVIEW

Integrating user impact with building performance through occupants' related behavior and presence patterns are important elements in any whole building energy simulation analysis. The occupant's presence within a building changes the indoor environment resulting in changes to building energy performance. Occupants influence building energy consumption through a variety of activities such as emitting heat and water vapor through mere presence, making changes to the building's indoor environment such as opening/closing window shades and adjusting thermostat controls, and engaging in work and leisure-related tasks conducted within the building. Degelman [32] noted that the building's operational characteristics, implicitly implying occupant behavior, can have an even greater impact on building energy performance than the building's thermal envelope. However, much less has been done on modeling building occupant behavior as compared to building systems. The American Society of Civil Engineers (ASCE) Visualization, Information Modeling and Simulation (VIMS) technical committee states that accurately modeling building occupant behavior is a challenge that demands attention [33].

Integrating behavior models with whole building energy models largely began with incorporating behavior models with energy models associated with indoor artificial lighting. Hunt [34] began this area of research by translating detailed observations of how people used indoor lighting under varying circumstances into a prediction model for the likely use of manually-operated lighting systems. His research produced broad assumptions regarding how occupants use indoor lighting that further formed the basis for developing an associated energy prediction method.

Unfortunately, many building energy models typically address user presence and behavior through static and rigid methods such as occupant profiles and consumption factors. The occupant profiles generally consist of 24 hourly values representing the percentage of an assumed peak load. Building energy models may also use separate schedules for weekdays, weekends, and holidays to account for the assumed differences in usage based on building type during these time periods. Page et al. [35] listed multiple shortcomings of this approach that included over simplifying the variety of occupancy patterns among building occupants during weekdays or weekends and excluding atypical behaviors such as intense presence or long periods of vacancy, all of which can be accounted for when observing actual energy data. This agrees with Degelman [32] who noted that energy models tend to better align with reality when building operations are more constant and routine (e.g. when the occupant exhibits less control over indoor environmental conditions). Kwok and Lee [36] further illustrated this shortcoming in their study of relating occupant behavior to building energy consumption. Their study consisted of evaluating a large office building comprised of numerous multi-national firms that utilized the building during various sets of business hours.

Bourgeois et al. [37] addressed these shortcomings by developing a behavior model that accounted for the variety and frequency of occupant responses to adjusting indoor lighting levels. He integrated a sub-hourly occupancy-based control (SHOCC) model with the Lightswitch2002 behavior model, developed by the contributions from Newsham et al. [38] and Reinhart [39], into the whole building energy simulation program ESP-r so that the related effects on heating and cooling requirements could be better realized. In this study, he demonstrated a savings of greater than 40% in energy consumption resulting from building occupants actively seeking daylighting solutions as opposed to relying on artificial means. The author also cited however, that this approach while adequate for buildings containing single occupancy patterns like a classroom or single-person office may be somewhat unsuitable for buildings containing more complex occupancy patterns. Tabak and de Vries [40] later extended Bourgeois' work by developing a User Simulation of Space Utilization model that simulates actual occupant movements within building spaces.

While integrating human behavior into energy models began with activities associated with controlling the indoor environment, additional research has focused on greater levels of complexity regarding occupant activities affecting energy consumption. Tabak and de Vries [40] studied intermediate activities in office buildings that require users to move through the building's spaces. Hoes et al. [41] recognized the growing range of complexity in integrating occupant behavior with building energy simulation models and prescribed a methodology for determining the appropriate level of behavior resolution in a modeling effort.

The study of occupant presence and absence in a building is another aspect of occupants' impact on building energy performance. Wang et al. [42] focused on intermediate periods of presence and absence among building occupants of single person offices in a large office building. From the data collected from individual office motion detectors, she developed a prediction model that could simulate the building's overall hourly occupancy, thereby generating multiple daily occupancy profiles based on the data collected. While the method focused on short periods of absence, it did not account for occupants' long absences.

Page et al. [35] recognized this shortcoming from this and other studies involving the modeling of occupant presence and further elaborated that excluding occupant long absences actually overestimates total occupant presence and the related, yearly energy consumption prediction. Page et al. also developed an occupancy model for simulating presence by using a Markov chain to create random occupancy profiles that exhibited similar statistical properties from the collected data. Virote and Nueves-Silva [43] also used Markov chains to simulate occupant presence and their related behavior in a building space. However, Page et al. discovered during calibration that while the model worked well in replicating short and intermediate periods of daily presence and absence, it did not account for long periods of absence (i.e. time periods greater than 24 hours). In order to account for these occurrences, the authors added an algorithm that created random long periods of vacancy based on probabilistic parameters describing the frequency and duration.

Page et al. [35] and Wang et al.'s [42] studies focused on occupancy presence on a timescale of hours. However, circumstances may exist where focusing on a greater timescale of days and weeks may be more appropriate. The significant and prolonged changes observed in Figure 1's water consumption patterns due to likely related changes in occupancy appear to suggest focusing on long vacancy-causing activities of days and even weeks. The characteristics of these activities can then, in turn, be integrated into the whole building energy model to simulate building performance under more realistic conditions with respect to occupancy. Kwok and Lee [36] also used building operation-related metrics to mimic building occupancy. In their study, they used the building's fresh air supply rate as an indirect indicator of building occupancy as the air supply rate was related to the building's indoor CO_2 rate. In this study, we present a method for integrating the characteristics of known activities causing long periods of vacancy for building occupants and apply it to a military dormitory building.

3.3 Research Method

The research method used for this study followed the steps illustrated in. The process begins with first identifying the building's major occupant groups as determined by common long vacancy activities which were defined as any activity resulting in a physical absence from the building of greater than or equal to 1 week. Shorter term absences (<7 days) such as those due to training, 3-day weekend, illness, and vacation were excluded from this study. We also assumed that the building's occupant group proportions would be constant throughout the analysis period (1 year). In reality, this could change slightly or dramatically depending on a number of factors such as military personnel summer rotation cycles, deployments, or changes in leadership philosophy regarding unit cohesion in the dormitories. In this research study, we established the occupant group based on the occupant's respective assigned military unit. The installation's Enterprise Military Housing (eMH) database supplied the data to determine the building's occupant group proportions.

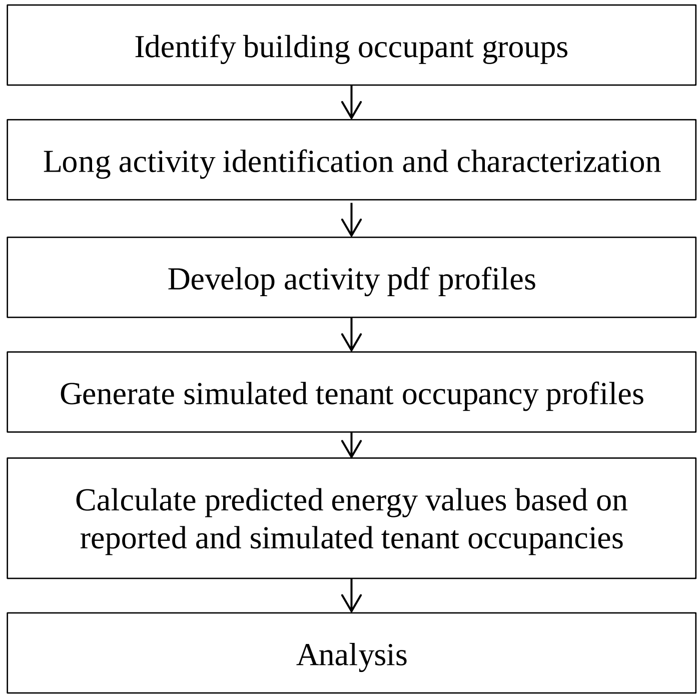

Figure 20: Research Method for Constructing Simulated Energy Consumption Values Based on Occupants' Long Vacancies

We then identified the long vacancy activities associated with each occupant group based on input from the installation's military housing office, public works department, and data collected from building occupants that resulted in three distinct activity groups: training activities, deployments, and vacation periods. Characterizing the activities not only included knowledge of the activity frequency and duration, but also how the activities related to one another. For example, some activities may be sequence-driven and exhibit tendencies as to when they occur with respect to other activities. In our study building, the occupants' long vacancy activities were sequence-driven and it was therefore necessary to incorporate their related interaction rules in order to create more realistic occupancy profiles. Figure 3 illustrates the decision flow diagram used to randomly select the annual activities and their associated start date and duration.

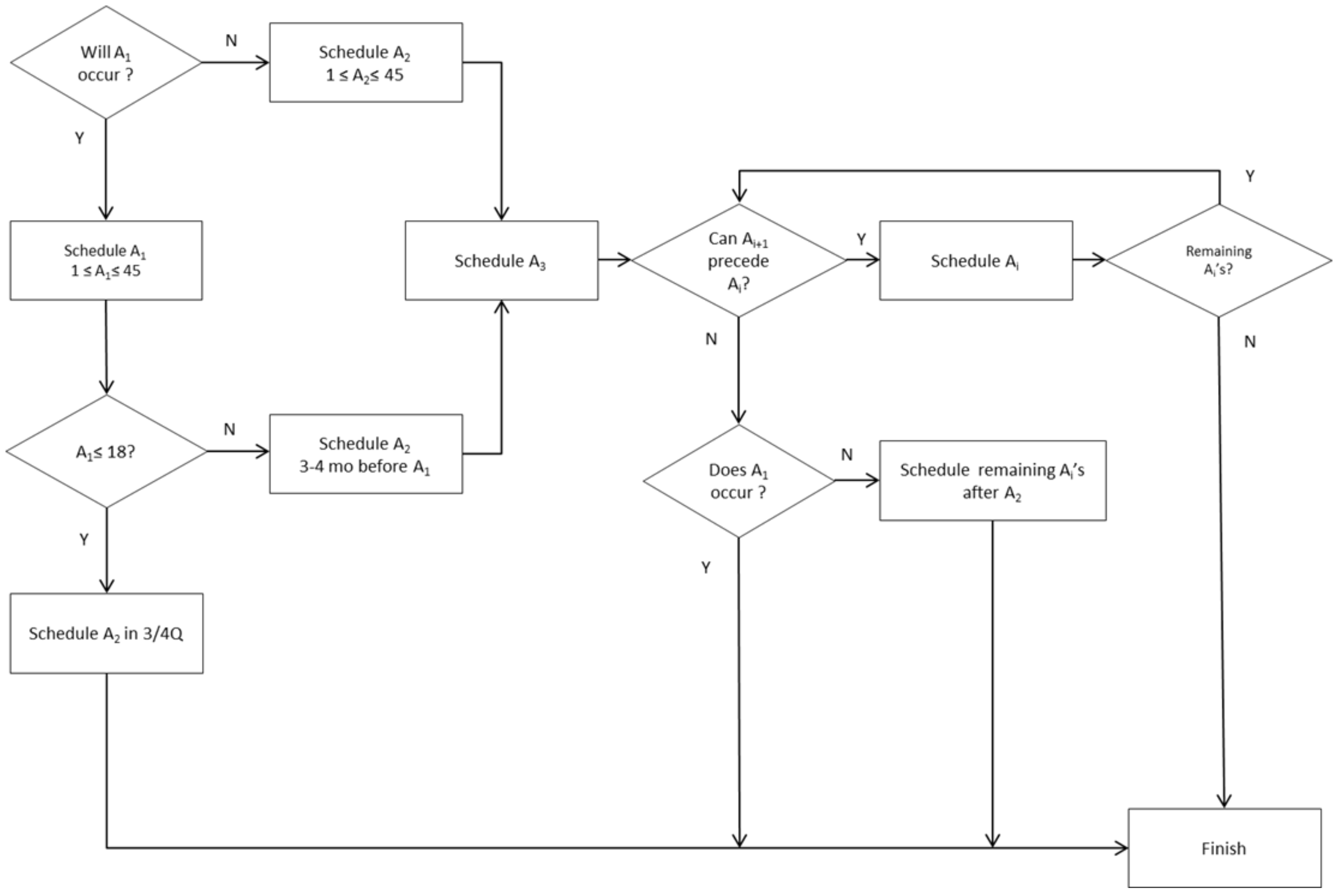

Figure 21: Decision Flow Diagram for Constructing Occupant Group Long Vacancies

In this study, we identified three types of training activities. The first training activity represents the significant drop in water consumption observed in Figure 19's October - November timeframe. This activity lasts approximately 4 – 6 weeks, affects all building occupant groups, and was considered as a prerequisite to an occupant group's deployment activity. The next training activity corresponded to individual occupant groups, while the third training activity also reflects training within the occupant group, but at a lower organizational level.

The deployment and vacation activities were relatively simpler to characterize. While the deployment activity was characterized with an unlimited range of start date and prescribed durations, the vacation period was always defined as the year's last two weeks. The drop in water consumption in Figure 19's December timeframe is ascribed to this activity.

The next step involved integrating the characteristics of the long vacancy activities into a method for simulating annual occupancy profiles. This entailed constructing probability density functions (pdf's) for the activities' duration (weeks) as well as the range of occupant group members (percentage) directly participating in the activity and therefore physically absent from the building. For simplicity, each occupancy profile consisted of 52 weekly values and all simulated activity durations' were whole numbers. Activities resulting in partial week absences were not included. We used @RISK to generate random iterations of annual, long vacancy-related activities and their associated start dates, durations, and % participating for each occupant group with the following stipulations. First, the long vacancy activities within the same occupant group could not overlap one another, which would dampen the overall occupancy rate. Second, long vacancy activities involving all building occupant groups took precedence over individual occupant group events. In other words, training activities for individual occupant groups could not be scheduled during periods which required the entire military organization's participation. This stipulation represents Figure 19's observed long vacancy activity in November which affected all building occupant groups. Third, occupant groups' deployment-related activities could be simulated to occur at any time during the analysis period, while training-related activities could only be scheduled around deployment and vacation-related activities. For each iteration, we calculated the building occupancy profile for each occupant group by subtracting out the percentage of the occupant group's participation (P) in each simulated activity in accordance with its simulated start time and duration. Therefore, each group's occupancy profile consisted of

52 weekly occupancy values that accounted for each simulated, long absence. The building's combined occupancy profile was then calculated as the weighted summation of each of the corresponding occupant group profiles.

Note that the above calculation implicitly assumes a year-round, fully-occupied building. In order to account for periods of varying building sub-utilization, as observed in Figure 19, we defined a reported occupancy (*RO*) variable as the percentage of assigned dormitory rooms. The calculation for determining the building's simulated occupancy profile may now be defined as the series of weekly values corresponding to the sum of each occupant group's weighted simulated occupancy, as shown in Equation 5.

Equation 5: Simulated Building Occupancy$_i$ = $\sum_{j=1}^{n} \boldsymbol{w_j}(\boldsymbol{RO_i})(\boldsymbol{1}-\boldsymbol{P_j})$

The final step in the simulation process entailed pairing the values from the simulated building occupancy series with the corresponding building energy model results. To accomplish this, we conducted multiple energy model (TRACE 700, version 6.2.8.3) simulation runs by adjusting the occupancy-related schedules by 1% in each simulation and using the TMY3 weather dataset for the building's corresponding geographical location. The case building's energy model contained weekly schedules for lighting, dormitory rooms, and common use areas.

Figure 22 illustrates these simulation results in a sensitivity analysis graph that depicts predicted annual electricity and natural gas consumption based on varying occupancy values. Both electricity and natural gas values were converted to kBtu's using the thermal conversion factors prescribed by the U.S. Environmental Protection Agency's Portfolio Manager Program [9]. The graph's solid line represents the Energy Use Intensity (EUI) value calculated as the sum of the building's predicted total annual energy consumption divided by the building's gross square footage. The EUI values corresponding to varying occupancy values are annotated on the graph's secondary vertical axis and range from approximately 34 – 61 kBtu/gsf. The predicted annual electricity consumption increases at a more consistent rate and exhibits a greater range of values as compared to natural gas. The predicted annual natural gas values showed a somewhat different trend, sharply spiking from 5 – 6% occupancy rate, nearly constant values between 6 – 43% occupancy, and then a noticeable increase thereafter. Reasons for the observed sharp rise in natural gas consumption are likely attributed to heating equipment related to the building's mechanical systems as the model assumed a constant value of natural gas used for water heating regardless of the occupancy rate.

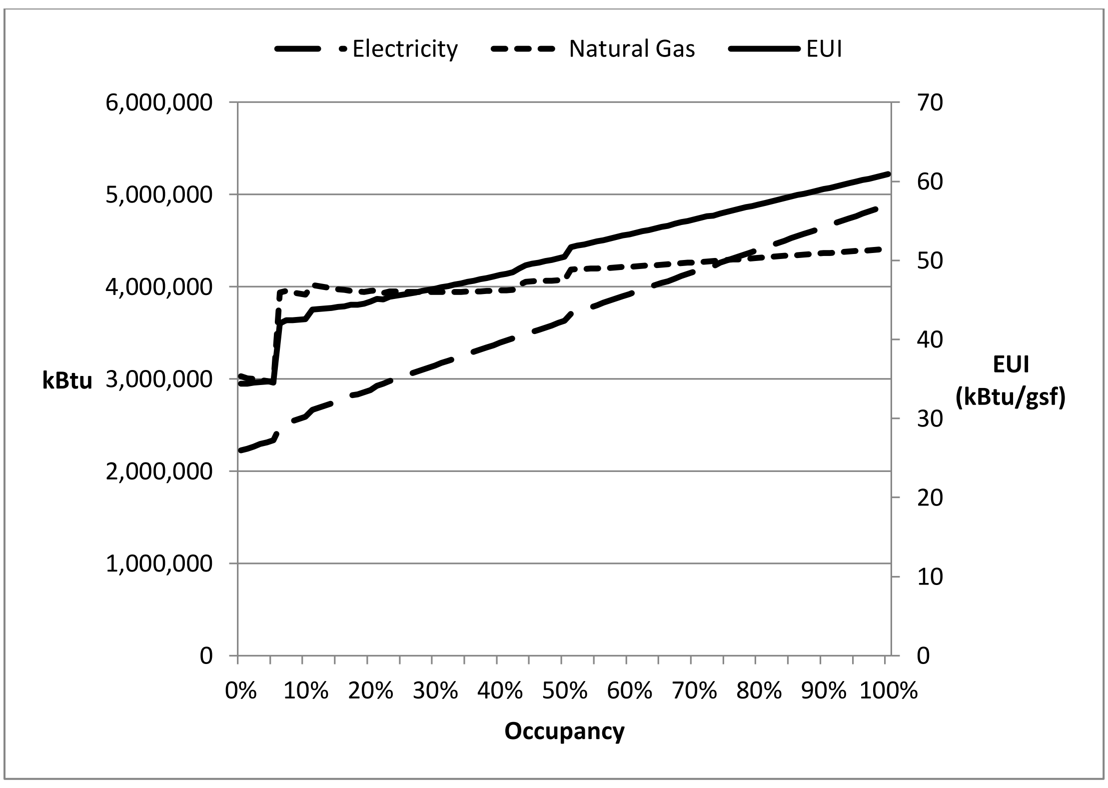

Figure 22: Sensitivity Analysis of Occupancy (%) on Simulated Building Energy Consumption

The results from this series of simulations produced a table of simulated energy consumption values corresponding to any day in a calendar year and level of occupancy. From this table, the simulated sets of daily building occupancy values were converted to predicted energy consumption values. The final step in the process created a simulated Energy Use Intensity (EUI) metric by dividing the sum of simulated daily energy values by the building's gross square footage (kBtu/gsf). We selected the EUI metric as it's used as a common building energy performance metric to compare building performance within its respective building type and is used by the U.S. Department of Energy's Energy Information Agency in creating the Commercial Buildings Energy Consumption Survey (CBECS) data set [30].

3.3.1 Research Method Validation

In the methodology validation step, we applied the occupancy-based building energy model to the previously mentioned military dormitory building for five various occupant group configurations. We identified seven occupant groups based on the data collected from the eMH database as well as six potential long vacancy activities based on earlier discussions with the installation's military and civilian personnel. Table 12 lists the long vacancy activities and their associated characteristics used in the simulation.

A_i	Activity Type	Duration	% Affected
1	Deployment	5, 12 mo	90 – 95%
2	TE-1	4 – 6 wks	90 – 95%
3	TE-2	2 – 3 wks	30 – 40%, 90 – 95%
4	TE-3	10 – 15 wks	15 - 20%
5	TE-2	2 – 3 wks	30 – 40%, 90 – 95%
6	Vacation	2 wks	90 – 95%

Table 12: Characteristics of Occupant Group Long Vacancy Activities

In total, we included five different activities in the simulation with one activity occurring twice a year. Prior to simulation, all duration values within each activity as well as the %-affected by each activity were assigned equal probabilities of occurrence. The deployment activity affects individual occupant groups once a year given the simulation's assigned probability of occurrence. For all occupant groups affected by this activity, we assumed an equal start time and duration. For example, one possible simulated set of activities could include occupant groups 1, 2, and 4 all participating in a 5 month deployment beginning on Week 30. The TE-1 activity represents a single training event participated in by all occupant groups (e.g. same start time and duration) unless the event occurred during a time when a particular occupant group was already engaged in a deployment activity. The TE-2 activity affects all occupant groups and occurs twice a year, but was not restricted to occurring simultaneously with other occupant groups' TE-2 start dates. We observed two different %-affected ranges for the set of occupant groups based on the character of their primary mission. The operations-focused occupant groups were assigned the higher %-affected values (90 – 95%) while the support-focused occupant groups contained the lesser (30 – 40%). TE-3 represents smaller echelon training and therefore exhibits a longer duration, but lesser %-affected, as compared to the TE-1 and TE-2 activities. The vacation activity represents the calendar year's final two weeks reserved for military members to take annual leave for the holiday season. In our simulation, we assumed no training events occurred during the last two weeks of the year, but deployment activities could still occur during this time.

We used the occupancy model based on long vacancy activities developed with @RISK to generate random annual occupancy profiles for five buildings each containing different occupant group configurations as illustrated in Figure 23. The five buildings consisted of a Base Case building which contained equally-portioned occupant groups and Buildings A – D which comprised of actual occupant group percentages collected on four of the identically-constructed, LEED dormitory buildings from the eMH database (A – D). The fifth LEED dormitory building contained different occupant groups from the other four buildings and was therefore not included in this study. Occupant groups (OG) 1 – 3 represent support-focused groups while 4 – 7 comprise of the operations-focused groups. The given set of occupant group configurations represents a wide range of possible scenarios and therefore deemed useful in quantifying how much, if any, the building's energy performance could change based on changes to this variable.

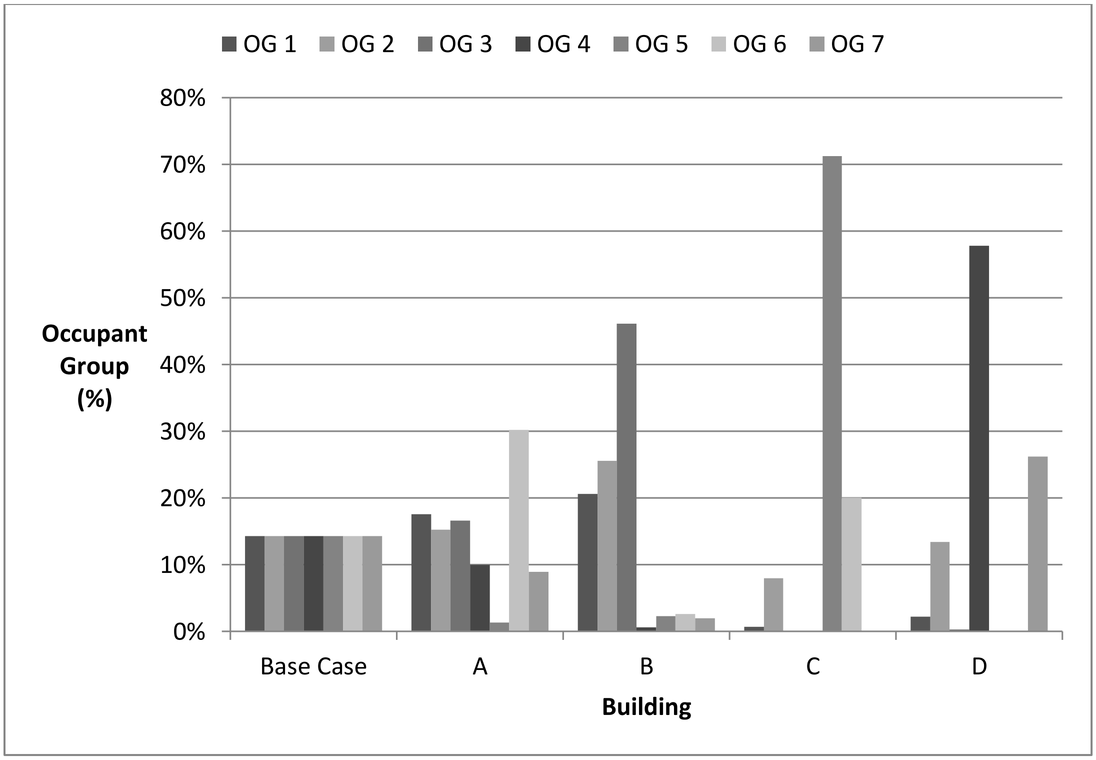

Figure 23: Building Occupant Group Percentages

We implemented the model in three basic scenarios. The first scenario consisted of running the model for each building assuming continuous 100% occupancy. In the second scenario, we used the building's actual reported building occupancy. In both of these scenarios, the probability of the deployment activity occurring was held to 0, so that only the long vacancy activities described in Table 12 affected building energy performance. The third scenario comprised of a series of simulations at various probability of deployment values (0.25, 0.5, 0.75, and 1.0) performed on Base Case and Building A. Section 3.4 presents the results and related discussion and analysis.

3.3.2 Building Description

The subject building is a 4-story, military dormitory constructed in 2008 and has been in operation and utilized since 2009. Comprising of approximately 153,000 gsf, it contains 368 bed spaces and was certified LEED-Gold in 2009. The subject building is one of five identically-constructed and co-located buildings, referred to in this chapter as Building A. The building uses electricity and natural gas to operate its mechanical heating and cooling systems. Twelve months of Building A's actual building energy data collected from 2012 were compared with the original building energy model's prediction as well as the modeling results performed in this study.

3.4 RESULTS

In order to illustrate the impacts on energy consumption from occupants' long vacancy activities and the building's under-utilization (<100% occupancy rates), we first conducted simulations under two different scenarios for Buildings A – D. In each simulation, we compared the results to the Base Case building defined as being continuously 100%-occupied and comprised of equally-sized occupant groups. The first set of simulations comprised of continuously 100%-occupied buildings containing the same ratio among occupant groups as recorded during the data collection of each buildings' occupant group makeup. The purpose of this set of simulations was to determine the impact of different occupant group configurations on building energy consumption. In the second set of simulations, the buildings retained their respective building occupant group ratios, but the Reported Occupancy value (RO variable in Equation 5) now reflected the buildings' calendar year 2012 reported daily occupancy values. The purpose of these simulations was to determine the additional effect on energy consumption from building under-utilization (i.e. reported daily occupancy values less than 100%). In both of these initial scenarios, we held the probability of a deployment activity to zero so that only training and vacation activities described in Table 12 contributed to occupant long vacancies.

Figure 22 illustrates the two simulation scenarios performed for Building A. The graph contains two histogram plots as well as the base case histogram converted into a line graph to better view the difference between the Base Case and Building A simulation distributions. The graph's horizontal axis represents simulated EUI (kBtu/gsf) values and the vertical axis corresponds to percent values indicating the frequency of occurrence within the simulation. In this set of simulations, we observed virtually no difference between the Base Case and simulation conducted at 100% occupancy. This was somewhat expected as the Base Case and Building A possess very similar occupant group configurations as seen in Figure 23. The simulation conducted with Building A's actual reported occupancy yielded a lesser mean value of 53.8 kBtu/gsf as compared to Building A's 100% occupancy simulated mean value of 56.4 kBtu/gsf.

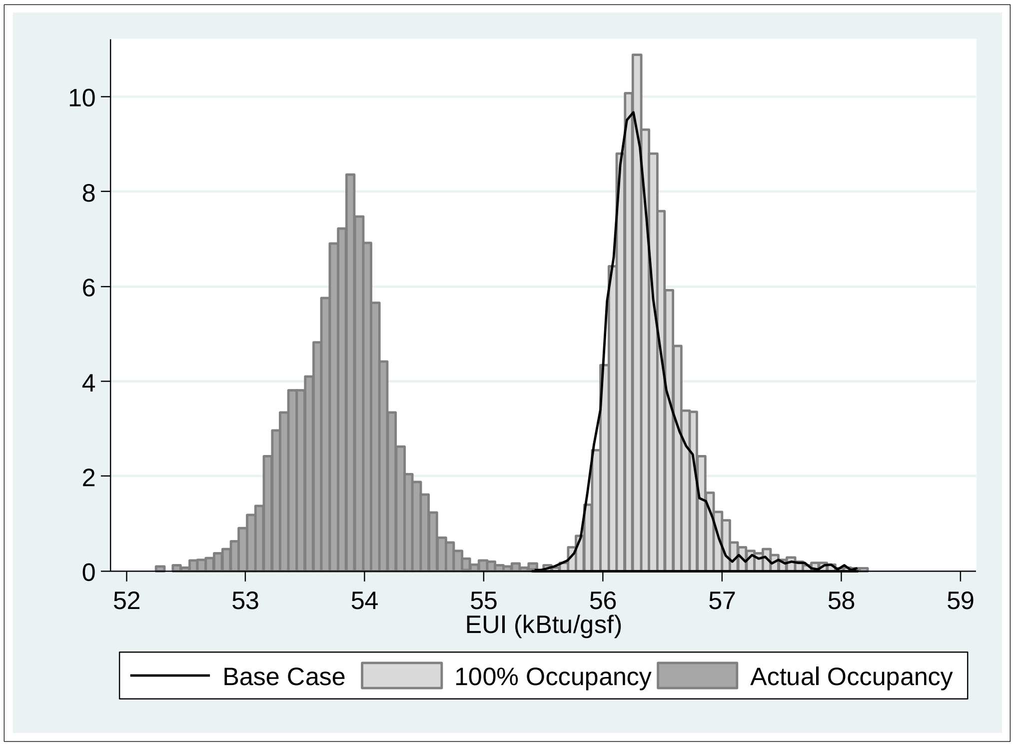

Figure 24: Building A 100% and Actual Reported Occupancy vs Base Case

Figure 25, Figure 26, and Figure 27 illustrate the same simulation scenarios conducted for Buildings B – D, respectively. Similar to Building A, Building B's simulation conducted at 100% occupancy resulted in a distribution of EUI values slightly greater than the Base Case. Buildings C and D, whose occupant group configurations both exhibit higher percentages of operations-focused groups, both yielded sets of simulated EUI values slightly less than the Base Case. In all cases, the first set of simulations produced minor deviations (±0.6 EUI units) from the Base Case. The second set of simulations, now accounting for vacant and unassigned rooms, produced relatively greater shifts in the simulation mean values. Building A exhibited the greatest shift from the Base Case (-2.5 EUI units) which corresponds to the lower observed occupancy rates during the first half of 2012 (Figure 19).

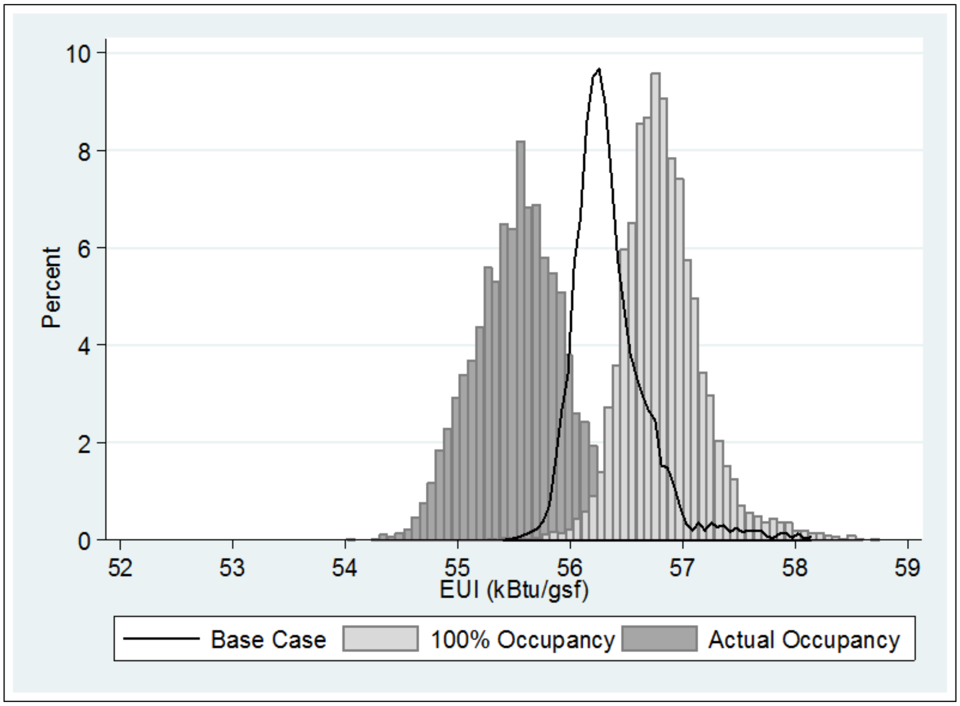

Figure 25: Building B 100% and Actual Reported Occupancy vs Base Case

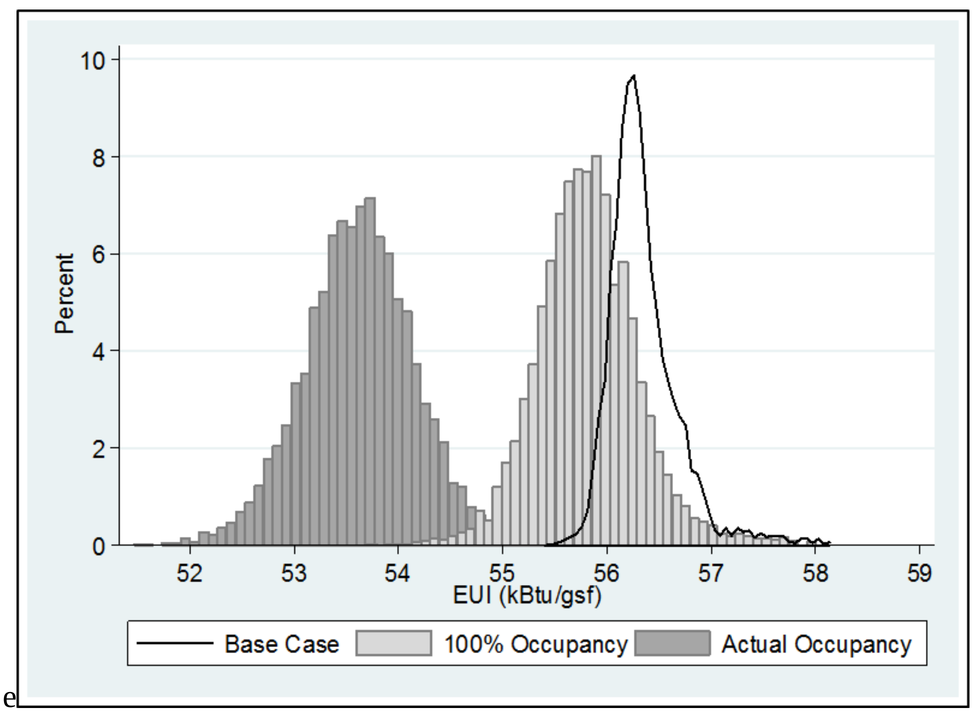

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Figure 26: Building C 100% and Actual Reported Occupancy vs Base Case

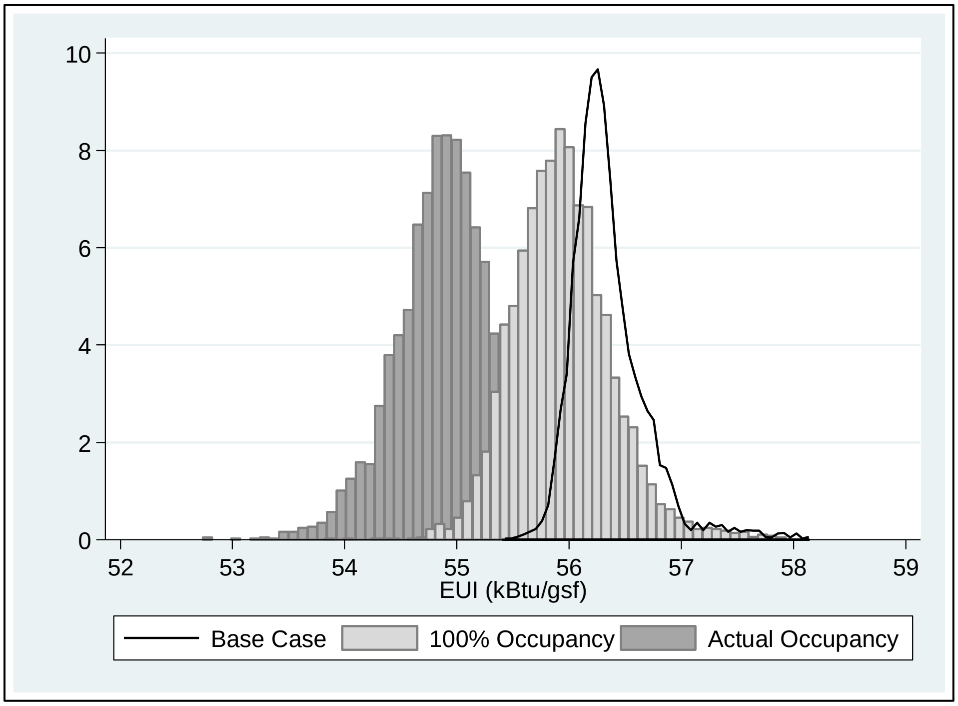


Figure 27: Building D 100% and Actual Reported Occupancy vs Base Case

Figure 28 presents a series of box plots that compare the spread of simulated values among Buildings A – D and the Base Case. In the Base Case's Reported Occupancy simulation, the daily reported occupancy values represented the average among Buildings A – D. There are four points associated with this graph. First, the original energy model calculated a predicted EUI value of 60.8 kBtu/gsf. Incorporating the long vacancy activities alone decreased the mean value of the model estimate from 4 – 5 EUI units depending on the building's occupant group configuration. This range corresponds to the figure's second point that despite a relatively wide range of occupant group configurations, the range of means was only 1 EUI indicating the occupant group configurations in this case did not significantly contribute toward large changes in energy consumption. Third, the model's mean value decreased an additional 1 – 2 EUI units when we included the building's actual reported building occupancy data. Fourth, it's worth noting that the distance between each building's respective box plots reflects the building's reported occupancy rate. Building C exhibited the highest reported occupancy rates (small change in 100% and Reported box plots) while Building A demonstrated the least.

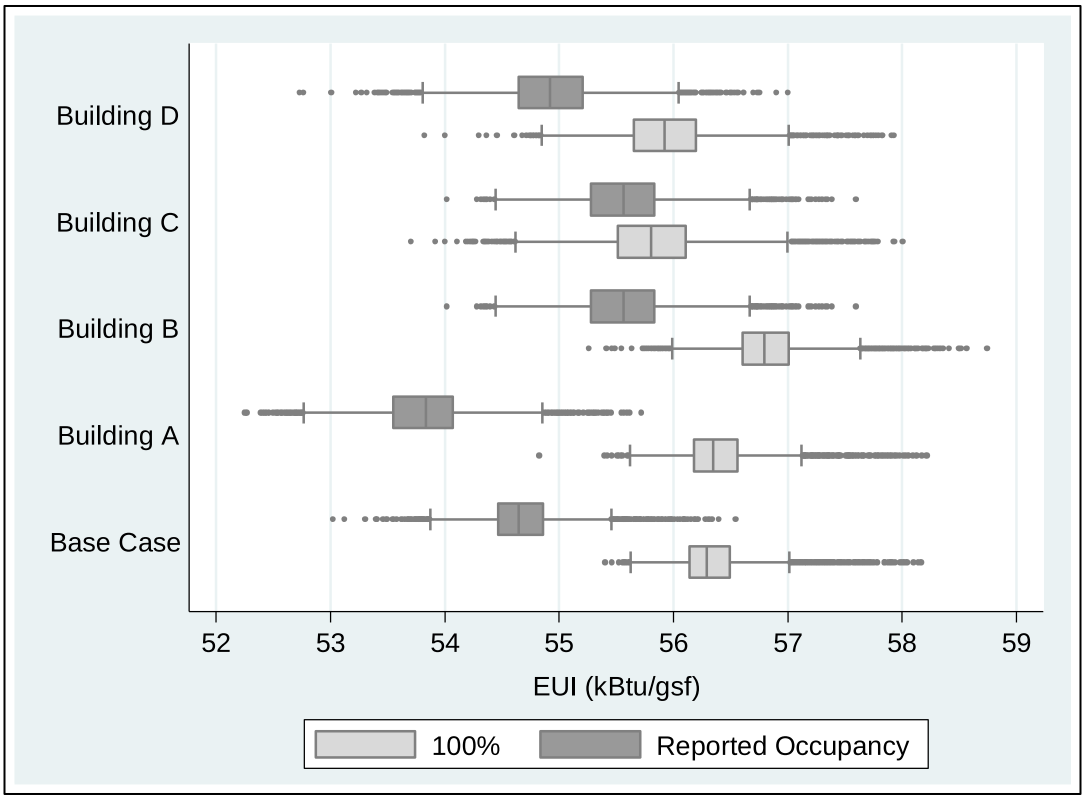


Figure 28: Building Comparison at 100% and Actual Occupancy to Base Case Scenarios

The next set of simulations consisted of varying the probability by which a deployment activity, P(D), would occur. Figure 11 illustrates the simulation results for P(D) values of 0, 0.25 0.50, 0.75 and 1.0. There are three main observations taken from this figure. First, as P(D) increases, the range of possible EUI values also increases. This observation results from the simple fact that as P(D) increases, so does the likelihood of multiple combinations of occupant groups being affected by this long vacancy activity. Second, as soon as P(D)>0, the distributions begin to exhibit a negative skew. The outliers are likely due to iterations when the simulation selected a 12-month deployment activity to begin early in the year that affected a large percentage of occupant groups. Finally, we superimposed the building energy model's predicted EUI value (60.8) as well as Building A's actual EUI (51.9) value calculated for 2012 on the Base Case and Building A's respective box plots at P(D) = 0. Superimposing these points on the P(D) = 0 boxplots was deemed appropriate as the occupant groups did not participate in this activity during the subject year. Including these points illustrate a noticeable improvement in accurately predicting the building's energy performance by incorporating occupants' known long vacancy activities as a method of modeling occupant presence. As such, Building A's simulation at P(D) = 0 yielded a mean value of 53.8 kBtu/gsf.

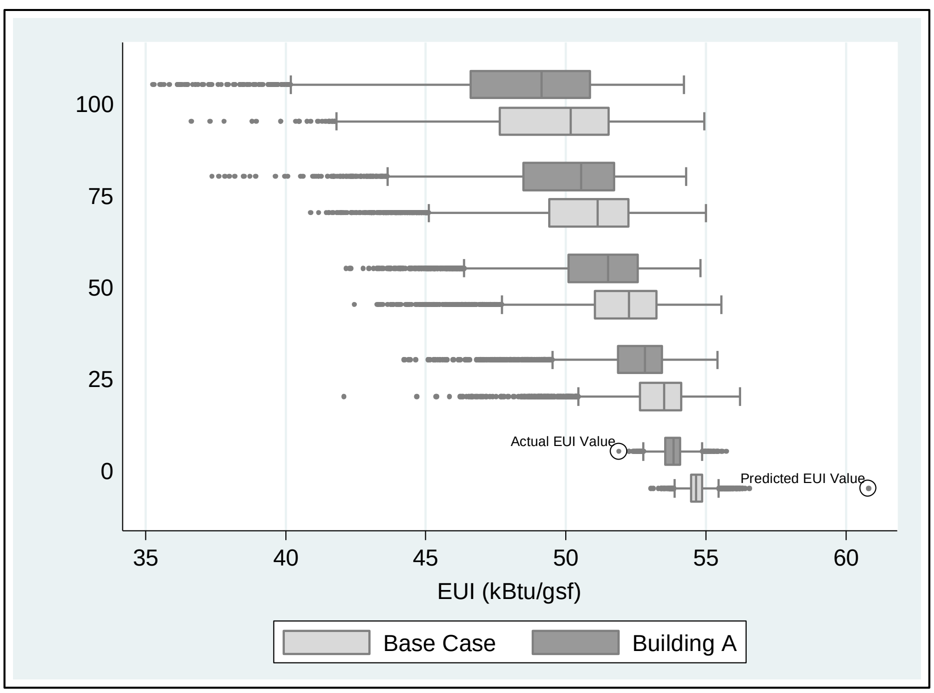


Figure 29: Comparison Between Building A and Base Case (Reported Occupancy) at Various Probabilities of Deployment Activity

Histograms and box plots are useful for displaying a dataset's distribution shape and range, but overlaying numerous datasets on a single plot can quickly become too cumbersome. To better illustrate the effect on the shape and distribution of EUI values at various P(D) values, we constructed a surface plot for Building A, illustrated in two viewpoints in Figure 30 and . Similar to the histograms, the horizontal and vertical axis's represent EUI and percentage values, respectively, and the depth axis now represents P(D) values. The surface plot clearly illustrates the higher peak representing building performance at low values of P(D) as well as increasing the range of likely values due to increasing P(D). Towards the upper end of P(D) values, the distribution of likely EUI values appears to decrease slightly noted by the relatively smaller peak located at approximately 51 kBtu/gsf.

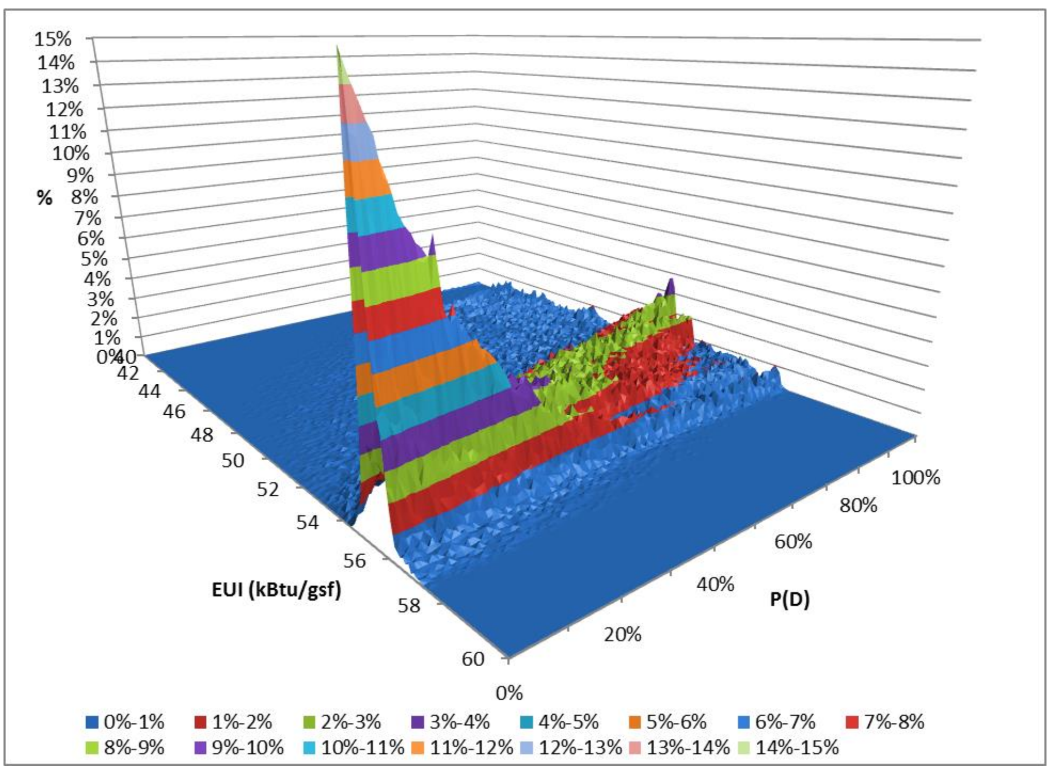


Figure 30: Surface Plot Depicting Building A Simulations at Various P(D) Values

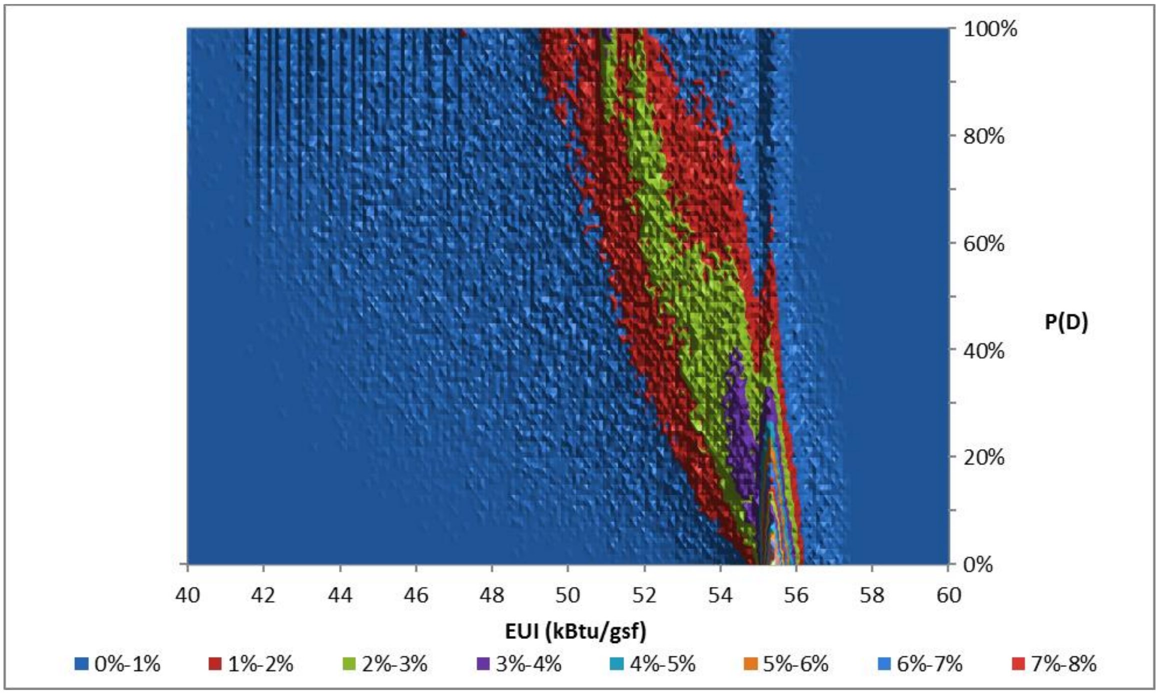


Figure 31: Surface Plot (Plan View) of Building A Simulations at Various P(D) Values

In this surface plot, we focused on the deployment activity's effect on building performance since it represented the activity posing the greatest influence on building energy consumption among the pre-identified long vacancy activities. In fact this method could be applied toward other variables exhibiting greater degrees of uncertainty that are difficult to model with deterministic values, such as occupant behavior. The method could be used as a potential approach in addressing areas of uncertainty or managing expectations with respect to building performance for building owners and/or decision makers as opposed to current practices that largely use deterministic methods for calculating building performance.

Although the study results suggest a potentially modest improvement to the overall model's accuracy on building performance, it also demonstrates the study's limitations in two key areas. First, the energy model values for various occupancy rates were all calculated assuming constant thermal set points for cooling and heating seasons. In reality, as occupancy decreases due to under-utilization or other long vacancy activities, room thermostats could be adjusted accordingly to save energy. Second, the model does not consider the potentially wide range of occupant presence or usage patterns that can easily exist during actual building operation and instead uses a single schedule for hourly occupant presence for weekday and weekend time periods. Further discussion with the building's operations and maintenance personnel could provide greater clarification of more realistic outcomes on building performance as a result of large decreases in building occupancy. Future research could include integrating the occupant groups' known long vacancy activities with other human behavior models that could provide greater understanding of occupant impact on building performance.

3.5 CONCLUSIONS

In this chapter, we presented a method for integrating probabilistic methods to describe building energy performance based on occupants known long vacancy activities. We included long vacancy activities related to training, vacation, and deployments as well as known building underutilization as reported in the buildings daily occupancy rates. The characteristics of the known long vacancy activities were further incorporated into an occupancy model using @RISK that generated random sets of simulated building occupancy profiles that were later translated into simulated EUI values. The simulated buildings included a Base Case building as well as four other buildings using actual occupant data to characterize each building's occupant group configuration. We performed multiple simulations by varying the probability of a deployment activity occurring in 1% increments and later displayed the results using histograms, box plots, and finally a surface plot to provide a single representation of all simulations performed for a single building.

Comparing the simulation results (53.8 kBtu/gsf) to a single building's actual annual energy consumption value (51.9 kBtu/gsf) indicated a modest improvement from the original energy model's EUI prediction of 60.8 kBtu/gsf. However, the results also pointed to significant limitations within the approach that included assuming constant thermal set points for heating and cooling seasons regardless of occupancy rates as well as deterministic occupant schedules.

Nevertheless, the method discussed in this chapter could be incorporated into future energy modeling efforts of new buildings with relative ease and offer additional benefits. First, the method could facilitate discussion regarding the building's operation among building owners, maintainers, and designers early in the design phase. Knowing how state variables such as occupant behavior can potentially affect building performance can lead to more informed decisions. The method could also facilitate discussion in the building's operation and maintenance phase. In this example, the method identified a wide range of possible building occupancy scenarios that could produce later produce informed policy decisions regarding building space utilization. Applying this method to other building types could generate similar discussions on building operation and utilization.

Chapter 4 Conducting Retrospective Analyses of Building Energy Models with Various Levels of Available Data

4.1 INTRODUCTION

Today, the building sector represents the largest energy consumer among United States (U.S.) end use sectors. The U.S. Department of Energy reported buildings in the U.S. consumed nearly 40% of the nation's total energy in 2011 as compared to nearly 31% and 27% for the industrial and transportation industries, respectively [1]. As buildings continue to consume significant amounts of energy, building owners will continue to place high importance on identifying effective building energy solutions through building energy models. It is therefore important that energy models not only aid design teams in selecting building systems that optimize performance, but also provide reliable estimates of actual energy consumption. This is especially important among Federal agencies required by the Energy Policy Act of 2005 to design life-cycle cost-effective buildings that are 30% below energy performance standards established by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) [2]. The reliance on model accuracy whether for federal law compliance or maintaining building operational costs within budget underscores the importance of retrospective analysis in order to benefit future modeling efforts.

The building energy literature contains numerous studies of energy model accuracy, particularly of new buildings certified through the Leadership in Energy and Environmental Design (LEED) certification system [16, 17, 19-21, 24, 44]. Turner and Frankel (2008) conducted a large study of 121 LEED buildings in evaluating building energy model performance [19]. Their study compared buildings' predicted and actual

Energy Use Intensity (EUI) values as a means of quantifying model accuracy on an individual and programmatic level. The EUI metric is calculated as the sum of the building's annual energy usage from all energy types and then normalized by the building's gross square footage area. The study used actual building energy data in the form of whole building, monthly utility bills, while predicted energy values were collected from model simulation results contained in the building's LEED submittal documents [19]. While Turner and Frankel's study covered a significant number of buildings, the study only provided surface-level information regarding model accuracy at the individual building level. The authors conceded that given the observed variance in individual building model accuracy, further research was necessary to identify likely causes of error to improve future modeling efforts.

The purpose of this study is to address the following research question: how can a more in-depth retrospective analysis of the building energy model be accomplished beyond the traditional comparison of predicted and actual building EUI metric? To answer that question, this chapter identifies the elements necessary to conduct a more thorough analysis as well as the potential gains in information regarding the model's accuracy. To illustrate these points, we applied this approach to three LEED-certified dormitory buildings, owned and operated by the U.S. Department of Defense (DoD). The three buildings exhibit various levels of available building and energy data and were therefore deemed useful in demonstrating the potential gains in further explaining model error as related to the building's available data.

4.2 LITERATURE REVIEW

The methodology for conducting retrospective analysis of building energy models discussed in this chapter can be divided into three areas: comparing building energy model parameters to the final-constructed building; comparing weather data used in the energy model to actual weather data; and comparing model assumptions regarding building occupancy to actual occupancy-related data.

Comparing parameter values used in the building energy model to the actual, completed facility is a common step used in calibrating building energy models. Reddy [45] presents a thorough literature review regarding model calibration techniques and notes multiple studies that cite the comparison of the model's parameter values to other verifiable sources and methods, such as as-built drawings, conducting site inspections, and interviewing building operations and maintenance personnel, as a necessary step in calibrating design-phase energy models [46-49]. While model calibration efforts can be used for evaluating proposed energy control measures to existing buildings or identifying faulty mechanical equipment, Raftery et al. [49] observed that from a research perspective, model calibration studies can improve future modeling efforts by identifying common mistakes as well as best practices.

Evaluating weather data also plays a role in determining the building energy model's accuracy. When the design-phase building energy model is completed, the model typically uses long-term average weather data to perform the simulation. Weather data used for energy simulation, such as TMY3 data sets created by the National Renewable Energy Laboratory [26], simulate typical annual weather conditions for a given location. However, the weather conditions coinciding with the time period of collected building energy data may differ from the weather conditions used in the energy model. Therefore, when conducting retrospective analysis of the energy model, it's important to know the extent to which simulated and actual weather conditions differ. One method for better understanding this difference can be accomplished by comparing the monthly Heating and Cooling Degree Days between weather data sets.

Building energy models make explicit assumptions regarding occupant presence and behavior that in-turn, impact building energy performance and should therefore also be considered when evaluating the model's accuracy. Degelman [32] observed that the building's operational characteristics possess a significant influence on building performance, noting that the chances for good model calibration decrease as building occupants exhibit more control over the building's environmental controls. Energy models frequently use occupant-related schedules consisting of assumed, hourly peak load factors and plug load factors to model occupant presence and behavior patterns. Page et al. [35] recognized the shortcomings of this current practice in that it neglects temporal variation in occupancy patterns and also incorrectly assumes these values correspond to all building occupants.

Methods for collecting actual data regarding occupancy can be found in the building post occupancy evaluation literature as well as other model calibration studies that focus on occupants' impact on building energy performance. For macro-level detail, post occupancy evaluation methodologies used by the U.S. General Services Administration [20] and Pacific Northwest National Laboratory [50] prescribe occupancy metrics such as number of occupants and visitors per work day, number of computers, and work hours per week. However, these high level metrics may limit researchers' ability to more fully understand greater-detailed occupancy patterns within the building. Wang et al. [42] utilized time-stamped motion sensor data collected from Jennings et al. [51] and Rubenstein et al. [52] in order to develop a calibrated occupancy model. Kwok and Lee [36] incorporated a building's fresh air supply rate as an indirect measure of CO_2, and thus occupancy, to model observed changes in occupancy within a building.

As mentioned in the previous section, previous retrospective studies of design-phase energy models used for LEED certification have largely focused on comparing predicted to actual annual energy consumption values. Conducting greater in-depth comparative analyses between the energy model and actual building energy data can produce greater incite and lessons for future modeling efforts. But the gains in knowledge will also depend on the amount of available information regarding actual building performance. The next section explains the method used for conducting the analysis.

4.3 RESEARCH METHOD

Conducting the in-depth retrospective analysis of the building energy model entails collection of several pieces of data, all related to calculating the building's predicted and actual EUI. This section discusses seven items used for this analysis.

The analysis begins with comparing parameter values used in the building energy model to the completed building. This entails comparing the model's parameter values that are verifiable through the building's as-built drawings or confirmation from the building owner's staff. Acquiring a copy of the building energy model provides the greatest method of understanding the parameter values used in the model. If the building was submitted for LEED certification or some other third-party verification system, obtaining a copy of the building's LEED submittal documents regarding energy efficiency can also provide insight on the energy model. LEED uses standard templates that can aid comparison among multiple buildings, while extracting parameter values from the energy model will require greater familiarity with the model used in the study.

Collecting data regarding the building's predicted annual energy consumption value may be obtained through either the LEED submittal documents or the building energy model. The LEED documents again provide a more uniform synopsis of the simulation's annual results by energy type and end use, but running the energy model with location-specific simulation weather data can produce more-detailed information in the form of smaller interval data which can in-turn be used to tailor the comparison to the actual data's respective level of detail (i.e. months, days, 15-minutes).

The building owner's staff typically provides actual energy consumption data which can appear in the form of monthly utility bills or actual meter data. The building post occupancy evaluation literature contains numerous references referring to collecting building energy data [44, 50, 53-56]. This data can come in the form of monthly utility bills or actual utility meter data in various intervals. Collecting the building's actual energy data also requires a thorough understanding of the building's utility metering system as well as the units used by the meters to report consumption values. For the purpose of this study, we converted all energy readings to kilo British Thermal Units (kBtu) using the thermal conversion factors listed in the U.S. Environmental Protection Agency's Energy Star Portfolio Manager Program [9].

Identifying the facility manager or the building owner's utility meter manager can greatly assist the researcher's efforts in becoming better-familiarized with the building's metering system for measuring energy consumption. If multiple meters are enlisted to measure the same energy type (i.e. electricity) within the building, it may be possible to estimate end use consumption. This requires additional knowledge regarding what end uses are associated with the energy meter's measurements. Matching utility submeter readings with building end uses can be facilitated by referencing the building's panel schedules and/or discussing with the building's designated energy representative. As individual meters contain more end use types in their readings, the more difficult it becomes to further de-aggregate the data into single end uses.

Collecting actual energy data, particularly interval data, also requires inspecting the data for irregularities and/or missing data. Discussing these types of occurrences with the utility meter manager can sometimes result in salvaging questionable data, but in other cases, the data is eliminated from further analysis. Regardless, the utility meter manager should disclose up front any problems associated with the building's energy meter(s) that could cause unreliable data results. To summarize, the analyst should ensure data is collected from meters in good-working condition and identify a protocol for addressing data irregularities.

Conducting retrospective analysis of design-phase energy models not only requires actual energy consumption data, but also requires the building systems to be operating normally. For this study, we purposely sought out buildings that had been in operation for at least a year before any energy consumption data was to be collected. This was to ensure the buildings were in good-working order and to allow sufficient time to address any mechanical system deficiencies identified during commissioning. This stipulation also agrees with post occupancy evaluation literature and past retrospective building energy studies [18, 20, 50].

Weather plays an obvious role in affecting building energy performance and was also considered in our retrospective building energy analysis. While simulated weather data sets are readily available for use in calculating predicted energy values, creating or obtaining weather files based on actual weather data is also possible. However, prior to automatically constructing weather files with actual weather data corresponding to the time of collected energy data, we first compared the Heating Degree Days (HDD_{65}) and Cooling Degree Days (CDD_{50}) between the two sets of weather data. The degree days were calculated in accordance with ASHRAE Standard 90.1-2010 [10] where the mean daily temperature was taken as the average among the 24-hourly dry-bulb temperature readings. We conducted this preliminary test to determine if creating an actual weather data file, compatible with the building energy model, would substantially contribute toward gaining greater insight on identifying source(s) of model error.

Conducting this preliminary test of weather data implies a working knowledge of the building's mechanical system operation and applicable heating and cooling season time periods. This underscores the importance of early identifying the building's respective maintenance department. Conducting guided building tours led by the department's Heating, Ventilation, and Air Conditioning (HVAC) personnel represents the ideal method for becoming familiar with the building's mechanical system operation. Interviews via phone or email can also accomplish this, but can be more time-consuming. In our study, we utilized all of these methods to become familiar with the buildings' systems.

Finally, we collected occupancy-related data to evaluate the building energy model's assumptions regarding occupancy. In our study of LEED dormitory buildings owned and operated by the DoD, we collected occupancy-related data from two sources. First, we collected daily occupancy rates as calculated by the military installation's housing management office. The reported occupancy rate represents the percentage of total assigned rooms in the dormitory, but it does not account for time periods when a significant percentage of building occupants are physically absent from the building. In order to gain greater perspective regarding building utilization, we also collected buildings' daily water consumption data where possible. Collecting these data revealed interesting consumption patterns that translated into identifying occasions where the buildings likely experienced dramatic changes in occupancy over time. Using the water consumption data as a qualitative indicator of building occupancy also required knowledge of the metered water's end uses (e.g. boiler/chiller operation, outdoor irrigation, occupant use).

While we used water consumption as an indirect measure of actual occupancy, other indicators could also be used to the extent that data is available as accomplished in previous studies [36, 51, 52]. For example, if the analysis involved an office building, employee time cards, travel records, or even computer log-in/log-out records could be used as other occupancy indicators.

Table 13 summarizes the previously discussed areas of interests pertaining to the retrospective analysis. For each area, the table includes the sources used for obtaining information regarding predicted and actual information.

In this chapter, we applied this method to three LEED-certified dormitory buildings, owned and operated by the DoD. We restricted the analysis to evaluating electricity consumption only. We did not perform the retrospective analysis of the energy model's building systems as the consultant utilized the final version of the building's as-built drawings and therefore assumed them to be reasonably accurate for the purpose of continuing this retrospective analysis. Comparing the results among predicted and actual building performance of these buildings with varying levels of interval data also revealed the limits of insight gained from analyzing such data.

Area of Interest	Predicted	Actual
Building Systems	Building Energy Model LEED Submittal Docs	As-Built Drawings Real Property Records Site Visit Interviews with Owner Staff
Weather Data	TMY3 Data set	Actual Data provided by Air Force 14th Weather Squadron
Energy consumption	Building Energy Model LEED Submittal Docs	Actual Energy Consumption Data Building Meter Plan Panel Schedules
Occupancy and Utilization	Model's occupant-related schedules	eMH Records Daily Water Consumption Interviews w/ Occupants
Building Operation	Building Energy Model	Interviews with Occupants and Building Owner's Staff

Table 13: Data Sources for Conducting Energy Model Retrospective Analysis

4.3.1 Building Descriptions and Related Available Data

The three dormitory buildings used in this study (referred to hereafter as Buildings A, B, and C) are all LEED-certified Gold facilities and located in the continental U.S. The following paragraphs provide a brief description of each of these buildings.

Building A represents one of five identically-constructed dormitories, constructed in 2008. It comprises of approximately 153,000 gross square feet and contains 368 bed spaces. The four-floor facility uses electricity and natural gas to power its mechanical systems. The building contains two natural gas meters that provide daily meter readings. The building's north natural gas meter measures commodity use for the boiler and north mechanical room's domestic hot water (DHW) production. The building's south water meter measures natural gas usage pertaining to the south mechanical room's DHW. The building has a single electricity meter that provides 15-min interval data. The building also has a north and south water meter that provides daily readings. The north meter end uses include: building indoor usage, boiler and chiller operations, and outdoor irrigation. The south meter measures water usage for indoor usage only.

Building B is a 120-person dormitory complex consisting of four, 3-story dormitory buildings and a related commons building. The two dormitories located in Wing A each contain 72 bed spaces and comprise of approximately 13,500 gsf. Alternatively, the two dormitories in Wing B each contain 48 bed spaces and comprise of nearly 9,200 gsf. The dormitory buildings are not individually metered, but rather contain a single meter that measures electricity for the four dormitories and the 3,000 gsf commons area building. The buildings operate on electricity as well as the heat energy sourced from a 200-well point geothermal field. Building occupancy began in April 2010.

Building C represents a 166,000 gsf dormitory building constructed in 2009 and contains 252 bedrooms with 504 total bed spaces. The dormitory comprises of a central six-story wing adjoined to an east and west wing. The symmetrical east and west wings each consist of a smaller five-story section adjoined to the central wing and a larger 4-story section. The building operates on electricity and natural gas. Unlike Building A's mechanical system that operates based on the installation's defined heating and cooling season, Building C's heating and cooling systems provide conditioned air based on the outdoor air temperature in an exclusive mode.

As previously mentioned, each of the buildings contains slightly different utility metering arrangements. Table 14 lists the building metering configurations, frequency of measurement, and the time periods of data collected. As Building B operates on electricity only, the respective cell in the Natural Gas column was marked Non-Applicable. Building B also contained a smart meter capable of measuring 15-minute interval readings, but was unable to at the time of data collection, providing monthly data only.

Building	# Meters	Data Interval	Data Collection Period
A	1	15-minute	Oct 2011 – Nov 2012
B	1	Monthly	Oct 2010 – Sep 2012
C	4	15-minute	Nov 2011 – Oct 2012

Table 14: Summary of Building Utility Meters and Measurement Frequency

4.4 RESULTS

This section begins with evaluating model accuracy with monthly interval energy consumption data. Figure 32 illustrates actual and predicted monthly electricity consumption for Building B (left vertical axis) in Fiscal Years (FY) 2011 and 2012 as well as the differences in monthly total degree days (right vertical axis) between actual weather data and the applicable TMY3 weather dataset. The monthly predicted electricity consumption values were obtained using the TMY3 weather dataset. Each total degree day data point represents the sum of that month's HDDs and CDD's. We combined

HDD's and CDD's since the building's mechanical systems, similar to Building C, also operate based on outdoor temperature.

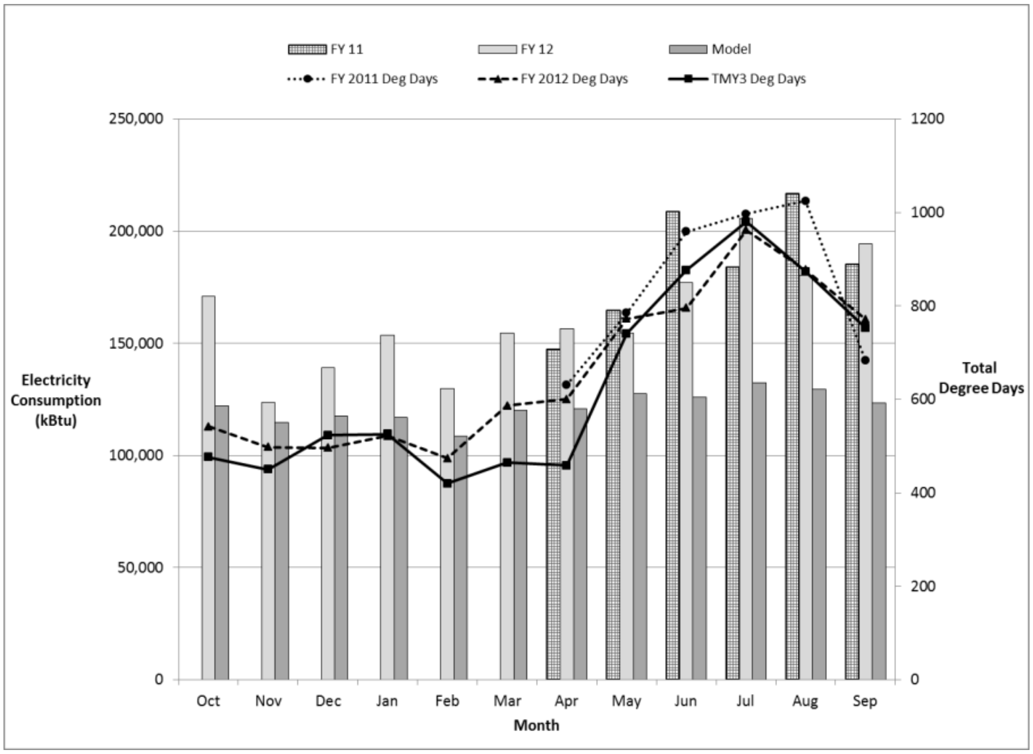


Figure 32: Building B Monthly Electricity Consumption

There are three points to be made regarding Figure 1. First, the actual and TMY3 weather data trended together fairly consistently. The six months of actual weather data in FY 11 yielded approximately 10% more degree days, while the FY 12 weather data exhibited 7% greater degree days. The smallest deviation occurred in Aug 2011 (0.4%) and the greatest deviation between monthly weather data occurred in Apr 2011 (37%). Second, the energy model consistently underestimated monthly energy consumption despite the TMY3 data exhibiting greater or nearly equal total degree days in some months. Finally, the energy model predicted small variation in monthly consumption, likely due to assumptions made regarding the efficiencies gained from the geothermal ground water heating and air conditioning system. However, actual monthly energy consumption exhibited greater variation, particularly in the summer months of Jun – Aug illustrating the greatest deviations between predicted and actual building energy consumption. Given the small variation exhibited in the modeled monthly energy consumption values and the consistency between actual and TMY3 weather data (with the exception of Mar and Apr values), it does not appear that integrating actual weather data with the building energy model would result in significantly greater model accuracy.

Figure 33 illustrates a similar analysis between actual and TMY3 weather data as well as predicted and actual monthly energy consumption for all Buildings A – C. In Figure 33, the horizontal axis represents the ratio between actual and predicted monthly electricity consumption. The vertical axis represents the ratio between actual monthly degree days and monthly degree days within the TMY3 dataset corresponding to the building's location. The data points are labeled A, B, or C to correspond with its respective building.

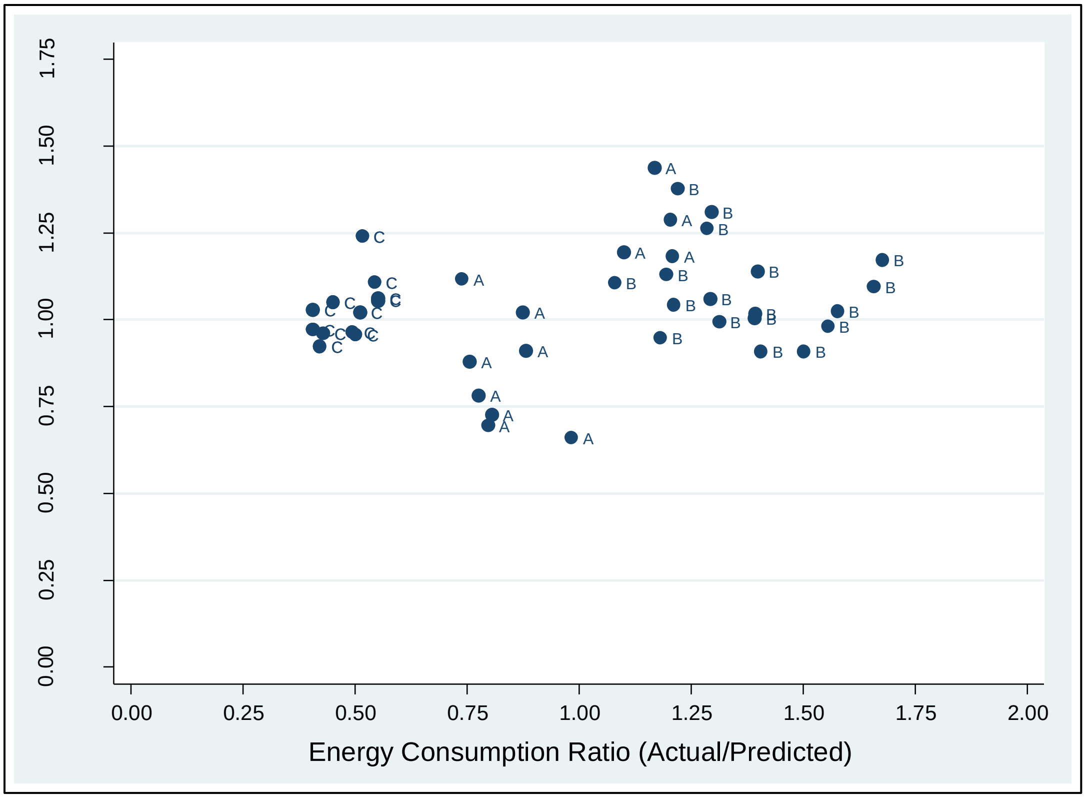


Figure 33: Scatterplot of Building's Monthly Electricity Consumption and Degree Days Ratios

Data points near 1.0 on both axes correspond to greater alignment between model and actual values. Data observed in the right-hand quadrants indicate model underestimation of energy consumption, while the left-side quadrants equate to the model over-predicting energy consumption. Data points residing in the top quadrants illustrate more-varied weather conditions compared to the building's respective TMY3 data set, while data points viewed in the lower quadrants indicate a relatively milder weather month. The benefit of displaying the data in this arrangement allows the reader to compare the magnitude of variability among buildings regarding model accuracy. The next paragraphs discuss observations made from the figure regarding each building.

Building A exhibits the greatest spread of variability with respect to accurately predicting electricity consumption, albeit the spread appears to center near 1.0. Further examination of these data indicate the data reflecting the over-predicting energy consumption (values < 1.0) correspond to the heating season months, while the points indicating an under-prediction (values > 1.0) correspond to the cooling season months.

Building B's data points all exhibit sizeable over-predictions as was seen in Figure 1. The spread between the ratio of actual and TMY3 degree days is less than the range seen in Building A.

Building C exhibits the tightest arrangement of data points illustrating the greatest consistency among the three building. While consistent, the model clearly over-predicted monthly electricity consumption during a time period when the TMY3 weather data closely approximated actual conditions during the data collection period. So among the three buildings, we may conclude that weather contributed the least amount to deviation observed in model accuracy.

So what can we learn from monthly interval energy data? First, we can better quantify the range in model accuracy which may later contribute to identifying cases of cancelling of errors among multiple commodities used by a building. For example, from an annual perspective, the Building A model predicted electricity consumption fairly well. But it also exhibited a relatively wide range of variability that coincidentally centered near the point where actual consumption equals prediction. Second, studying monthly data to model predictions may result in identifying greater error during certain heating/cooling seasons. What monthly interval data cannot provide is greater insight regarding the occupants' impact on building energy performance. In order to better understand the occupant's influence, we now consider the building's daily energy consumption.

Figure 34 illustrates Building C's daily electricity consumption alongside its respective daily water consumption. There are three main observations to discuss from Figure 29. First, weekend dates are further highlighted on the electricity consumption plot to indicate weekend consumption. The building energy model utilizes different schedules for weekdays and weekends to indicate relatively greater usage during the weekends. The highlighted weekends appear to occur during relative peaks in consumption. Other days of non-scheduled activity, such as identified with Building A in the analysis demonstrated in Chapter 2, were not included in this graph, but to simply to provide as an illustration of where weekend consumption occurs with respect to observing local peaks.

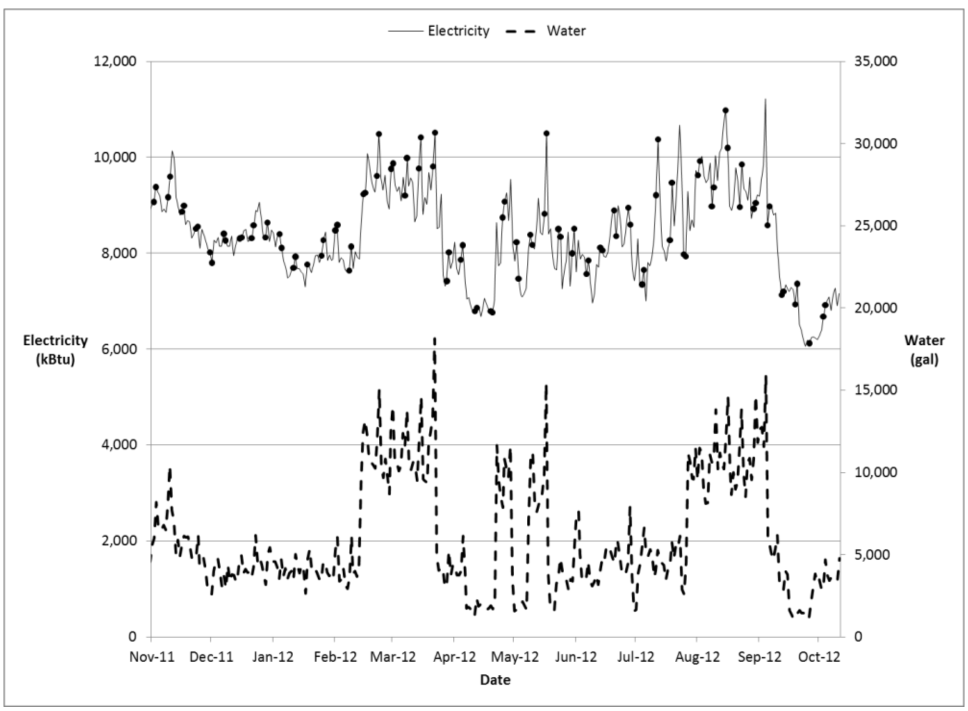


Figure 34: Building C Daily Electricity and Water Consumption

We evaluated the model's assumption of greater energy consumption during weekends by conducting a paired t-test. Prior to the test, we first converted the daily electricity consumption values into weekly average values for weekdays as well as weekends. Next we evaluated the deltas (weekend – weekday) for each pair of weekend and weekday values for normality and independence. Figure 30 illustrates the normal quantile plot of the data indicating a positive skewness in the data.

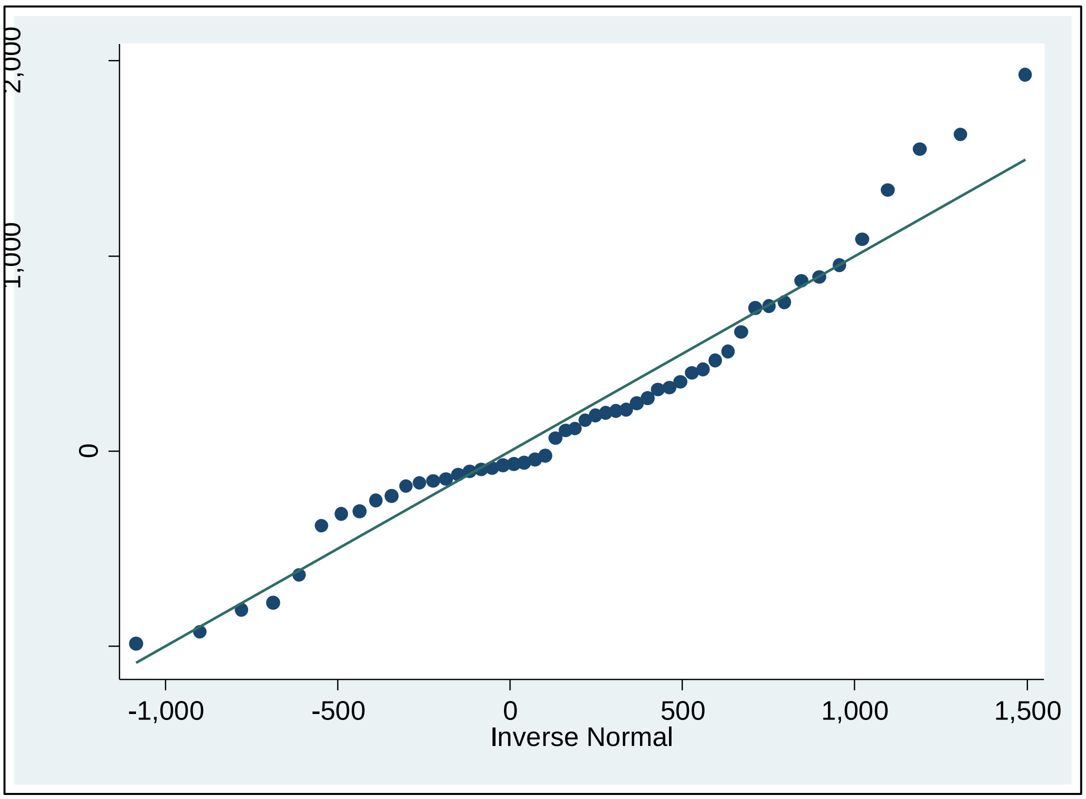


Figure 35: Normal Quantile Plot of Paired, Average Weekend and Weekday Electricity Consumption

In order to test for independence between data points, we constructed a time series plot of the data, illustrated in Figure 31. A visual inspection of this data revealed no apparent cyclical pattern, so we determined the assumption of independence as valid.

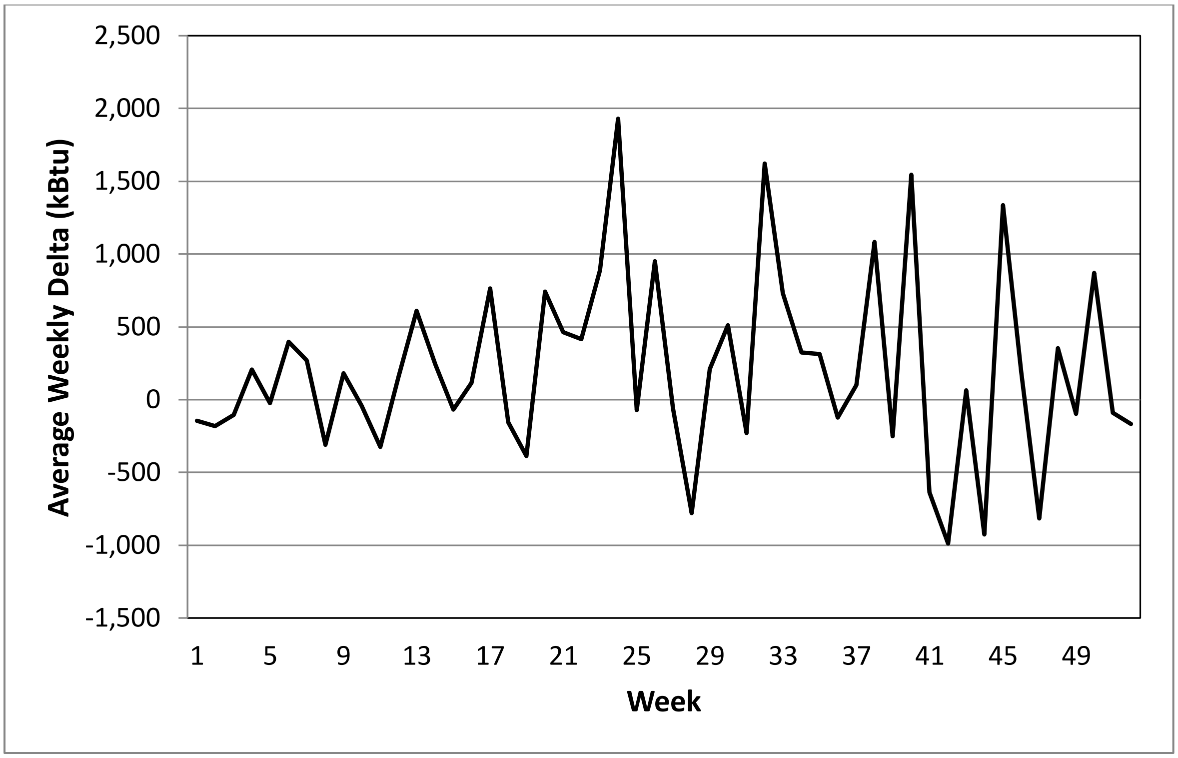


Figure 36: Time Series Plot of Weekly Average Differences between Weekend and Weekday Electricity Consumption

To account for the data's non-normality, we conducted a Wilcoxon matched-pairs signed-rank test. A resulting p-value of 0.03 indicated strong validation of the building energy model's usage of multiple occupant schedules (weekdays and weekends) and greater energy consumption during the weekends.

Second, the daily water consumption appeared quite synchronous with the daily electricity values. In fact, the correlation coefficient between the two variables for the entire time period of collected data was calculated to be 0.76. The water consumption data exhibits four distinct peaks, occurring in Feb – Mar 2012, late Apr 2012, early May 2012, and finally Aug – Sep 2012. The water consumption data does not contain water used for outdoor irrigation purposes, so the likely cause for the noticeable peaks in water consumption may be due to changes in the building's actual occupancy.

Finally, the observed changes in occupancy reflects the similar observation made during Building A's aggregate analysis in Chapter 2 in that the dormitory building is likely not fully-utilized year-round as was assumed in both building energy models. This speculation was later confirmed during interviews with the installation's public works staff that the large changes in building water consumption were in fact due to changes in the building's actual occupancy.

This simple analysis serves to illustrate how daily interval energy data can provide more insight regarding the building energy model's accuracy, particularly with respect to the occupant schedules used by the model. Studying the building's daily energy consumption patterns could also provide justification for additional occupant schedules beyond traditional weekday/weekend. Attributing large swings in energy consumption to changes in occupancy can be difficult with energy data alone. Observing significant changes in energy consumption could also be weather-related or due to mechanical system changeover during the beginnings of the heating and cooling seasons, or even mechanical system degradation. In this case, the daily water consumption data served as a reliable secondary source of the building's actual occupancy. Note that simply collecting the building's reported occupancy rates may or may not identify the observed changes in building utilization.

Figure 37 illustrates the daily electricity consumption further separated into the building's four submeter readings. The military installation provided the panel schedules to attempt to segregate electricity consumption by end use. However, inspecting the panel schedules revealed no submeters containing a single end use. Meter 2 included the building's chiller unit as can be evidenced by the meter's relatively higher readings during the summer months. It's interesting to note that Meters 2 and 4 were also significantly correlated to the building's daily water consumption. Meter 2 exhibited the highest correlation coefficient of 0.80, while Meter 4's correlation value with water consumption was 0.59. This suggests that Meters 2 and 4 contain end that are likely related to occupant behavior, such as plug loads or indoor lighting. Further de-aggregating the electricity data into exact values for specific end uses would require more advanced techniques.

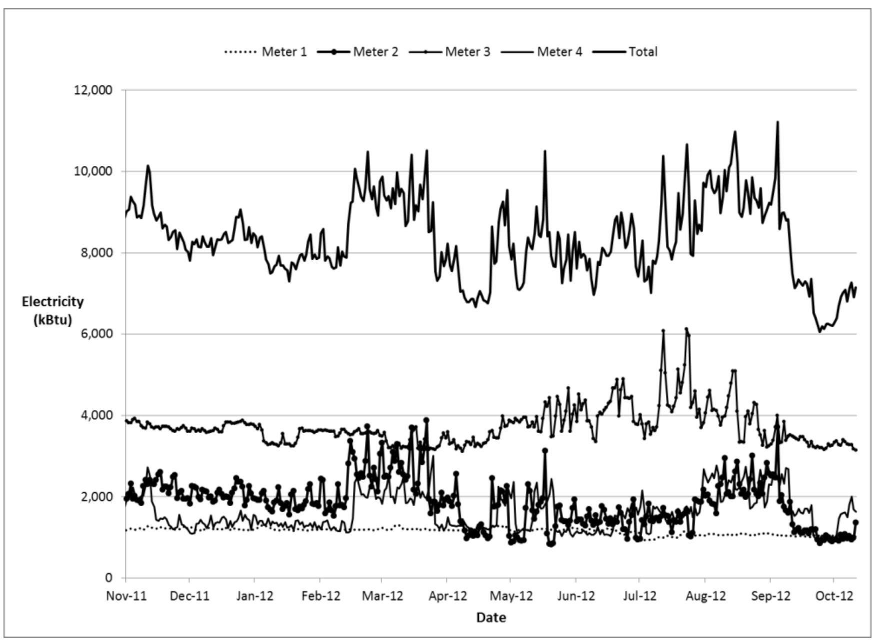


Figure 37: Building C Daily Electricity Consumption (Total and Submeter Values)

4.5 CONCLUSIONS

The purpose of this chapter was to address the following research question: how can a more in-depth retrospective analysis of the building energy model be accomplished beyond the traditional comparison of predicted and actual building EUI metric? This chapter discussed seven items for conducting an in-depth retrospective analysis of the building energy model, followed by demonstrating the analysis using actual and simulated weather and energy data. We also incorporated the building's daily water consumption data to illustrate how further insight regarding building occupancy may be obtained.

This chapter also discussed the respective gains in insight regarding model accuracy as related to various levels of available building energy data. Monthly data can be used to identify potential seasonal-related error that may otherwise go unnoticed due to cancelling errors when the data is viewed from an annual perspective. Observed differences in the variation or trends of successive months of modeled and actual data may also identify errors potentially linked with inaccurate assumptions regarding the building's mechanical systems or occupancy. Daily data provided greater insight regarding the use of multiple occupancy schedules, such as weekday and weekend schedules. The daily consumption data also served as an indicator of building utilization, but we first compared it with the building's water consumption data to verify this use of the data. Finally, we looked at daily output from Building B's four electricity submeters. The panel schedules were used to identify the submeters' end uses, but no submeters were found to have a single end use that could be used to further de-aggregate the energy data. However, submeters 2 and 4 contained relatively high correlation coefficient values of 0.80 and 0.59, respectively. In the absence of water data, these meter readings could also be used as a qualitative indicator of changes in building occupancy. Recall from

Chapter 2 that we were able to approximate natural gas end uses (boiler and Domestic Hot Water operation) from Building A's two meters. This operation becomes much more difficult for electricity and its multiple end uses.

There are several areas for potential future research that could extend the work performed in this study. First, analyzing the 15-minute interval data could be accomplished to potentially validate the model's hourly values contained in the weekday and weekend schedules. As indicated in the study, the building was clearly underutilized during certain times of the analysis period. Additional work in identifying more-realistic occupancy schedules or building-related data (such as water consumption) that can be used to more accurately assess actual building occupancy can further advance our efforts for constructing more accurate building energy models. Additional work in further de-aggregating electricity data into end uses using more advanced, inexpensive methods can also yield even greater insight to the building energy model's accuracy. Finally, we applied this method of retrospective analysis to a single building type. Future research efforts could expand this method by applying to other building types.

Chapter 5 Conclusions and Future Work

This chapter summarizes the conclusions from this dissertation study. It discusses the conclusions in the order of the listed research questions as well as the suggested areas of future research.

5.1 Research Question 1: What are the potential causes of variation between predicted and actual building energy consumption?

5.1.1 Conclusions

The most significant source of verifiable difference between the building energy model and post-occupancy was attributed to building occupancy. This conclusion was evident in both the two military dormitories analyzed in Chapter 2 as well as Building C as discussed in Chapter 4. This was verified from two sources. First, the data reported occupancy data collected from the military installation's eMH database indicated under-utilized buildings. Dramatic changes observed in the building's daily water consumption data also revealed significant changes in building occupancy. These changes in occupancy would not be captured by viewing the reported occupancy data alone. So the data indicated that not only were the buildings less than fully-utilized in terms of rooms being assigned to occupants, but there were also multiple long vacancy activities resulting in an actual lower-than-reported occupancy rate.

While the model appeared to accurately reflect the as-built building based on review of as-built drawings, the model incorrectly assumed the mechanical system changeover date from heating to cooling by a month. This resulted in greater over-estimated heating season %-differences and higher under-estimated cooling season %-differences that required re-analysis by considering only the coinciding time periods within seasons. To prevent this type of modeling error in future efforts, we suggest close coordination with the building maintainers during the energy model's design phase to ensure actual building operation and maintenance activities that influence energy consumption are reflected in the model.

The aggregate analysis of the energy consumption data indicated that the total calculated difference between predicted and actual energy consumption was largely attributed to natural gas usage. When correcting for coinciding heating and cooling seasons, the total variance between predicted and actual attributed to error in estimating natural gas consumption was calculated as 83% and 64% for the two identical buildings discussed in Chapter 2. While the model appeared to accurately reflect the as-built building and contained accurate values reflecting the boiler's specifications, we could not confirm the actual operating efficiency of the building's mechanical equipment.

The building energy model's use of a weekday and weekend schedule appeared valid, as the simple, paired t-test confirmed greater electricity consumption during the weekends. However, visually inspecting the daily energy consumption data appeared to indicate a noticeable difference among weekend days. In fact, it appeared peak consumption occurred during the day prior to resuming the work week. Additional analysis could test this hypothesis.

While the first request question dealt with identifying sources of model error, it's interesting to note the observed 14% difference in actual, annual energy consumption between the two co-located and identically-constructed buildings. This observation illustrates the impact of occupant behavior and presence on building energy performance.

5.1.2 Future Work

Utilizing the building's indoor water consumption data served as a good, qualitative indicator of occupancy and revealed changes in occupancy that were otherwise undetected by inspecting the reported occupancy data alone. Further research in estimating actual occupancy based on water consumption values and occupancy patterns could provide a better estimate of actual occupancy.

This study limited the analysis to a single building type. Applying this retrospective analysis method to other building types could further refine this method so that it could be applicable to all building types and continue to add to our knowledge for the actual reasons for deviation between model results and actual building performance.

Conducting the simple, paired t-tests to determine statistical significance associated with greater weekend consumption was useful in validating the model's use of multiple occupancy schedules. While the paired t-tests performed on actual data confirmed greater consumption on weekends, there also appeared to be a difference in consumption within weekend days. Visual inspection of the data appeared to indicate that peak consumption actually occurred during the day prior to beginning the work week. Additional statistical analysis could be conducted to test this observation for significance. If a significant difference in consumption among weekend days exist, it would be interesting to see if this observation exits for other dormitory buildings.

5.2 Research Question 2: How can current building energy modeling techniques be improved to account for occupant presence patterns associated with long vacancies?

5.2.1 Conclusions

Incorporating the probabilistic-based occupancy model developed in Chapter 3 that included occupants' long vacancies, defined as greater than or equal to 1 week, resulted in a range of simulated EUI values that more closely approximated the building's actual annual consumption, relative to the original prediction. Comparing the simulation results (53.8 kBtu/gsf) to a single building's actual annual energy consumption value (51.9 kBtu/gsf) indicated a modest improvement from the original energy model's EUI prediction of 60.8 kBtu/gsf. However, the results also pointed to significant limitations within the approach that included assuming constant thermal set points for heating and cooling seasons regardless of occupancy rates as well as deterministic occupant schedules.

Incorporating the building's known under-utilization, as evidenced in the building's reported occupancy rates, resulted in a more significant decrease in predicted energy consumption as compared to the effects observed when incorporating long vacancy activities related to training and vacation.

Conducting the simulation at increasing values of the probability of a deployment activity occurring resulted in EUI distributions exhibiting a lesser mean value, but greater variance. We created a surface plot from multiple simulation results to illustrate how the distribution of simulated EUI values changed as the probability of a deployment activity increased. This could be a very useful tool in the building's design phase for discussing how the building will be operated. For example, the surface plot could be used to facilitate discussing various scenarios of lower occupancy at which the building operators would consider closing the dormitory and relocating remaining occupants to other dormitories in an effort to lower operating costs.

5.2.2 Future Work

The probabilistic-based occupancy model developed in this study focused on long vacancies only. Significant research had already been dedicated to integrating human behavior in building energy models. Other studies have focused on integrating occupant presence into building energy models, but concluded that occupant vacancies should be included. Future research devoted to integrating occupants' behavior and short-and long-term vacancies could further improve efforts in more accurately predicting building energy performance.

As there have been numerous efforts in modeling occupant behavior and presence, the lack of a standard dataset that already incorporates the characteristics of known human behavior demonstrates the need for additional future work in this area. The American Society of Civil Engineers (ASCE) Visualization, Information Modeling and Simulation (VIMS) technical committee states that accurately modeling building occupant behavior is a challenge that demands attention.

Finally, the use of integrating probabilistic methods with modeling building energy performance is an area of potential future research. Traditional building energy modeling is conducted deterministically. However, the values of certain parameters used in the energy model can actually assume a range of values during operation. Weather, occupancy, and occupant behavior are three examples that illustrate the shortfalls of using deterministic values to describe these inputs. Using probabilistic methods with building energy models can also provide building owners with a range of likely performance values that can be used to better manage owner expectations. Recall the co-located, identical buildings in Chapter 2 exhibited a 14% difference in annual energy consumption.

5.3 Research Question 3: How can a greater in-depth retrospective analysis of building energy models be accomplished beyond the traditional comparison of predicted/actual EUI metric?

5.3.1 Conclusions

Chapter 4 discussed seven items for conducting an in-depth retrospective analysis of the building energy model, followed by demonstrating the analysis using actual and simulated weather and energy data. We also incorporated the building's daily water consumption data to illustrate how further insight regarding building occupancy may be obtained.

The chapter also discussed the respective gains in insight regarding model accuracy as related to various levels of available building energy data. Monthly data can be used to identify potential seasonal-related error that may otherwise go unnoticed due to cancelling errors when the data is viewed from an annual perspective. Observed differences in the variation or trends of successive months of modeled and actual data may also identify errors potentially linked with inaccurate assumptions regarding the building's mechanical systems or occupancy. Daily data provided greater insight regarding the use of multiple occupancy schedules, such as weekday and weekend schedules. The daily consumption data also served as an indicator of building utilization, but we first compared it with the building's water consumption data to verify this use of the data. Finally, we looked at daily output from Building B's four electricity submeters. The panel schedules were used to identify the submeters' end uses, but no submeters were found to have a single end use that could be used to further de-aggregate the energy data. However, submeters 2 and 4 contained relatively high correlation coefficient values of 0.80 and 0.59, respectively. In the absence of water data, these meter readings could also be used as a qualitative indicator of changes in building occupancy. Recall from Chapter 2 that we were able to approximate natural gas end uses (boiler and Domestic Hot Water operation) from Building A's two meters. This operation becomes much more difficult for electricity and its multiple end uses.

5.3.2 Future Work

There are several areas for potential future research that could extend the work performed in this study. First, analyzing the 15-minute interval data could be accomplished to potentially validate the model's hourly values contained in the weekday and weekend schedules. As indicated in the study, the building was clearly underutilized during certain times of the analysis period. Additional work in identifying more-realistic occupancy schedules or building-related data (such as water consumption) that can be used to more accurately assess actual building occupancy can further advance our efforts for constructing more accurate building energy models. Additional work in further de-aggregating electricity data into end uses using more advanced, inexpensive methods can also yield even greater insight to the building energy model's accuracy. Finally, we applied this method of retrospective analysis to a single building type. Future research efforts could expand this method by applying to other building types.

Appendices

APPENDIX A – OCCUPANCY DATA COLLECTION DOCUMENT

Survey Directions: Thank you for taking the time to complete this survey. Your responses will further improve the accuracy for predicting building energy usage among military barracks in a typical year. Please know that your individual responses on this survey will be kept confidential.

Name: ______________________________ Brigade: _____________________

Barracks Building #: (Please circle): 2340 / 2344 Battalion: ____________________

Military Occupation Specialty:___________________

1. Approximately what date (Month and Year) were you assigned to your current barracks?

2. Please list the dates that you remember being absent from the barracks due to Leave, Special Pass, TDY, deployment, training, conference, ceremony, etc. from December 2011 to present. A calendar is provided below for your reference.

Dates	Reason

Dates	Reason

Dec 2011

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Jan 2012

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Feb 2012

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29			

Mar 2012

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Apr 2012

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

May 2012

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Jun 2012

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Jul 2012

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Aug 2012

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Sep 2012

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23/30	24	25	26	27	28	29

Oct 2012

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Nov 2012

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

APPENDIX B – COMPLEX 1A ACTUAL ENERGY, WATER, WEATHER AND OCCUPANCY DATA

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Oct-11	15,995	2,058	2,032	3,300	3,500	63.2	81.5
2-Oct-11	17,357	2,315	2,149	7,100	4,700	66.2	81.5
3-Oct-11	16,569	2,161	2,277	8,400	4,900	67.1	82.1
4-Oct-11	15,276	2,109	2,238	3,200	4,500	63.2	81.5
5-Oct-11	15,033	2,058	2,226	7,100	4,700	61.1	81.5
6-Oct-11	13,716	2,264	1,955	3,600	4,800	59.4	81.0
7-Oct-11	12,171	6,791	1,917	1,700	3,900	48.5	80.2
8-Oct-11	10,031	13,017	1,749	1,600	3,300	44.1	80.2
9-Oct-11	10,130	10,805	1,801	1,700	3,400	43.6	80.2
10-Oct-11	10,666	10,187	2,046	2,600	5,000	46.7	80.2
11-Oct-11	9,612	5,968	1,866	1,800	4,100	54.3	79.3
12-Oct-11	9,622	4,631	1,801	2,100	4,000	54.1	79.3
13-Oct-11	9,523	4,322	1,724	1,800	3,600	52.6	79.9
14-Oct-11	9,345	4,476	1,763	1,900	3,700	51.9	80.7
15-Oct-11	9,482	3,653	1,826	1,900	3,900	54.4	80.7
16-Oct-11	10,161	4,682	2,032	2,300	4,600	56.7	80.7
17-Oct-11	9,762	6,791	2,058	2,600	4,600	47.3	81.3
18-Oct-11	9,274	7,254	1,994	2,900	4,200	42.7	81.0
19-Oct-11	9,158	6,946	2,020	2,600	4,500	42.2	80.7
20-Oct-11	9,233	5,762	2,135	2,300	4,300	48.8	81.0
21-Oct-11	9,212	4,836	2,058	2,500	4,100	52.6	80.7
22-Oct-11	9,485	4,219	1,968	1,800	3,600	54.4	80.7
23-Oct-11	10,458	4,939	2,135	2,800	5,000	53.0	80.7
24-Oct-11	9,878	3,859	2,432	2,600	5,600	55.8	79.9
25-Oct-11	9,390	4,425	2,084	2,200	4,500	59.1	79.1
26-Oct-11	9,376	7,975	1,943	2,000	3,800	35.1	79.1
27-Oct-11	9,400	8,541	1,891	2,200	4,100	28.0	79.1
28-Oct-11	9,257	7,872	1,994	2,100	4,400	35.9	78.5
29-Oct-11	9,393	5,814	2,303	1,500	4,900	45.5	78.5
30-Oct-11	10,574	6,997	2,264	2,400	5,200	44.7	78.5
31-Oct-11	9,584	5,454	2,290	2,100	4,700	47.9	78.3

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Nov-11	9,004	5,814	2,149	1,900	3,800	49.7	78.3
2-Nov-11	9,618	10,805	2,135	1,900	3,800	34.0	77.7
3-Nov-11	9,247	9,878	2,097	2,300	3,900	28.0	77.7
4-Nov-11	9,069	7,049	2,303	2,300	4,000	41.5	77.7
5-Nov-11	9,492	7,975	2,187	1,900	4,000	43.5	77.7
6-Nov-11	10,959	8,592	2,457	2,900	5,600	39.4	77.7
7-Nov-11	9,226	8,283	2,341	2,000	4,400	35.9	76.9
8-Nov-11	9,328	8,541	2,200	2,200	4,000	37.3	77.4
9-Nov-11	9,219	9,107	2,007	2,200	3,700	33.1	77.2
10-Nov-11	9,595	8,026	2,084	1,800	4,000	35.1	77.2
11-Nov-11	9,690	6,586	2,418	1,600	4,500	43.9	77.2
12-Nov-11	9,584	5,557	2,097	1,600	3,900	50.2	77.2
13-Nov-11	10,625	5,608	2,457	3,000	5,500	51.6	77.2
14-Nov-11	9,284	6,534	2,367	2,100	4,100	46.3	78.0
15-Nov-11	9,151	7,152	2,470	2,300	4,600	44.2	76.9
16-Nov-11	9,209	9,364	2,084	2,300	4,000	33.7	76.4
17-Nov-11	9,277	8,952	2,251	2,000	4,300	29.7	76.6
18-Nov-11	9,008	7,203	2,226	2,000	3,800	48.2	75.8
19-Nov-11	9,427	6,637	2,071	2,000	3,600	50.7	75.8
20-Nov-11	10,847	9,210	2,392	3,200	5,800	31.0	75.8
21-Nov-11	9,253	7,152	2,174	2,000	4,100	35.8	75.0
22-Nov-11	9,236	6,483	2,084	2,000	4,000	42.0	75.0
23-Nov-11	8,919	6,328	2,161	2,200	4,200	44.6	75.0
24-Nov-11	8,619	4,836	1,943	1,200	2,900	48.2	75.0
25-Nov-11	8,646	5,094	1,943	1,300	3,100	51.8	74.7
26-Nov-11	9,182	11,679	1,981	1,900	3,200	33.7	74.7
27-Nov-11	10,403	9,415	2,329	3,300	5,200	32.7	74.7
28-Nov-11	8,936	6,534	2,432	2,400	4,400	43.5	75.3
29-Nov-11	8,936	7,718	2,264	2,800	3,900	40.3	75.5
30-Nov-11	9,137	6,946	2,509	3,100	4,200	40.4	75.5

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Dec-11	9,581	13,017	2,457	2,400	4,100	35.9	75.8
2-Dec-11	9,117	12,245	2,329	2,000	4,100	22.6	75.5
3-Dec-11	9,949	14,612	2,624	1,800	5,300	27.3	75.5
4-Dec-11	10,703	15,332	2,200	2,900	5,400	18.8	75.5
5-Dec-11	9,789	20,117	2,341	2,100	4,400	13.5	75.3
6-Dec-11	9,796	18,573	2,380	2,200	4,300	7.3	75.3
7-Dec-11	9,066	13,274	2,470	1,900	4,100	28.5	75.8
8-Dec-11	9,182	12,760	2,303	2,200	3,600	28.3	75.8
9-Dec-11	9,148	13,326	2,341	1,900	4,000	26.0	75.0
10-Dec-11	9,680	11,628	2,367	2,100	4,200	29.4	75.0
11-Dec-11	11,147	10,650	2,753	2,900	6,100	30.5	75.0
12-Dec-11	9,762	10,187	2,432	2,400	4,200	31.2	75.0
13-Dec-11	9,455	10,753	2,650	2,800	4,600	28.9	73.9
14-Dec-11	9,376	9,210	2,560	2,300	3,800	35.8	74.2
15-Dec-11	9,738	11,988	3,126	3,200	5,400	31.3	74.2
16-Dec-11	9,905	11,679	3,447	2,500	5,200	27.6	74.5
17-Dec-11	10,052	10,136	2,315	2,200	3,300	30.1	74.5
18-Dec-11	9,260	7,769	2,174	1,800	3,100	40.0	74.5
19-Dec-11	9,052	13,017	2,097	1,200	2,500	36.7	73.1
20-Dec-11	8,697	12,657	1,711	1,100	2,300	22.6	73.1
21-Dec-11	8,957	11,319	1,891	1,100	2,600	23.5	72.8
22-Dec-11	8,612	12,863	1,775	1,000	2,100	25.4	72.8
23-Dec-11	8,479	14,921	1,531	800	1,500	16.8	72.8
24-Dec-11	8,322	12,965	1,646	800	1,600	24.0	72.8
25-Dec-11	8,018	12,502	1,557	600	1,100	26.4	72.8
26-Dec-11	8,226	12,554	1,621	700	1,600	24.1	72.8
27-Dec-11	8,376	12,091	1,801	900	1,800	27.9	73.4
28-Dec-11	8,516	10,907	1,852	1,100	1,900	32.7	73.4
29-Dec-11	8,653	6,586	1,866	800	1,700	46.9	73.6
30-Dec-11	8,933	7,409	1,929	1,200	2,300	41.8	73.6
31-Dec-11	8,946	8,438	1,852	1,100	2,000	45.3	73.6

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Jan-12	9,765	11,062	1,544	1,400	1,900	28.1	73.6
2-Jan-12	10,410	10,599	1,929	2,300	3,800	27.9	73.6
3-Jan-12	9,577	7,718	2,329	2,600	4,200	41.2	73.6
4-Jan-12	9,366	8,695	2,329	2,800	3,900	40.8	73.6
5-Jan-12	9,707	7,100	2,470	3,300	4,800	44.4	73.9
6-Jan-12	9,356	7,460	2,123	2,600	3,400	42.9	74.5
7-Jan-12	9,595	10,290	2,109	2,200	3,700	30.4	74.5
8-Jan-12	10,659	11,165	2,058	3,300	4,600	30.0	74.5
9-Jan-12	9,281	10,393	2,457	2,700	3,900	31.0	75.5
10-Jan-12	9,427	8,489	2,444	3,200	3,600	38.7	75.8
11-Jan-12	9,823	13,994	2,406	2,400	3,600	31.1	75.8
12-Jan-12	9,403	14,612	2,380	2,300	3,500	20.0	76.4
13-Jan-12	9,073	12,348	2,315	2,000	3,100	30.9	76.1
14-Jan-12	9,308	9,981	2,226	2,100	2,900	36.9	76.1
15-Jan-12	9,581	8,849	2,212	1,800	2,900	43.0	76.1
16-Jan-12	11,205	10,136	2,792	3,600	5,300	44.4	76.1
17-Jan-12	9,690	11,374	2,573	3,200	4,200	23.6	76.4
18-Jan-12	9,690	11,403	2,527	2,900	3,600	30.1	76.4
19-Jan-12	9,131	7,555	2,370	2,500	3,400	43.6	77.7
20-Jan-12	9,093	6,684	2,589	2,400	3,700	52.9	78.0
21-Jan-12	9,642	7,437	2,548	3,000	3,600	39.0	78.0
22-Jan-12	11,239	8,257	2,597	3,400	4,800	45.6	78.0
23-Jan-12	9,325	9,270	2,393	2,200	4,000	32.3	76.6
24-Jan-12	9,584	10,722	2,623	2,300	4,200	32.5	76.6
25-Jan-12	9,294	10,582	2,569	2,500	4,000	30.8	76.6
26-Jan-12	9,380	8,797	2,385	2,500	3,400	39.9	76.6
27-Jan-12	9,625	10,151	2,636	2,600	3,800	35.8	77.2
28-Jan-12	9,953	12,246	2,292	2,400	3,300	24.6	77.2
29-Jan-12	11,109	9,797	2,591	3,400	4,400	33.7	77.2
30-Jan-12	9,410	7,613	2,601	2,500	3,900	44.3	78.0
31-Jan-12	9,472	8,655	2,547	2,700	3,900	41.2	78.0

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Feb-12	9,369	9,005	2,686	2,400	4,200	37.7	78.3
2-Feb-12	9,813	11,524	3,082	3,100	5,100	33.2	78.8
3-Feb-12	10,342	18,335	2,595	2,800	3,600	30.0	78.8
4-Feb-12	10,850	20,907	2,094	2,300	3,000	27.2	78.8
5-Feb-12	11,696	20,778	2,047	2,700	3,500	22.4	78.8
6-Feb-12	10,772	19,822	2,295	2,500	3,700	26.2	78.3
7-Feb-12	10,690	21,877	2,308	2,800	4,300	25.9	78.3
8-Feb-12	10,437	19,603	2,631	2,500	4,100	23.8	78.0
9-Feb-12	10,830	16,583	2,649	2,300	4,200	30.5	78.0
10-Feb-12	10,475	17,643	2,319	2,203	3,600	28.1	78.0
11-Feb-12	11,225	23,359	2,142	2,100	3,600	19.3	78.0
12-Feb-12	12,215	19,943	2,546	2,900	5,100	17.8	78.0
13-Feb-12	10,465	27,341	2,468	2,200	3,800	31.9	76.9
14-Feb-12	10,372	26,831	2,315	2,300	3,300	33.3	76.9
15-Feb-12	10,318	17,044	2,363	2,100	3,500	33.7	76.4
16-Feb-12	10,557	16,361	2,411	2,400	2,600	29.0	76.4
17-Feb-12	10,680	16,087	2,216	1,700	1,100	32.1	76.4
18-Feb-12	10,615	16,355	2,007	1,700	1,000	29.2	76.4
19-Feb-12	10,608	14,797	2,031	1,700	900	31.6	76.4
20-Feb-12	11,686	16,767	2,425	2,600	2,000	33.1	76.4
21-Feb-12	9,987	13,620	2,265	2,000	1,300	33.4	76.6
22-Feb-12	9,874	5,507	2,474	1,600	1,500	48.3	75.5
23-Feb-12	10,379	17,705	2,355	2,000	1,600	41.4	75.5
24-Feb-12	10,096	18,287	2,154	2,500	1,500	23.8	77.2
25-Feb-12	10,727	12,958	2,727	2,400	1,500	33.4	77.2
26-Feb-12	11,495	15,569	2,432	3,000	2,200	40.0	77.2
27-Feb-12	10,004	16,220	2,204	2,100	1,200	29.8	78.0
28-Feb-12	9,765	14,628	2,175	2,500	1,300	34.9	78.3
29-Feb-12	9,584	11,171	2,128	2,100	1,100	39.5	78.3

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Mar-12	9,813	14,710	2,049	2,100	1,000	42.8	78.5
2-Mar-12	9,891	18,740	2,404	2,600	1,700	24.2	78.5
3-Mar-12	10,918	17,564	2,021	3,300	1,100	23.2	78.5
4-Mar-12	11,574	10,658	2,634	3,500	2,000	40.2	78.5
5-Mar-12	9,980	8,805	2,212	2,500	1,300	47.1	78.5
6-Mar-12	9,755	8,446	2,477	2,800	1,400	52.7	78.5
7-Mar-12	9,949	13,205	2,327	2,800	1,500	44.8	78.5
8-Mar-12	9,943	14,533	2,334	2,100	1,700	33.4	78.5
9-Mar-12	10,093	13,262	2,361	3,200	1,700	34.5	78.5
10-Mar-12	10,710	10,771	2,191	2,600	1,400	40.1	78.5
11-Mar-12	11,154	10,270	2,522	3,200	2,300	41.5	78.5
12-Mar-12	10,072	7,685	2,338	2,400	1,400	46.4	78.0
13-Mar-12	9,547	6,643	2,414	2,100	1,500	56.8	78.0
14-Mar-12	9,093	6,565	2,308	2,100	1,100	56.0	78.0
15-Mar-12	9,339	6,348	2,176	2,300	1,000	54.2	78.8
16-Mar-12	9,305	5,693	2,092	2,100	900	55.6	78.8
17-Mar-12	9,554	5,080	2,151	1,700	900	59.5	78.8
18-Mar-12	10,434	7,725	2,102	2,000	1,100	54.7	78.8
19-Mar-12	9,284	11,769	1,984	1,600	2,800	42.0	79.1
20-Mar-12	8,926	16,273	2,112	1,800	1,900	38.7	79.1
21-Mar-12	8,946	11,064	1,891	1,900	700	40.5	79.3
22-Mar-12	8,864	8,259	2,238	1,900	1,100	51.5	79.3
23-Mar-12	9,526	6,548	2,131	2,000	1,400	49.4	79.3
24-Mar-12	9,485	4,009	2,117	1,500	1,600	58.6	79.3
25-Mar-12	9,680	4,316	2,198	2,500	1,100	58.7	79.3
26-Mar-12	10,127	4,435	2,105	2,400	1,200	59.8	79.1
27-Mar-12	9,806	4,672	2,558	2,600	3,100	61.2	79.1
28-Mar-12	9,779	5,338	2,342	2,500	1,500	54.1	79.1
29-Mar-12	9,673	4,649	2,241	2,500	1,300	58.4	78.8
30-Mar-12	9,932	4,827	2,106	2,800	1,300	54.6	79.1
31-Mar-12	10,540	3,644	2,119	2,600	1,100	61.3	79.1

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Apr-12	11,161	3,580	2,225	2,900	1,900	67.3	79.1
2-Apr-12	9,857	10,469	2,148	2,600	1,300	52.3	79.1
3-Apr-12	10,018	15,579	2,112	3,000	1,200	36.4	79.1
4-Apr-12	10,301	9,700	2,219	2,300	1,600	37.7	79.3
5-Apr-12	9,915	7,075	2,317	3,100	1,300	45.8	79.3
6-Apr-12	10,441	5,324	2,195	2,500	1,000	53.2	79.1
7-Apr-12	10,359	8,541	1,930	2,500	900	48.0	79.1
8-Apr-12	10,086	6,184	2,117	2,300	900	48.7	79.1
9-Apr-12	11,099	5,286	2,406	3,500	1,800	56.3	79.1
10-Apr-12	10,110	4,653	2,340	2,800	1,600	55.3	79.1
11-Apr-12	9,864	5,874	2,206	3,200	1,300	54.9	78.8
12-Apr-12	9,574	5,029	2,176	2,800	1,300	54.3	79.1
13-Apr-12	9,533	6,068	2,315	2,700	1,200	52.3	80.2
14-Apr-12	10,256	7,433	2,322	2,200	1,400	50.1	80.2
15-Apr-12	11,208	12,225	2,272	3,500	1,600	44.0	80.2
16-Apr-12	9,305	8,194	2,184	2,500	1,200	43.8	80.4
17-Apr-12	9,274	5,500	2,065	1,800	900	49.6	81.3
18-Apr-12	9,219	4,902	2,082	1,900	900	56.0	81.5
19-Apr-12	9,120	5,949	1,857	1,400	700	53.9	82.1
20-Apr-12	9,581	5,869	2,313	2,200	1,600	46.8	82.6
21-Apr-12	10,492	3,910	1,885	2,300	1,000	57.1	82.6
22-Apr-12	11,594	4,539	2,121	3,500	1,900	56.5	82.6
23-Apr-12	9,451	4,020	1,925	1,600	1,100	59.8	82.6
24-Apr-12	9,376	2,665	1,796	1,500	800	66.8	82.6
25-Apr-12	9,366	2,632	1,771	1,500	900	66.4	83.2
26-Apr-12	9,448	1,825	1,766	1,300	1,100	65.9	83.2
27-Apr-12	10,198	3,853	2,137	3,100	1,700	59.6	83.2
28-Apr-12	10,594	3,510	1,960	2,000	1,400	49.1	83.2
29-Apr-12	11,137	4,715	2,284	3,500	1,800	49.8	83.2
30-Apr-12	9,308	1,997	1,857	1,300	900	56.8	82.9

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-May-12	9,407	1,897	1,772	1,000	700	61.1	82.9
2-May-12	9,796	1,837	1,647	1,000	600	61.6	82.6
3-May-12	10,557	2,262	2,179	9,000	1,500	63.7	82.3
4-May-12	11,150	2,422	2,003	2,400	1,300	66.7	82.6
5-May-12	11,420	2,190	1,741	4,800	800	70.6	82.6
6-May-12	11,990	2,105	1,961	5,200	1,700	59.8	82.6
7-May-12	9,898	2,102	1,572	1,100	700	44.9	82.6
8-May-12	9,810	2,183	1,739	900	900	46.2	82.6
9-May-12	9,632	2,074	1,851	600	600	55.9	82.6
10-May-12	10,188	2,361	2,038	4,300	900	63.4	82.6
11-May-12	10,369	2,498	2,108	2,600	900	55.1	83.4
12-May-12	11,447	2,603	2,128	5,800	1,300	43.4	83.4
13-May-12	12,386	2,772	2,296	7,000	2,100	47.7	83.4
14-May-12	10,710	2,496	2,319	2,600	1,400	52.1	83.4
15-May-12	10,782	2,251	2,127	5,300	1,100	61.7	83.7
16-May-12	11,045	2,284	2,158	2,800	1,200	64.2	83.2
17-May-12	12,467	2,296	2,144	5,700	1,200	66.4	83.2
18-May-12	13,013	2,299	2,185	3,200	1,200	67.2	82.9
19-May-12	12,641	2,116	1,876	4,700	900	59.4	82.9
20-May-12	13,822	2,176	2,278	4,900	2,000	53.5	82.9
21-May-12	12,870	2,297	2,276	2,400	1,500	62.0	83.7
22-May-12	13,228	2,232	2,106	5,800	1,300	70.1	84.5
23-May-12	13,338	2,469	2,249	6,000	1,700	71.8	84.5
24-May-12	13,286	2,492	2,398	6,100	1,900	56.3	84.2
25-May-12	12,938	2,320	2,009	2,900	800	56.6	84.2
26-May-12	14,136	2,216	2,430	5,200	1,400	66.1	84.2
27-May-12	13,628	2,257	2,120	5,500	900	68.0	84.2
28-May-12	14,460	2,427	2,156	2,700	1,700	58.9	84.2
29-May-12	16,497	2,261	2,194	5,100	1,300	63.4	84.2
30-May-12	17,835	2,326	2,237	2,400	1,200	66.6	84.2
31-May-12	15,736	2,412	2,189	5,400	1,100	60.9	84.5

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Jun-12	16,562	2,401	2,260	2,500	1,400	65.6	85.1
2-Jun-12	17,541	2,282	2,052	5,300	700	67.8	85.1
3-Jun-12	18,568	2,406	2,314	6,200	1,600	68.8	85.1
4-Jun-12	18,111	2,392	2,176	3,400	1,200	72.1	85.3
5-Jun-12	18,585	2,302	2,385	6,100	1,600	67.2	85.6
6-Jun-12	18,524	2,232	2,414	3,700	2,000	69.1	85.6
7-Jun-12	18,677	2,344	2,459	5,700	2,000	68.1	86.1
8-Jun-12	19,462	2,161	2,296	4,200	1,400	72.7	88.0
9-Jun-12	20,373	2,268	2,252	9,000	1,400	79.9	88.0
10-Jun-12	19,261	2,490	2,911	9,100	3,300	72.3	88.0
11-Jun-12	17,128	2,557	2,476	6,600	1,900	64.8	87.8
12-Jun-12	17,449	2,397	2,631	5,400	2,200	68.4	87.5
13-Jun-12	17,510	2,201	2,376	4,100	1,500	69.5	88.9
14-Jun-12	17,964	2,460	2,457	7,900	1,600	74.8	90.5
15-Jun-12	18,261	2,265	2,338	6,700	1,400	69.5	91.6
16-Jun-12	17,831	2,455	2,295	6,400	1,300	69.0	91.6
17-Jun-12	18,732	2,385	2,223	6,700	1,400	69.7	91.6
18-Jun-12	20,073	2,399	2,445	13,000	2,100	81.5	91.6
19-Jun-12	19,517	2,399	2,383	8,800	2,200	83.0	91.6
20-Jun-12	18,988	2,378	2,260	9,600	1,700	75.0	91.3
21-Jun-12	17,637	2,491	2,202	9,400	1,500	68.3	91.3
22-Jun-12	14,972	2,239	2,326	8,100	1,700	72.9	91.0
23-Jun-12	14,839	2,178	2,030	10,700	1,500	85.8	91.0
24-Jun-12	17,783	2,026	1,923	10,600	1,900	84.8	91.0
25-Jun-12	19,530	2,049	2,093	9,200	1,900	83.1	91.3
26-Jun-12	19,943	2,073	2,127	10,200	2,300	83.8	90.8
27-Jun-12	19,578	2,011	2,178	11,200	2,000	82.6	90.5
28-Jun-12	20,131	2,159	2,268	9,400	2,200	79.7	90.5
29-Jun-12	18,964	2,262	2,301	8,700	2,000	77.0	92.4
30-Jun-12	19,046	2,259	2,238	9,400	4,600	80.6	92.4

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Jul-12	19,885	2,389	2,278	10,300	5,700	78.2	92.4
2-Jul-12	20,213	2,463	2,656	10,500	5,800	78.2	92.9
3-Jul-12	19,783	2,379	2,442	9,800	5,300	80.2	93.2
4-Jul-12	20,585	2,389	2,427	9,900	5,600	74.2	93.2
5-Jul-12	19,599	2,272	2,328	9,300	5,500	81.1	92.7
6-Jul-12	18,937	2,098	2,168	9,400	4,600	79.0	92.4
7-Jul-12	18,357	2,258	2,233	9,700	4,900	69.2	92.4
8-Jul-12	18,384	2,354	2,250	8,400	5,400	65.7	92.4
9-Jul-12	16,971	2,623	2,551	6,100	7,000	63.9	92.4
10-Jul-12	14,180	2,332	2,330	4,700	5,700	65.8	92.4
11-Jul-12	14,361	2,140	2,170	4,800	5,400	67.6	91.3
12-Jul-12	14,637	2,050	2,097	7,500	5,800	72.6	91.3
13-Jul-12	21,185	2,092	2,071	7,200	5,500	76.4	91.3
14-Jul-12	19,206	1,958	1,987	6,200	4,100	78.4	91.3
15-Jul-12	19,223	1,958	1,816	6,500	3,500	79.2	91.3
16-Jul-12	20,380	2,081	1,910	6,900	3,600	79.3	91.3
17-Jul-12	17,988	2,036	1,961	1,500	3,700	73.7	91.0
18-Jul-12	18,285	1,960	1,894	6,300	3,100	76.0	91.0
19-Jul-12	18,537	1,896	1,841	5,600	3,300	78.7	91.6
20-Jul-12	18,773	1,936	1,835	6,600	3,200	80.2	91.6
21-Jul-12	19,121	1,812	1,755	5,400	2,900	80.2	91.6
22-Jul-12	19,346	1,825	1,824	900	3,600	81.2	91.6
23-Jul-12	15,869	1,760	1,759	6,700	3,200	80.4	91.8
24-Jul-12	18,636	1,676	1,774	11,800	3,800	81.3	93.8
25-Jul-12	18,660	1,831	1,890	6,600	3,800	78.2	94.3
26-Jul-12	18,346	1,939	1,932	5,800	3,600	71.5	94.3
27-Jul-12	18,568	1,888	1,955	6,700	3,800	75.3	94.6
28-Jul-12	18,456	1,882	2,004	3,600	3,800	77.5	94.6
29-Jul-12	19,807	2,238	2,288	2,500	5,900	77.2	94.6
30-Jul-12	18,275	2,190	2,318	8,400	4,100	75.5	94.3
31-Jul-12	18,125	2,236	2,209	10,500	5,100	71.1	94.3

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Aug-12	18,015	2,167	2,189	2,400	4,800	75.4	94.3
2-Aug-12	18,319	2,393	2,250	3,600	5,400	73.0	94.3
3-Aug-12	17,251	2,278	2,470	2,300	5,500	70.8	93.5
4-Aug-12	18,319	2,101	2,169	1,400	4,600	70.9	93.5
5-Aug-12	15,398	2,080	2,271	2,200	6,200	69.2	93.5
6-Aug-12	20,513	2,196	2,188	2,500	5,700	78.4	93.2
7-Aug-12	20,445	2,229	2,307	2,500	5,400	79.8	92.9
8-Aug-12	18,984	2,344	2,301	2,600	5,500	74.5	92.7
9-Aug-12	18,841	2,198	2,323	2,100	5,200	74.2	92.1
10-Aug-12	18,514	2,273	2,306	2,300	5,200	73.3	92.1
11-Aug-12	19,421	2,196	2,247	1,800	5,500	75.6	92.1
12-Aug-12	20,168	2,434	2,296	2,900	6,400	72.8	92.1
13-Aug-12	18,254	2,303	2,386	2,300	5,800	68.8	92.1
14-Aug-12	17,572	2,249	2,125	2,300	4,400	70.2	92.1
15-Aug-12	17,940	2,341	2,269	1,900	4,900	74.6	91.8
16-Aug-12	17,446	2,174	2,320	2,400	4,800	67.4	91.8
17-Aug-12	18,476	2,185	2,401	4,100	5,400	64.0	91.8
18-Aug-12	19,462	2,087	2,258	1,800	4,600	71.1	91.8
19-Aug-12	19,087	2,217	2,294	1,600	5,500	66.0	91.8
20-Aug-12	17,944	2,233	2,434	4,100	5,700	64.6	91.8
21-Aug-12	19,070	2,344	2,511	4,600	5,700	68.5	91.6
22-Aug-12	19,465	2,250	2,493	4,600	5,900	72.1	91.6
23-Aug-12	19,158	2,368	2,418	2,400	5,700	73.0	91.6
24-Aug-12	19,008	2,405	2,444	5,100	5,600	67.8	92.1
25-Aug-12	18,978	2,453	2,325	2,200	5,300	68.1	92.1
26-Aug-12	20,899	2,361	2,453	2,300	6,500	71.3	92.1
27-Aug-12	19,831	2,286	2,484	6,800	5,900	73.5	92.1
28-Aug-12	19,926	2,280	2,416	2,200	5,400	75.9	92.1
29-Aug-12	19,646	2,127	2,408	5,600	5,500	74.2	92.1
30-Aug-12	19,240	2,190	2,526	2,000	5,700	73.2	92.7
31-Aug-12	19,503	2,081	2,255	5,700	4,800	72.8	92.7

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Sep-12	19,155	1,897	2,282	1,100	4,600	72.6	92.7
2-Sep-12	20,431	1,828	2,181	1,100	4,700	77.0	92.7
3-Sep-12	20,428	2,184	2,603	7,100	7,000	71.9	92.7
4-Sep-12	18,749	1,886	2,314	1,300	5,200	70.7	92.7
5-Sep-12	17,654	1,959	2,351	1,500	4,600	71.9	91.8
6-Sep-12	18,026	1,877	2,146	1,100	4,000	70.7	92.1
7-Sep-12	16,320	1,974	2,199	3,900	4,100	67.8	92.1
8-Sep-12	16,412	2,344	2,177	1,700	4,400	61.8	92.1
9-Sep-12	18,462	2,525	2,355	2,500	5,600	65.0	92.1
10-Sep-12	19,384	2,268	2,474	6,100	6,200	69.1	91.3
11-Sep-12	19,121	2,372	2,456	2,400	5,300	74.6	91.0
12-Sep-12	15,337	2,521	2,417	2,800	5,600	60.7	91.0
13-Sep-12	16,982	2,393	2,560	2,700	5,500	52.9	91.0
14-Sep-12	16,545	2,355	2,364	2,600	5,100	56.5	90.5
15-Sep-12	17,384	2,441	2,246	2,000	4,800	58.6	90.5
16-Sep-12	19,923	2,553	2,553	3,400	7,400	65.8	90.5
17-Sep-12	16,661	2,450	2,517	6,200	5,800	62.6	90.5
18-Sep-12	16,135	2,534	2,443	2,800	5,400	56.9	89.7
19-Sep-12	16,971	2,411	2,586	4,200	6,000	64.3	89.4
20-Sep-12	16,692	2,402	2,440	2,300	5,500	64.4	89.4
21-Sep-12	17,156	2,312	2,422	4,400	5,300	63.7	89.7
22-Sep-12	17,742	2,396	2,306	1,900	5,500	62.1	89.7
23-Sep-12	18,902	2,394	2,372	3,100	7,100	61.2	89.7
24-Sep-12	17,214	2,408	2,417	5,700	5,800	65.5	89.7
25-Sep-12	16,432	2,489	2,533	3,300	6,100	58.2	89.9
26-Sep-12	15,832	2,460	2,509	2,200	6,100	53.9	90.2
27-Sep-12	15,180	2,355	2,535	2,100	5,900	53.6	89.9
28-Sep-12	15,422	2,363	2,273	2,800	4,600	53.9	89.9
29-Sep-12	16,497	2,204	2,374	1,600	5,000	56.5	89.9
30-Sep-12	18,428	NA	2,338	2,300	6,300	60.6	89.9

Appendix C – Complex 1B Actual Energy, Water, Weather, and Occupancy Data

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Oct-11	13,273	NA	2,264	NA	NA	63.2	91.0
2-Oct-11	13,938	NA	2,573	NA	NA	66.2	91.0
3-Oct-11	13,378	NA	2,444	NA	NA	67.1	91.6
4-Oct-11	12,078	NA	2,521	NA	NA	63.2	91.6
5-Oct-11	11,833	NA	2,444	NA	NA	61.1	90.2
6-Oct-11	10,860	NA	2,367	NA	NA	59.4	89.9
7-Oct-11	9,328	NA	2,547	NA	NA	48.5	89.4
8-Oct-11	8,557	NA	2,264	NA	NA	44.1	89.4
9-Oct-11	8,264	NA	2,392	NA	NA	43.6	89.4
10-Oct-11	8,898	NA	2,521	NA	NA	46.7	89.4
11-Oct-11	7,885	NA	2,444	NA	NA	54.3	89.7
12-Oct-11	7,786	NA	2,341	NA	NA	54.1	89.9
13-Oct-11	7,984	NA	2,341	NA	NA	52.6	90.2
14-Oct-11	7,595	NA	2,315	NA	NA	51.9	90.2
15-Oct-11	7,868	NA	2,290	NA	NA	54.4	90.2
16-Oct-11	8,762	NA	2,470	NA	NA	56.7	90.2
17-Oct-11	7,803	NA	2,495	NA	NA	47.3	90.2
18-Oct-11	7,950	NA	2,675	NA	NA	42.7	90.8
19-Oct-11	7,766	4,425	2,521	NA	NA	42.2	90.8
20-Oct-11	7,793	3,859	2,675	NA	NA	48.8	91.8
21-Oct-11	7,465	3,910	2,701	NA	NA	52.6	91.3
22-Oct-11	7,691	3,293	2,418	NA	NA	54.4	91.3
23-Oct-11	8,260	3,704	2,495	NA	NA	53.0	91.3
24-Oct-11	8,892	3,344	2,855	NA	NA	55.8	91.3
25-Oct-11	7,899	4,270	2,598	NA	NA	59.1	91.8
26-Oct-11	8,510	6,071	2,392	NA	NA	35.1	91.8
27-Oct-11	7,827	4,631	2,264	NA	NA	28.0	92.1
28-Oct-11	7,841	4,322	2,778	NA	NA	35.9	91.8
29-Oct-11	8,066	4,219	2,521	NA	NA	45.5	91.8
30-Oct-11	8,561	4,785	2,727	NA	NA	44.7	91.8
31-Oct-11	8,434	4,528	2,727	NA	NA	47.9	91.6

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Nov-11	7,486	4,733	2,701	NA	NA	49.7	91.6
2-Nov-11	8,008	4,888	2,804	NA	NA	34.0	91.0
3-Nov-11	7,848	2,984	2,804	NA	NA	28.0	91.3
4-Nov-11	8,104	5,145	3,087	NA	NA	41.5	91.6
5-Nov-11	8,421	5,454	2,830	NA	NA	43.5	91.6
6-Nov-11	9,577	6,740	3,113	NA	NA	39.4	91.6
7-Nov-11	8,264	5,711	2,958	NA	NA	35.9	90.5
8-Nov-11	8,817	7,512	2,907	NA	NA	37.3	89.9
9-Nov-11	9,496	10,239	2,958	NA	NA	33.1	89.7
10-Nov-11	10,048	9,055	2,830	NA	NA	35.1	89.4
11-Nov-11	9,482	7,203	2,753	NA	NA	43.9	89.4
12-Nov-11	9,847	5,865	2,958	NA	NA	50.2	89.4
13-Nov-11	10,779	4,116	3,396	NA	NA	51.6	89.4
14-Nov-11	9,352	6,946	2,830	NA	NA	46.3	89.7
15-Nov-11	9,700	8,283	3,267	NA	NA	44.2	90.8
16-Nov-11	10,454	11,370	2,830	NA	NA	33.7	90.8
17-Nov-11	10,158	9,621	2,907	NA	NA	29.7	92.1
18-Nov-11	9,813	6,225	2,958	NA	NA	48.2	92.7
19-Nov-11	9,857	7,872	2,830	NA	NA	50.7	92.7
20-Nov-11	11,447	10,753	3,036	NA	NA	31.0	92.7
21-Nov-11	10,007	8,283	2,881	NA	NA	35.8	92.9
22-Nov-11	10,205	7,872	3,087	NA	NA	42.0	93.2
23-Nov-11	9,799	7,666	3,010	NA	NA	44.6	93.2
24-Nov-11	9,772	6,020	2,598	NA	NA	48.2	93.2
25-Nov-11	10,069	7,049	2,521	NA	NA	51.8	92.9
26-Nov-11	10,454	11,936	2,598	NA	NA	33.7	92.9
27-Nov-11	11,304	9,673	3,036	NA	NA	32.7	92.9
28-Nov-11	10,209	7,152	3,010	NA	NA	43.5	93.8
29-Nov-11	10,134	9,158	3,113	NA	NA	40.3	93.8
30-Nov-11	9,932	7,203	3,087	NA	NA	40.4	93.2

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Dec-11	10,212	13,428	3,113	NA	NA	35.9	94.3
2-Dec-11	NA	4,219	3,087	NA	NA	22.6	94.6
3-Dec-11	NA	16,833	3,190	NA	NA	27.3	94.6
4-Dec-11	NA	16,833	3,113	NA	NA	18.8	94.6
5-Dec-11	NA	16,833	2,881	NA	NA	13.5	94.6
6-Dec-11	NA	16,833	2,830	NA	NA	7.3	94.8
7-Dec-11	NA	16,833	2,778	NA	NA	28.5	94.6
8-Dec-11	NA	16,833	2,830	NA	NA	28.3	95.1
9-Dec-11	9,878	13,017	2,778	NA	NA	26.0	95.1
10-Dec-11	10,935	11,679	3,138	NA	NA	29.4	95.1
11-Dec-11	11,710	10,702	3,627	NA	NA	30.5	95.1
12-Dec-11	10,949	11,113	3,319	NA	NA	31.2	95.1
13-Dec-11	10,533	10,805	3,473	NA	NA	28.9	94.6
14-Dec-11	10,120	9,827	3,447	NA	NA	35.8	94.6
15-Dec-11	10,516	12,039	3,010	NA	NA	31.3	94.3
16-Dec-11	10,594	11,834	3,293	NA	NA	27.6	94.3
17-Dec-11	10,417	10,856	3,164	NA	NA	30.1	94.3
18-Dec-11	10,888	8,489	3,087	NA	NA	40.0	94.3
19-Dec-11	10,297	13,840	3,061	NA	NA	36.7	93.2
20-Dec-11	10,154	13,840	2,470	NA	NA	22.6	94.0
21-Dec-11	9,226	11,782	2,444	NA	NA	23.5	94.6
22-Dec-11	9,124	13,994	2,367	NA	NA	25.4	94.6
23-Dec-11	9,322	14,509	2,341	NA	NA	16.8	94.6
24-Dec-11	9,025	11,988	2,109	NA	NA	24.0	94.6
25-Dec-11	8,823	11,885	1,878	NA	NA	26.4	94.6
26-Dec-11	9,052	12,297	2,187	NA	NA	24.1	94.6
27-Dec-11	8,987	11,113	2,290	NA	NA	27.9	95.4
28-Dec-11	9,124	9,724	2,187	NA	NA	32.7	94.8
29-Dec-11	8,933	6,225	2,392	NA	NA	46.9	94.8
30-Dec-11	8,957	7,100	2,084	NA	NA	41.8	94.8
31-Dec-11	8,817	7,615	2,212	NA	NA	45.3	94.8

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Jan-12	9,885	9,518	2,007	NA	NA	28.1	94.8
2-Jan-12	11,041	8,798	2,675	NA	NA	27.9	94.8
3-Jan-12	9,803	6,740	2,907	NA	NA	41.2	95.9
4-Jan-12	9,840	7,718	2,984	NA	NA	40.8	95.9
5-Jan-12	9,932	6,894	3,319	NA	NA	44.4	95.9
6-Jan-12	10,001	7,975	3,087	NA	NA	42.9	95.9
7-Jan-12	10,877	10,444	2,881	NA	NA	30.4	95.9
8-Jan-12	11,870	10,856	3,036	NA	NA	30.0	95.9
9-Jan-12	10,229	9,518	3,241	NA	NA	31.0	96.2
10-Jan-12	10,171	8,078	3,241	NA	NA	38.7	96.2
11-Jan-12	10,970	14,200	3,241	NA	NA	31.1	96.2
12-Jan-12	10,574	13,120	3,293	NA	NA	20.0	96.7
13-Jan-12	10,529	10,856	3,036	NA	NA	30.9	96.7
14-Jan-12	10,308	9,055	2,933	NA	NA	36.9	96.7
15-Jan-12	10,659	8,592	2,933	NA	NA	43.0	96.7
16-Jan-12	11,539	10,702	3,447	NA	NA	44.4	96.7
17-Jan-12	10,847	10,290	3,602	NA	NA	23.6	95.7
18-Jan-12	10,581	10,525	3,323	3,400	NA	30.1	95.4
19-Jan-12	10,137	7,246	3,323	3,200	NA	43.6	95.1
20-Jan-12	9,758	7,238	3,323	3,300	NA	52.9	95.1
21-Jan-12	10,768	6,858	3,323	2,400	NA	39.0	95.1
22-Jan-12	11,608	6,342	3,323	3,900	NA	45.6	95.1
23-Jan-12	10,042	7,698	3,323	3,100	NA	32.3	94.8
24-Jan-12	10,721	10,112	3,323	3,300	NA	32.5	95.4
25-Jan-12	10,451	9,776	3,323	3,900	NA	30.8	94.8
26-Jan-12	10,120	8,295	3,323	3,000	NA	39.9	96.2
27-Jan-12	9,994	10,087	3,323	3,200	NA	35.8	96.2
28-Jan-12	10,918	9,681	3,323	3,400	NA	24.6	96.2
29-Jan-12	11,403	5,017	3,323	4,600	NA	33.7	96.2
30-Jan-12	9,693	6,604	3,323	3,200	NA	44.3	95.7
31-Jan-12	9,632	7,628	3,323	2,900	NA	41.2	95.4

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Feb-12	9,530	7,868	3,323	3,300	NA	37.7	95.4
2-Feb-12	10,188	9,858	3,323	3,900	NA	33.2	95.7
3-Feb-12	10,949	10,750	3,323	3,400	NA	30.0	95.7
4-Feb-12	10,966	10,279	3,323	2,600	NA	27.2	95.7
5-Feb-12	11,328	10,743	3,323	3,700	NA	22.4	95.7
6-Feb-12	10,175	10,671	3,323	3,400	NA	26.2	95.4
7-Feb-12	10,601	11,877	3,323	3,000	NA	25.9	95.4
8-Feb-12	10,011	10,990	3,323	3,500	NA	23.8	95.4
9-Feb-12	10,018	8,965	3,323	2,800	NA	30.5	95.9
10-Feb-12	10,113	18,268	3,323	3,200	NA	28.1	96.2
11-Feb-12	11,038	12,262	3,027	3,100	3,400	19.3	96.2
12-Feb-12	12,109	10,813	3,958	4,100	5,400	17.8	96.2
13-Feb-12	9,956	8,396	3,658	3,500	4,400	31.9	96.2
14-Feb-12	9,410	7,890	3,559	2,900	4,200	33.3	96.2
15-Feb-12	9,885	9,044	3,394	3,400	3,900	33.7	96.5
16-Feb-12	9,349	8,283	3,437	2,600	4,200	29.0	95.9
17-Feb-12	9,963	7,995	3,137	2,300	3,400	32.1	95.9
18-Feb-12	10,035	7,520	2,915	2,000	3,200	29.2	95.9
19-Feb-12	10,198	7,481	3,024	2,400	3,200	31.6	95.9
20-Feb-12	11,468	8,747	3,224	3,500	3,900	33.1	95.9
21-Feb-12	9,403	7,029	3,275	3,200	3,700	33.4	95.9
22-Feb-12	8,997	5,244	3,104	2,900	3,300	48.3	95.9
23-Feb-12	9,502	8,299	3,007	2,600	3,300	41.4	96.2
24-Feb-12	9,646	8,232	3,075	2,900	3,700	23.8	96.5
25-Feb-12	10,178	7,362	3,224	3,100	3,800	33.4	96.5
26-Feb-12	11,239	8,194	3,469	4,200	5,000	40.0	96.5
27-Feb-12	10,059	7,831	3,346	3,200	4,000	29.8	96.7
28-Feb-12	9,738	7,605	3,239	3,100	3,700	34.9	97.0
29-Feb-12	9,305	6,164	3,371	2,800	3,700	39.5	97.3

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Mar-12	9,656	7,592	3,106	2,800	3,600	42.8	97.3
2-Mar-12	10,263	8,732	3,023	2,700	3,500	24.2	97.3
3-Mar-12	10,014	8,298	3,023	2,400	3,400	23.2	97.3
4-Mar-12	10,673	6,142	2,990	2,700	3,900	40.2	97.3
5-Mar-12	9,096	5,363	2,786	2,500	3,100	47.1	97.3
6-Mar-12	8,772	4,842	2,632	2,100	2,600	52.7	97.6
7-Mar-12	NA	6,619	2,929	2,700	3,200	44.8	95.9
8-Mar-12	NA	6,966	2,603	2,200	2,700	33.4	95.9
9-Mar-12	NA	6,907	3,264	2,800	5,000	34.5	96.5
10-Mar-12	NA	5,762	3,033	2,700	3,800	40.1	96.5
11-Mar-12	NA	5,207	3,127	2,500	4,600	41.5	96.5
12-Mar-12	NA	5,108	3,463	3,100	4,700	46.4	95.9
13-Mar-12	8,701	4,579	3,350	3,100	4,700	56.8	95.9
14-Mar-12	8,455	4,734	3,298	2,900	5,200	56.0	96.2
15-Mar-12	8,387	4,486	2,984	2,600	3,800	54.2	95.7
16-Mar-12	8,769	4,165	3,522	2,500	4,300	55.6	95.9
17-Mar-12	8,844	3,984	3,056	1,800	3,300	59.5	95.9
18-Mar-12	10,192	5,405	3,286	2,800	4,000	54.7	95.9
19-Mar-12	8,765	6,107	3,021	2,600	3,400	42.0	95.4
20-Mar-12	8,957	7,451	2,945	2,400	3,300	38.7	95.4
21-Mar-12	8,892	6,388	2,943	2,800	3,500	40.5	95.7
22-Mar-12	8,247	5,341	2,822	2,400	3,400	51.5	95.9
23-Mar-12	8,888	4,478	2,958	2,000	3,500	49.4	95.7
24-Mar-12	8,943	3,719	2,831	2,100	3,400	58.6	95.7
25-Mar-12	9,209	3,738	2,966	2,400	3,900	58.7	95.7
26-Mar-12	9,721	3,937	3,171	2,800	4,100	59.8	95.4
27-Mar-12	8,550	4,232	3,081	3,100	3,800	61.2	95.1
28-Mar-12	8,458	4,096	2,836	2,600	3,400	54.1	95.1
29-Mar-12	7,957	3,785	2,887	2,200	3,400	58.4	93.8
30-Mar-12	8,086	3,882	2,898	2,300	3,500	54.6	94.6
31-Mar-12	9,137	3,503	2,792	2,400	3,300	61.3	94.6

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Apr-12	9,994	3,989	2,693	3,500	3,800	67.3	94.6
2-Apr-12	8,438	7,290	2,711	2,300	2,900	52.3	94.6
3-Apr-12	9,021	8,785	2,747	2,100	2,700	36.4	94.6
4-Apr-12	8,370	5,696	2,656	2,100	2,700	37.7	94.8
5-Apr-12	8,728	5,215	3,256	3,000	3,900	45.8	94.8
6-Apr-12	8,881	4,603	2,912	1,800	3,500	53.2	94.6
7-Apr-12	8,540	5,975	2,828	2,600	4,000	48.0	94.6
8-Apr-12	8,404	4,013	2,331	2,100	2,700	48.7	94.6
9-Apr-12	9,400	4,262	2,807	3,100	3,900	56.3	94.6
10-Apr-12	8,489	4,187	3,155	3,000	4,100	55.3	95.4
11-Apr-12	8,636	4,487	2,845	2,800	3,700	54.9	97.0
12-Apr-12	8,527	4,005	2,910	2,800	3,700	54.3	97.8
13-Apr-12	8,486	4,292	2,958	2,400	3,400	52.3	97.8
14-Apr-12	9,151	4,853	2,721	2,200	3,200	50.1	97.8
15-Apr-12	10,100	7,756	2,992	3,500	4,100	44.0	97.8
16-Apr-12	8,765	4,858	2,837	3,400	3,600	43.8	97.8
17-Apr-12	8,605	4,385	3,077	3,000	4,100	49.6	97.8
18-Apr-12	8,581	4,405	2,940	2,800	3,800	56.0	97.8
19-Apr-12	8,622	4,154	2,806	2,500	3,700	53.9	97.8
20-Apr-12	9,110	4,376	2,696	2,800	3,500	46.8	96.5
21-Apr-12	9,513	3,128	2,469	2,100	3,300	57.1	96.5
22-Apr-12	9,915	3,477	2,804	2,900	4,200	56.5	96.5
23-Apr-12	8,513	3,808	2,755	3,900	3,600	59.8	96.5
24-Apr-12	8,018	3,207	2,630	2,900	3,400	66.8	96.5
25-Apr-12	8,411	3,233	2,503	3,000	3,500	66.4	96.5
26-Apr-12	8,284	3,462	2,015	2,900	3,600	65.9	95.9
27-Apr-12	8,274	3,859	2,722	2,800	3,900	59.6	96.2
28-Apr-12	8,718	5,501	2,580	2,200	3,700	49.1	96.2
29-Apr-12	9,898	4,326	3,030	3,300	4,900	49.8	96.2
30-Apr-12	10,519	3,849	2,588	2,700	3,700	56.8	95.9

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-May-12	12,150	11,961	2,352	2,400	2,900	61.1	95.9
2-May-12	13,494	11,386	2,634	2,200	3,400	61.6	95.9
3-May-12	13,099	3,006	2,781	11,200	3,800	63.7	95.9
4-May-12	13,003	2,671	2,665	2,800	3,700	66.7	95.9
5-May-12	13,914	2,413	2,427	5,400	2,800	70.6	95.9
6-May-12	13,433	2,780	2,685	6,300	4,000	59.8	95.9
7-May-12	9,854	2,458	2,545	2,400	3,700	44.9	95.9
8-May-12	9,049	2,598	2,348	3,300	3,100	46.2	95.9
9-May-12	10,110	2,116	2,127	1,600	2,200	55.9	96.2
10-May-12	10,993	2,084	2,297	6,300	2,300	63.4	97.6
11-May-12	8,370	2,351	2,437	1,700	2,800	55.1	97.6
12-May-12	9,540	2,929	2,666	3,300	4,100	43.4	97.6
13-May-12	10,973	2,828	2,936	7,800	4,800	47.7	97.6
14-May-12	9,943	2,230	2,212	8,300	2,700	52.1	97.6
15-May-12	10,362	1,963	2,028	1,800	2,200	61.7	97.8
16-May-12	11,707	1,908	2,115	6,000	2,100	64.2	97.0
17-May-12	12,007	2,123	2,317	4,400	2,600	66.4	96.5
18-May-12	13,211	2,806	2,864	3,600	3,700	67.2	97.0
19-May-12	10,963	2,637	2,385	7,800	3,200	59.4	97.0
20-May-12	13,378	2,752	2,726	3,600	4,600	53.5	97.0
21-May-12	12,314	2,592	2,532	6,700	3,200	62.0	96.2
22-May-12	14,402	2,651	2,524	3,900	3,000	70.1	95.7
23-May-12	12,287	2,792	2,658	6,600	3,300	71.8	96.7
24-May-12	11,765	2,925	2,784	3,100	3,900	56.3	96.7
25-May-12	12,256	2,804	2,826	10,000	3,700	56.6	96.7
26-May-12	14,446	2,658	2,462	8,000	3,300	66.1	96.7
27-May-12	12,781	2,662	2,438	8,300	3,500	68.0	96.7
28-May-12	13,593	2,909	2,738	6,600	4,300	58.9	96.7
29-May-12	12,775	2,895	2,725	6,000	3,900	63.4	96.7
30-May-12	12,921	2,566	2,677	6,200	3,600	66.6	96.5
31-May-12	12,955	2,484	2,602	2,900	3,700	60.9	97.0

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Jun-12	14,150	2,835	2,599	7,500	3,500	65.6	97.0
2-Jun-12	13,447	2,692	2,491	5,400	3,100	67.8	97.0
3-Jun-12	15,378	2,674	2,485	4,400	3,600	68.8	97.0
4-Jun-12	14,371	2,737	2,794	8,500	4,100	72.1	97.0
5-Jun-12	14,153	2,818	2,669	6,300	3,500	67.2	96.5
6-Jun-12	13,552	2,626	2,540	4,000	3,700	69.1	95.9
7-Jun-12	14,375	2,973	2,503	3,800	3,600	68.1	95.4
8-Jun-12	15,320	2,562	2,470	4,800	3,600	72.7	95.7
9-Jun-12	16,770	2,525	2,882	8,300	4,100	79.9	95.7
10-Jun-12	15,630	1,837	2,763	6,400	4,600	72.3	95.7
11-Jun-12	13,266	2,620	2,704	5,500	4,100	64.8	95.7
12-Jun-12	13,587	2,607	2,710	5,200	3,700	68.4	95.9
13-Jun-12	14,590	2,661	2,732	3,600	4,000	69.5	95.9
14-Jun-12	14,975	2,451	2,573	7,900	3,700	74.8	95.1
15-Jun-12	14,501	2,469	2,625	5,700	3,400	69.5	95.9
16-Jun-12	13,655	2,255	2,507	4,600	3,500	69.0	95.9
17-Jun-12	15,804	2,472	2,505	5,600	3,700	69.7	95.9
18-Jun-12	17,254	2,907	2,763	15,100	4,400	81.5	96.2
19-Jun-12	17,009	2,692	2,615	10,500	4,300	83.0	96.2
20-Jun-12	14,883	2,522	2,796	9,700	4,200	75.0	96.5
21-Jun-12	13,965	2,551	2,524	9,300	3,700	68.3	96.7
22-Jun-12	15,402	2,579	2,616	9,000	4,100	72.9	96.5
23-Jun-12	17,493	3,131	2,394	10,800	3,400	85.8	96.5
24-Jun-12	19,066	2,862	2,508	11,000	3,900	84.8	96.5
25-Jun-12	18,077	2,713	2,675	10,100	4,200	83.1	96.5
26-Jun-12	17,766	2,586	2,655	10,400	4,700	83.8	96.5
27-Jun-12	17,882	2,555	2,365	11,400	3,900	82.6	96.2
28-Jun-12	16,999	2,510	2,539	11,100	3,800	79.7	96.2
29-Jun-12	15,903	2,224	2,613	8,900	3,900	77.0	96.2
30-Jun-12	16,603	2,316	2,488	9,400	3,700	80.6	96.2

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Jul-12	17,616	2,428	2,718	10,500	4,500	78.2	96.2
2-Jul-12	16,893	2,250	2,602	10,000	4,500	78.2	95.9
3-Jul-12	16,391	2,188	2,602	9,700	4,100	80.2	95.9
4-Jul-12	16,374	2,353	2,414	9,800	4,400	74.2	95.9
5-Jul-12	16,674	2,240	2,598	9,600	4,300	81.1	95.7
6-Jul-12	15,784	2,039	2,260	9,900	3,400	79.0	95.4
7-Jul-12	13,471	2,062	2,050	9,600	3,300	69.2	95.4
8-Jul-12	13,986	2,132	2,097	8,300	3,500	65.7	95.4
9-Jul-12	16,006	2,645	2,666	3,900	5,200	63.9	95.4
10-Jul-12	15,579	2,246	2,386	2,800	4,200	65.8	95.4
11-Jul-12	15,122	2,283	2,531	3,100	4,500	67.6	95.7
12-Jul-12	15,948	2,204	2,628	8,800	5,400	72.6	95.4
13-Jul-12	16,245	2,249	2,688	9,000	4,600	76.4	95.9
14-Jul-12	16,593	2,132	2,259	7,900	3,000	78.4	95.9
15-Jul-12	16,917	2,037	1,933	8,000	2,200	79.2	95.9
16-Jul-12	16,545	2,327	2,038	10,000	2,600	79.3	95.9
17-Jul-12	15,688	2,197	2,084	3,000	2,500	73.7	95.7
18-Jul-12	15,429	2,029	1,874	8,400	1,800	76.0	95.9
19-Jul-12	15,678	1,884	1,875	7,200	2,100	78.7	95.9
20-Jul-12	16,023	1,822	1,840	8,200	1,900	80.2	95.1
21-Jul-12	15,907	1,698	1,889	7,500	2,000	80.2	95.1
22-Jul-12	16,374	1,627	1,853	1,100	2,400	81.2	95.1
23-Jul-12	16,094	1,719	2,152	8,400	2,800	80.4	95.1
24-Jul-12	16,176	1,793	1,973	13,800	2,700	81.3	96.5
25-Jul-12	15,753	1,907	1,970	8,800	2,600	78.2	96.5
26-Jul-12	15,647	1,822	1,994	11,900	3,200	71.5	96.5
27-Jul-12	15,388	1,883	2,199	8,600	3,500	75.3	96.2
28-Jul-12	15,204	1,900	1,926	6,000	2,900	77.5	96.2
29-Jul-12	17,568	2,198	2,333	2,600	5,100	77.2	96.2
30-Jul-12	16,408	2,191	2,315	10,600	4,500	75.5	95.9
31-Jul-12	15,869	2,216	2,404	13,100	4,700	71.1	95.4

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Aug-12	16,030	2,264	2,379	2,600	4,400	75.4	95.4
2-Aug-12	15,726	2,371	2,610	2,900	4,800	73.0	96.2
3-Aug-12	15,883	2,446	2,518	2,800	4,900	70.8	95.4
4-Aug-12	15,306	2,435	179	2,700	4,300	70.9	95.4
5-Aug-12	16,715	2,416	380	3,200	4,300	69.2	95.4
6-Aug-12	16,483	2,150	2,294	2,800	5,400	78.4	95.1
7-Aug-12	16,354	2,319	2,341	2,500	4,200	79.8	95.1
8-Aug-12	16,275	2,276	2,392	2,700	5,200	74.5	94.8
9-Aug-12	15,763	2,273	2,287	2,500	3,900	74.2	95.4
10-Aug-12	15,354	2,328	2,264	2,500	4,100	73.3	95.4
11-Aug-12	16,579	2,194	2,349	2,300	3,900	75.6	95.4
12-Aug-12	17,425	2,483	2,313	3,100	4,900	72.8	95.4
13-Aug-12	15,071	2,456	2,264	2,900	4,600	68.8	95.9
14-Aug-12	15,409	2,349	2,361	2,800	4,600	70.2	96.5
15-Aug-12	15,637	2,487	2,463	2,500	4,300	74.6	96.5
16-Aug-12	14,436	3,042	2,579	4,200	5,100	67.4	96.5
17-Aug-12	14,405	2,234	2,458	6,000	4,300	64.0	96.5
18-Aug-12	14,552	2,485	2,286	NA	3,400	71.1	96.5
19-Aug-12	14,399	2,778	2,326	NA	4,000	66.0	96.5
20-Aug-12	13,996	2,515	2,458	NA	4,500	64.6	96.5
21-Aug-12	14,637	2,739	2,349	NA	4,600	68.5	96.2
22-Aug-12	15,204	2,805	2,551	NA	4,600	72.1	95.9
23-Aug-12	14,945	2,591	2,488	4,400	4,300	73.0	95.9
24-Aug-12	15,825	2,400	2,424	6,600	4,600	67.8	95.9
25-Aug-12	15,378	2,405	2,475	2,600	5,000	68.1	95.9
26-Aug-12	17,289	2,101	2,476	3,300	5,900	71.3	95.9
27-Aug-12	16,343	2,306	2,559	9,900	4,900	73.5	95.4
28-Aug-12	16,282	2,297	2,460	2,400	4,900	75.9	95.4
29-Aug-12	16,245	2,378	2,555	8,800	4,600	74.2	95.4
30-Aug-12	16,367	2,174	2,486	2,700	4,500	73.2	95.4
31-Aug-12	15,405	2,309	2,172	8,300	3,700	72.8	94.6

Date	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)		Water Consumption (gal)		24-hr Average Temperature (°F)	Daily Reported Occupancy (%)
		North Meter	South Meter	North Meter	South Meter		
1-Sep-12	15,405	2,161	2,132	1,700	2,800	72.6	94.6
2-Sep-12	16,634	2,163	1,998	3,400	2,700	77.0	94.6
3-Sep-12	17,261	2,641	2,418	12,000	5,000	71.9	94.6
4-Sep-12	15,102	2,414	2,368	2,800	4,700	70.7	95.1
5-Sep-12	14,085	2,199	2,187	1,900	3,000	71.9	95.1
6-Sep-12	14,276	2,144	1,994	1,400	2,500	70.7	95.1
7-Sep-12	13,174	2,174	2,057	6,100	2,100	67.8	94.6
8-Sep-12	13,406	2,297	2,081	1,700	2,700	61.8	94.6
9-Sep-12	14,607	2,434	2,175	2,300	3,100	65.0	94.6
10-Sep-12	14,286	2,317	2,398	8,200	3,300	69.1	94.3
11-Sep-12	14,678	2,480	2,879	2,600	4,900	74.6	94.0
12-Sep-12	12,669	2,494	2,575	3,400	5,200	60.7	94.0
13-Sep-12	13,539	2,338	2,435	2,600	4,800	52.9	94.0
14-Sep-12	13,269	2,398	2,662	3,900	5,200	56.5	93.5
15-Sep-12	13,556	2,158	2,336	1,900	4,000	58.6	93.5
16-Sep-12	15,992	2,592	2,676	2,900	5,600	65.8	93.5
17-Sep-12	13,880	2,390	2,594	9,000	4,900	62.6	93.8
18-Sep-12	12,822	2,243	2,345	2,100	4,000	56.9	93.8
19-Sep-12	13,877	2,457	2,434	5,700	5,100	64.3	93.8
20-Sep-12	13,911	2,241	2,370	2,100	4,900	64.4	93.8
21-Sep-12	13,597	2,282	2,350	6,300	4,400	63.7	92.7
22-Sep-12	14,893	2,135	2,312	2,100	4,500	62.1	92.7
23-Sep-12	15,136	2,539	2,665	3,000	5,800	61.2	92.7
24-Sep-12	13,733	2,351	2,622	8,600	4,900	65.5	92.1
25-Sep-12	13,102	2,347	2,481	3,700	4,400	58.2	91.8
26-Sep-12	12,068	2,309	2,442	5,700	4,900	53.9	91.6
27-Sep-12	12,130	2,356	2,534	3,100	4,400	53.6	91.6
28-Sep-12	11,840	2,569	2,503	2,700	4,700	53.9	91.3
29-Sep-12	12,652	2,174	2,387	1,600	3,700	56.5	91.3
30-Sep-12	14,545	2,619	2,499	2,700	4,900	60.6	91.3

APPENDIX D – COMPLEX 2 ACTUAL ENERGY DATA

Month/Yr	Electricity Consumption (kBtu)
Oct-10	170,941.2
Nov-10	140,233.2
Dec-10	148,422.0
Jan-11	172,988.4
Feb-11	154,563.6
Mar-11	150,469.2
Apr-11	147,398.4
May-11	164,799.6
Jun-11	208,814.4
Jul-11	184,248.0
Aug-11	217,003.2
Sep-11	185,271.6
Oct-11	170,941.2
Nov-11	123,855.6
Dec-11	139,209.6
Jan-12	153,540.0
Feb-12	129,997.2
Mar-12	154,563.6
Apr-12	156,610.8
May-12	154,563.6
Jun-12	177,082.8
Jul-12	205,743.6
Aug-12	180,153.6
Sep-12	194,484.0

APPENDIX E – COMPLEX 2 ACTUAL WEATHER DATA

	24-hr Average Daily Temperature (°F) for Fiscal Year 2011											
Date	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11
1	71.8	64.9	53.2	62.3	58.1	65.2	58.8	72.1	85.2	81.4	80.5	81.3
2	70.0	61.6	41.8	62.2	64.9	57.4	62.0	73.6	81.1	82.0	82.6	78.2
3	67.3	63.9	44.8	44.3	49.0	60.4	64.9	75.9	82.3	80.5	85.6	77.8
4	62.7	63.3	51.7	45.9	43.9	59.6	69.2	69.7	83.8	81.4	87.9	78.3
5	60.8	53.2	55.1	45.4	51.1	63.4	64.9	63.2	81.2	83.2	86.5	76.1
6	60.5	46.7	38.0	51.5	48.3	63.5	57.5	69.0	85.6	84.4	85.6	75.9
7	62.2	45.4	37.7	47.2	48.3	49.9	61.8	70.0	78.8	82.4	83.8	70.1
8	68.0	49.1	34.6	51.3	46.0	57.2	68.5	69.9	78.3	80.8	82.3	67.9
9	69.2	58.7	35.9	38.5	41.7	63.6	76.3	78.6	77.7	80.5	82.2	70.3
10	70.5	58.5	41.5	37.7	43.6	58.3	77.2	80.2	80.1	80.7	80.9	73.6
11	73.4	58.3	53.3	36.8	44.3	50.9	72.6	82.3	81.1	81.0	85.6	74.8
12	71.2	56.1	49.9	35.0	42.3	53.1	70.7	81.1	83.7	83.3	81.7	76.0
13	73.2	50.5	35.6	31.1	45.7	60.1	65.2	79.6	84.9	86.1	82.9	78.1
14	72.1	52.6	31.3	32.9	51.4	62.2	69.7	73.3	85.6	84.4	82.7	77.4
15	62.5	58.3	34.1	36.4	54.8	62.3	71.9	67.2	86.8	76.0	83.6	78.7
16	63.2	63.9	45.8	41.5	58.1	67.1	73.4	67.2	82.8	73.9	79.8	77.8
17	61.2	60.8	60.3	45.1	62.5	60.5	61.4	63.4	79.8	77.8	79.9	70.5
18	63.0	51.7	56.1	54.1	60.6	64.4	66.5	62.9	77.9	86.5	81.5	70.0
19	67.8	52.5	44.6	53.8	62.8	69.4	72.5	68.0	85.0	82.1	80.5	71.7
20	70.0	58.5	39.1	44.8	62.3	68.5	73.6	76.3	85.0	85.5	83.5	75.1
21	66.9	63.6	45.7	48.9	63.9	68.1	77.8	78.2	86.7	85.2	83.0	75.7
22	64.1	64.7	58.4	37.7	69.1	71.6	78.6	79.7	86.0	85.0	82.9	75.5
23	67.0	65.1	50.3	36.0	62.6	71.1	73.9	81.8	81.7	80.4	82.3	76.8
24	70.8	66.0	40.7	41.2	59.8	72.1	76.1	82.2	78.9	82.0	83.0	NA
25	72.6	66.0	41.6	50.9	64.9	62.2	76.5	82.9	80.5	83.8	82.6	NA
26	78.1	67.6	39.2	55.5	64.5	64.9	78.0	79.6	81.6	81.1	83.0	NA
27	79.3	53.1	34.3	42.3	64.1	72.0	77.4	79.6	79.4	78.8	87.3	78.4
28	75.9	46.9	34.5	49.0	67.4	62.5	73.3	81.0	80.4	81.6	84.1	78.4
29	65.2	60.4	38.9	53.2	NA	53.2	66.5	82.2	77.8	83.3	83.0	75.3
30	60.6	71.2	46.6	56.3	NA	60.7	70.8	80.0	80.0	86.1	82.9	74.2
31	63.7	NA	56.6	57.0	NA	62.8	NA	79.0	NA	86.4	81.3	NA

	24-hr Average Daily Temperature (°F) for Fiscal Year 2012											
Date	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12
1	66.3	56.5	43.7	57.3	57.7	70.3	72.1	77.2	75.0	85.9	80.5	81.0
2	58.6	55.4	47.8	53.7	63.4	70.9	74.7	77.5	74.6	81.4	83.2	79.2
3	60.3	62.2	49.6	38.4	59.8	68.5	75.1	77.0	76.2	83.3	79.6	81.5
4	66.2	58.1	59.5	34.7	64.9	52.4	73.7	78.8	81.3	78.3	79.6	79.5
5	65.9	54.0	62.8	47.4	66.0	55.3	72.0	79.5	78.7	82.2	76.4	76.1
6	68.9	47.1	65.2	49.9	59.0	55.0	67.5	77.4	73.3	82.9	77.0	78.7
7	70.2	62.8	60.3	56.3	58.0	59.9	59.2	71.8	72.0	83.2	77.4	80.5
8	69.7	64.6	43.2	59.1	52.9	66.0	62.4	74.6	72.9	84.1	77.8	78.2
9	69.1	62.8	48.0	59.2	49.4	65.9	68.1	75.1	72.1	85.3	78.8	77.5
10	70.3	57.5	54.9	58.6	51.5	63.1	68.8	69.3	76.3	83.0	78.1	73.5
11	71.5	49.3	48.1	63.5	51.3	62.8	68.2	69.7	77.5	78.3	78.3	73.0
12	72.2	46.1	48.7	56.7	34.6	67.9	60.6	71.9	77.8	77.4	80.8	73.4
13	72.2	55.0	53.8	46.6	37.6	68.0	62.2	70.9	81.4	80.4	81.2	73.9
14	68.3	61.9	55.8	40.9	45.1	70.3	66.8	72.0	78.4	79.8	78.8	73.9
15	67.2	65.5	59.4	46.8	61.3	71.1	73.0	76.0	75.2	79.3	78.1	76.9
16	69.4	74.4	59.5	47.6	63.3	71.4	71.9	72.4	74.9	80.1	81.1	76.7
17	67.0	68.9	61.9	55.6	64.6	72.0	72.9	71.6	74.5	78.5	82.2	77.7
18	70.0	52.3	48.1	60.3	61.6	71.2	70.8	69.5	75.4	77.5	79.1	74.8
19	65.9	56.8	49.6	46.9	67.2	72.4	68.8	71.7	75.7	80.2	80.5	74.6
20	54.4	69.1	57.7	51.1	53.1	71.7	72.7	69.7	77.1	78.7	75.7	72.1
21	53.3	70.0	65.2	60.6	52.0	69.9	67.9	72.4	76.6	80.1	73.4	72.6
22	45.6	67.6	68.2	63.4	58.9	71.2	66.6	76.8	78.8	82.4	75.6	76.2
23	56.1	70.3	66.4	64.9	70.6	71.8	59.7	75.1	78.9	81.9	72.5	76.0
24	59.7	56.7	58.3	65.3	73.5	71.4	57.7	78.5	74.8	79.6	73.6	68.9
25	61.7	54.9	59.5	65.1	54.1	67.2	65.7	79.3	75.0	84.7	77.5	70.0
26	64.0	64.5	57.3	67.3	46.4	66.6	71.6	81.7	73.8	82.0	76.4	73.1
27	70.0	67.7	60.5	64.3	54.7	68.1	74.1	79.1	74.5	77.8	77.5	76.5
28	67.3	61.7	49.3	51.7	61.5	69.5	74.9	75.1	77.4	81.5	80.8	75.5
29	64.0	48.0	47.9	50.7	NA	70.7	76.4	74.3	81.9	81.7	77.9	75.4
30	52.5	45.0	51.8	46.6	NA	71.8	76.8	78.7	84.4	82.3	78.3	74.8
31	59.6	NA	59.8	51.1	NA	71.2	NA	78.2	NA	78.6	80.0	NA

APPENDIX F – COMPLEX 3 ACTUAL ENERGY AND WEATHER DATA

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Nov-11	1,205	1,724	3,808	1,784	8,521	5,760	43.4
2-Nov-11	1,210	1,716	3,691	1,641	8,258	5,990	46.2
3-Nov-11	1,180	1,674	3,628	1,708	8,190	6,530	45.4
4-Nov-11	1,192	1,919	3,734	1,791	8,636	5,630	40.3
5-Nov-11	1,179	2,091	3,685	1,677	8,632	6,110	41.2
6-Nov-11	1,222	2,225	3,708	1,820	8,975	8,250	39.1
7-Nov-11	1,225	2,045	3,738	2,232	9,240	7,480	41.7
8-Nov-11	1,230	2,200	3,718	1,911	9,060	6,090	47.8
9-Nov-11	1,223	2,360	3,697	1,730	9,010	6,660	50.7
10-Nov-11	1,195	2,100	3,695	1,789	8,779	5,740	52.0
11-Nov-11	1,166	2,171	3,663	1,657	8,658	5,200	47.5
12-Nov-11	1,191	2,161	3,667	1,575	8,593	4,120	40.5
13-Nov-11	1,191	2,581	3,626	1,540	8,938	8,030	45.2
14-Nov-11	1,210	2,193	3,668	1,980	9,052	5,760	45.7
15-Nov-11	1,220	2,122	3,747	1,754	8,843	5,690	40.0
16-Nov-11	1,196	2,158	3,816	1,736	8,905	6,170	38.4
17-Nov-11	1,177	2,118	3,871	1,798	8,965	5,890	43.3
18-Nov-11	1,197	2,089	3,889	1,789	8,964	5,630	37.9
19-Nov-11	1,197	2,054	3,864	1,570	8,684	5,580	34.7
20-Nov-11	1,180	2,417	3,892	1,749	9,238	6,480	32.7
21-Nov-11	1,214	2,161	3,855	1,934	9,163	6,420	39.0
22-Nov-11	1,182	2,206	3,818	1,903	9,109	7,400	45.7
23-Nov-11	1,190	2,066	3,836	2,084	9,176	6,460	46.3
24-Nov-11	1,167	1,769	3,855	2,079	8,870	4,580	40.6
25-Nov-11	1,181	1,940	3,867	2,025	9,012	5,620	40.5
26-Nov-11	1,197	2,071	3,824	1,976	9,068	6,020	44.5
27-Nov-11	1,214	2,318	3,813	2,038	9,382	8,220	50.2
28-Nov-11	1,207	1,945	3,893	2,228	9,272	6,710	44.3
29-Nov-11	1,190	2,017	3,929	2,049	9,184	6,470	39.1
30-Nov-11	1,201	1,915	3,848	1,903	8,866	6,560	42.4

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Dec-11	1,213	1,902	3,841	1,963	8,919	6,810	37.9
2-Dec-11	1,232	1,847	3,747	2,024	8,849	6,500	39.4
3-Dec-11	1,196	2,257	3,694	2,019	9,166	8,010	37.2
4-Dec-11	1,215	2,408	3,686	2,290	9,600	10,430	38.0
5-Dec-11	1,273	2,307	3,831	2,725	10,136	7,710	35.2
6-Dec-11	1,277	2,408	3,789	2,502	9,975	7,090	34.9
7-Dec-11	1,240	2,325	3,705	1,893	9,163	5,110	38.1
8-Dec-11	1,228	2,312	3,683	1,744	8,967	5,890	38.3
9-Dec-11	1,223	2,415	3,719	1,440	8,796	4,900	34.2
10-Dec-11	1,205	2,544	3,712	1,403	8,864	5,620	35.0
11-Dec-11	1,246	2,605	3,674	1,469	8,994	6,130	37.9
12-Dec-11	1,256	2,175	3,722	1,448	8,601	6,050	33.3
13-Dec-11	1,223	2,245	3,722	1,497	8,687	6,090	32.7
14-Dec-11	1,227	2,245	3,729	1,447	8,648	5,470	37.1
15-Dec-11	1,219	2,087	3,711	1,305	8,321	4,710	39.3
16-Dec-11	1,218	2,236	3,665	1,276	8,395	4,850	44.2
17-Dec-11	1,201	2,490	3,630	1,190	8,511	4,900	43.8
18-Dec-11	1,194	2,528	3,609	1,228	8,559	6,180	44.8
19-Dec-11	1,210	1,963	3,668	1,257	8,097	4,330	42.3
20-Dec-11	1,205	2,094	3,646	1,554	8,499	4,590	42.9
21-Dec-11	1,239	2,133	3,699	1,315	8,386	4,790	41.2
22-Dec-11	1,260	1,950	3,735	1,308	8,252	4,080	35.8
23-Dec-11	1,209	1,952	3,685	1,236	8,084	2,890	40.2
24-Dec-11	1,249	1,967	3,606	1,199	8,022	2,850	46.8
25-Dec-11	1,266	1,823	3,603	1,110	7,802	2,600	47.6
26-Dec-11	1,241	2,256	3,684	1,087	8,268	3,990	40.9
27-Dec-11	1,203	2,243	3,665	1,104	8,215	4,620	42.6
28-Dec-11	1,176	2,220	3,605	1,335	8,337	4,780	50.8
29-Dec-11	1,181	1,989	3,634	1,345	8,149	3,990	47.5
30-Dec-11	1,168	1,933	3,605	1,437	8,143	3,120	45.3
31-Dec-11	1,213	2,165	3,666	1,363	8,406	3,710	38.0

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Jan-12	1,183	2,143	3,622	1,317	8,266	2,990	41.8
2-Jan-12	1,217	2,130	3,581	1,223	8,150	4,360	48.0
3-Jan-12	1,229	1,976	3,598	1,346	8,148	3,370	48.1
4-Jan-12	1,210	2,005	3,607	1,537	8,359	3,800	49.6
5-Jan-12	1,207	1,873	3,629	1,239	7,948	3,780	46.6
6-Jan-12	1,237	1,907	3,682	1,340	8,166	3,360	39.7
7-Jan-12	1,207	2,090	3,654	1,378	8,329	3,540	38.7
8-Jan-12	1,185	2,176	3,586	1,364	8,310	4,630	44.5
9-Jan-12	1,193	2,061	3,593	1,479	8,325	4,950	48.5
10-Jan-12	1,246	1,975	3,737	1,512	8,471	3,900	41.8
11-Jan-12	1,234	2,006	3,832	1,433	8,504	4,110	35.2
12-Jan-12	1,192	1,991	3,835	1,221	8,240	3,930	35.5
13-Jan-12	1,193	1,838	3,833	1,411	8,276	3,920	34.9
14-Jan-12	1,180	2,088	3,796	1,252	8,316	3,610	36.1
15-Jan-12	1,216	2,195	3,796	1,373	8,581	4,270	31.9
16-Jan-12	1,212	2,456	3,824	1,396	8,888	6,190	30.6
17-Jan-12	1,203	2,368	3,838	1,459	8,868	4,560	33.8
18-Jan-12	1,179	2,359	3,854	1,665	9,058	4,830	29.3
19-Jan-12	1,184	2,245	3,878	1,413	8,719	4,410	25.7
20-Jan-12	1,171	1,779	3,811	1,562	8,323	3,810	32.5
21-Jan-12	1,185	1,911	3,771	1,461	8,328	3,190	41.6
22-Jan-12	1,180	2,264	3,776	1,417	8,638	5,050	38.8
23-Jan-12	1,186	2,086	3,788	1,183	8,243	5,460	40.6
24-Jan-12	1,189	1,965	3,775	1,553	8,482	4,760	40.6
25-Jan-12	1,211	1,941	3,731	1,524	8,408	4,590	45.5
26-Jan-12	1,227	1,920	3,667	1,321	8,135	4,590	43.2
27-Jan-12	1,260	1,919	3,778	1,412	8,370	4,270	37.6
28-Jan-12	1,288	2,076	3,635	1,401	8,401	3,550	38.0
29-Jan-12	1,302	2,144	3,361	1,305	8,113	4,700	46.1
30-Jan-12	1,286	1,904	3,321	1,325	7,837	3,660	45.7
31-Jan-12	1,244	1,733	3,273	1,463	7,713	4,180	44.9

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Feb-12	1,235	1,680	3,286	1,289	7,490	3,500	44.4
2-Feb-12	1,190	1,624	3,328	1,387	7,529	3,880	42.0
3-Feb-12	1,182	1,851	3,295	1,340	7,668	4,000	43.6
4-Feb-12	1,172	1,901	3,272	1,355	7,700	3,530	48.7
5-Feb-12	1,173	2,224	3,254	1,278	7,928	5,040	48.7
6-Feb-12	1,179	1,834	3,322	1,351	7,685	4,320	43.9
7-Feb-12	1,186	1,688	3,552	1,262	7,687	3,870	49.7
8-Feb-12	1,197	1,759	3,287	1,371	7,614	4,360	48.8
9-Feb-12	1,188	1,838	3,288	1,248	7,563	4,080	47.5
10-Feb-12	1,189	1,562	3,291	1,258	7,300	2,660	48.4
11-Feb-12	1,170	2,047	3,253	1,299	7,769	4,760	47.2
12-Feb-12	1,166	2,137	3,249	1,176	7,728	5,310	44.3
13-Feb-12	1,187	1,689	3,314	1,413	7,603	4,070	43.1
14-Feb-12	1,206	1,666	3,464	1,422	7,758	4,030	41.6
15-Feb-12	1,201	1,751	3,672	1,322	7,946	4,180	38.8
16-Feb-12	1,197	1,709	3,680	1,382	7,968	3,900	39.7
17-Feb-12	1,175	1,788	3,608	1,235	7,806	3,540	44.6
18-Feb-12	1,162	1,887	3,621	1,282	7,951	3,420	41.8
19-Feb-12	1,180	2,191	3,623	1,280	8,273	4,540	39.9
20-Feb-12	1,174	2,304	3,625	1,343	8,447	4,560	39.1
21-Feb-12	1,187	1,821	3,603	1,239	7,849	3,940	45.9
22-Feb-12	1,196	1,805	3,582	1,377	7,959	3,700	47.1
23-Feb-12	1,194	1,837	3,609	1,213	7,853	3,880	42.1
24-Feb-12	1,183	1,773	3,641	1,280	7,877	3,610	41.5
25-Feb-12	1,205	2,432	3,642	1,196	8,476	5,280	40.4
26-Feb-12	1,188	2,404	3,624	1,376	8,592	6,050	37.0
27-Feb-12	1,185	1,592	3,641	1,394	7,812	3,400	33.7
28-Feb-12	1,210	1,654	3,618	1,424	7,905	3,510	37.2
29-Feb-12	1,182	1,852	3,606	1,232	7,871	4,130	NA

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Mar-12	1,184	1,666	3,614	1,189	7,653	3,140	37.0
2-Mar-12	1,222	1,520	3,611	1,258	7,611	2,940	38.9
3-Mar-12	1,223	1,765	3,465	1,186	7,639	3,620	45.6
4-Mar-12	1,196	2,312	3,486	1,145	8,140	6,140	47.1
5-Mar-12	1,196	1,775	3,563	1,154	7,688	3,860	43.5
6-Mar-12	1,189	1,792	3,646	1,410	8,037	3,990	35.9
7-Mar-12	1,184	1,729	3,646	1,360	7,919	3,660	35.8
8-Mar-12	1,191	1,955	3,600	1,129	7,875	4,430	40.6
9-Mar-12	1,205	2,820	3,547	1,127	8,699	9,350	48.4
10-Mar-12	1,189	3,372	3,515	1,154	9,229	12,440	45.4
11-Mar-12	1,187	3,091	3,525	1,459	9,263	13,170	42.8
12-Mar-12	1,191	2,935	3,596	2,352	10,074	12,250	40.0
13-Mar-12	1,199	2,541	3,623	2,469	9,833	10,810	37.4
14-Mar-12	1,189	2,450	3,663	2,291	9,593	10,620	37.5
15-Mar-12	1,206	2,571	3,555	2,054	9,386	10,460	45.2
16-Mar-12	1,191	2,478	3,544	2,060	9,273	10,240	44.3
17-Mar-12	1,189	2,871	3,563	1,986	9,609	12,060	41.2
18-Mar-12	1,188	3,725	3,599	1,978	10,490	15,080	38.2
19-Mar-12	1,205	2,517	3,595	2,255	9,572	10,440	36.6
20-Mar-12	1,196	2,251	3,560	2,306	9,314	9,660	41.0
21-Mar-12	1,179	2,706	3,550	2,194	9,628	10,830	40.4
22-Mar-12	1,180	2,418	3,561	1,940	9,098	9,810	41.1
23-Mar-12	1,198	2,119	3,615	1,986	8,918	8,690	42.7
24-Mar-12	1,240	3,055	3,506	1,958	9,760	12,460	43.8
25-Mar-12	1,228	3,329	3,486	1,830	9,874	14,040	45.7
26-Mar-12	1,197	2,482	3,574	2,158	9,410	10,610	48.4
27-Mar-12	1,191	2,521	3,369	2,213	9,295	10,640	49.0
28-Mar-12	1,180	2,479	3,202	2,529	9,390	10,110	50.2
29-Mar-12	1,194	2,707	3,200	1,989	9,090	10,430	45.7
30-Mar-12	1,223	3,104	3,250	2,005	9,581	12,380	44.8
31-Mar-12	1,288	2,868	3,206	1,839	9,201	11,610	38.9

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Apr-12	1,307	3,287	3,166	2,225	9,985	13,790	44.4
2-Apr-12	1,295	2,600	3,305	2,198	9,399	10,620	47.8
3-Apr-12	1,237	2,830	3,182	2,324	9,574	10,160	51.0
4-Apr-12	1,202	2,549	3,227	2,491	9,468	10,620	42.4
5-Apr-12	1,192	2,403	3,213	1,846	8,654	10,450	43.3
6-Apr-12	1,201	2,503	3,218	1,860	8,783	9,520	42.5
7-Apr-12	1,205	3,205	3,394	1,962	9,766	11,970	44.6
8-Apr-12	1,209	3,696	3,573	1,937	10,415	14,610	52.9
9-Apr-12	1,208	2,175	3,634	1,789	8,806	9,580	54.6
10-Apr-12	1,194	2,062	3,717	2,193	9,166	9,460	53.5
11-Apr-12	1,227	2,319	3,195	2,285	9,026	9,400	52.3
12-Apr-12	1,191	3,186	3,336	1,969	9,681	11,740	49.3
13-Apr-12	1,193	2,849	3,160	2,118	9,320	12,490	46.3
14-Apr-12	1,205	3,190	3,413	1,997	9,806	13,370	49.4
15-Apr-12	1,221	3,875	3,459	1,959	10,515	18,140	49.5
16-Apr-12	1,195	1,946	3,159	2,210	8,510	4,920	52.6
17-Apr-12	1,178	1,586	3,187	2,595	8,546	4,060	45.7
18-Apr-12	1,175	1,878	3,179	3,006	9,237	4,180	47.5
19-Apr-12	1,185	1,869	3,159	1,327	7,539	4,230	48.9
20-Apr-12	1,176	1,642	3,217	1,285	7,319	3,010	50.1
21-Apr-12	1,168	1,795	3,249	1,209	7,420	3,320	49.4
22-Apr-12	1,162	2,098	3,445	1,313	8,018	5,220	54.2
23-Apr-12	1,176	1,774	3,561	1,168	7,679	3,780	57.1
24-Apr-12	1,184	1,933	3,449	1,255	7,822	4,420	53.5
25-Apr-12	1,177	1,969	3,587	1,492	8,225	4,250	54.2
26-Apr-12	1,184	1,890	3,297	1,312	7,683	3,760	50.5
27-Apr-12	1,180	1,768	3,317	1,285	7,552	3,760	47.9
28-Apr-12	1,167	2,018	3,393	1,287	7,865	3,990	51.0
29-Apr-12	1,167	2,556	3,180	1,265	8,168	6,160	52.6
30-Apr-12	1,172	1,808	3,252	1,292	7,525	3,880	51.8

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-May-12	1,188	1,387	3,191	1,281	7,045	1,760	47.3
2-May-12	1,180	1,333	3,113	1,452	7,077	1,830	45.5
3-May-12	1,121	1,171	3,257	1,344	6,893	1,700	49.1
4-May-12	1,175	976	3,359	1,273	6,784	1,500	46.3
5-May-12	1,175	1,052	3,331	1,233	6,791	1,250	45.9
6-May-12	1,219	1,163	3,279	1,202	6,862	2,380	49.9
7-May-12	1,219	1,038	3,455	1,159	6,870	1,870	54.4
8-May-12	1,167	1,118	3,240	1,149	6,674	2,000	56.5
9-May-12	1,199	1,053	3,313	1,319	6,884	1,920	48.3
10-May-12	1,207	1,234	3,284	1,331	7,057	1,930	46.8
11-May-12	1,174	1,316	3,239	1,226	6,955	1,660	49.0
12-May-12	1,162	1,123	3,305	1,243	6,833	1,740	55.0
13-May-12	1,215	1,047	3,317	1,217	6,796	1,910	60.7
14-May-12	1,179	978	3,404	1,203	6,763	1,690	62.0
15-May-12	1,224	1,022	3,595	1,184	7,025	2,230	62.2
16-May-12	1,281	2,455	3,621	1,283	8,641	11,670	56.4
17-May-12	1,276	1,747	3,453	1,259	7,736	9,430	53.4
18-May-12	1,285	1,762	3,443	1,303	7,793	8,490	51.7
19-May-12	1,277	1,789	3,438	2,242	8,746	7,860	51.7
20-May-12	1,290	2,162	3,676	1,945	9,072	10,860	57.7
21-May-12	1,270	2,118	3,981	1,893	9,262	10,280	56.2
22-May-12	1,289	1,879	3,722	1,787	8,677	9,740	52.3
23-May-12	1,228	2,265	3,740	2,312	9,545	11,610	50.8
24-May-12	1,193	1,027	3,871	2,082	8,173	3,530	49.4
25-May-12	1,160	869	3,840	1,961	7,831	1,600	54.3
26-May-12	1,148	901	3,822	2,358	8,229	1,680	59.9
27-May-12	1,151	1,049	3,926	1,345	7,471	1,890	57.6
28-May-12	1,147	1,009	3,874	1,097	7,126	1,950	55.6
29-May-12	1,202	925	3,830	1,138	7,095	2,150	51.1
30-May-12	1,189	907	3,893	1,178	7,166	1,890	54.6
31-May-12	1,184	923	3,946	1,220	7,272	1,670	57.1

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Jun-12	1,189	1,725	3,944	1,178	8,036	7,140	61.5
2-Jun-12	1,180	2,309	3,709	1,185	8,382	10,840	53.2
3-Jun-12	1,156	2,143	3,722	1,150	8,172	11,250	52.4
4-Jun-12	1,176	1,656	3,831	1,428	8,091	8,210	50.7
5-Jun-12	1,183	1,454	3,714	2,127	8,478	7,610	49.9
6-Jun-12	1,199	1,628	3,968	2,349	9,144	8,080	49.6
7-Jun-12	1,195	1,791	3,609	1,839	8,434	8,300	53.7
8-Jun-12	1,209	1,877	3,597	1,703	8,386	8,740	52.6
9-Jun-12	1,213	1,964	3,922	1,725	8,824	9,890	52.2
10-Jun-12	1,221	3,126	4,331	1,818	10,496	15,450	54.7
11-Jun-12	1,207	1,090	4,224	1,885	8,405	3,840	57.7
12-Jun-12	1,177	840	4,431	2,071	8,518	1,840	59.0
13-Jun-12	1,189	827	3,472	2,446	7,934	1,680	53.6
14-Jun-12	1,210	846	3,484	2,136	7,676	1,610	50.8
15-Jun-12	1,237	1,275	3,983	1,159	7,655	3,210	55.1
16-Jun-12	1,168	1,744	4,455	1,141	8,508	3,660	63.4
17-Jun-12	1,165	1,786	4,261	1,133	8,345	4,780	58.9
18-Jun-12	1,195	1,426	3,606	1,029	7,256	3,950	52.2
19-Jun-12	1,192	1,392	3,875	1,154	7,613	3,580	52.9
20-Jun-12	1,214	1,398	4,094	1,130	7,836	3,440	57.3
21-Jun-12	1,192	1,307	4,668	1,281	8,448	2,850	59.7
22-Jun-12	1,208	1,407	3,603	1,095	7,313	3,500	56.7
23-Jun-12	1,239	1,720	4,025	1,014	7,997	3,410	53.9
24-Jun-12	1,235	1,932	4,254	1,093	8,514	5,660	53.5
25-Jun-12	1,219	1,392	3,852	1,146	7,610	7,570	55.9
26-Jun-12	1,210	1,430	4,520	1,113	8,274	7,640	55.8
27-Jun-12	1,207	1,438	4,130	1,106	7,880	5,030	56.3
28-Jun-12	1,177	1,338	4,278	1,181	7,975	3,450	63.6
29-Jun-12	1,150	1,281	4,368	1,119	7,918	3,480	63.4
30-Jun-12	1,135	1,508	3,857	1,066	7,565	3,510	64.2

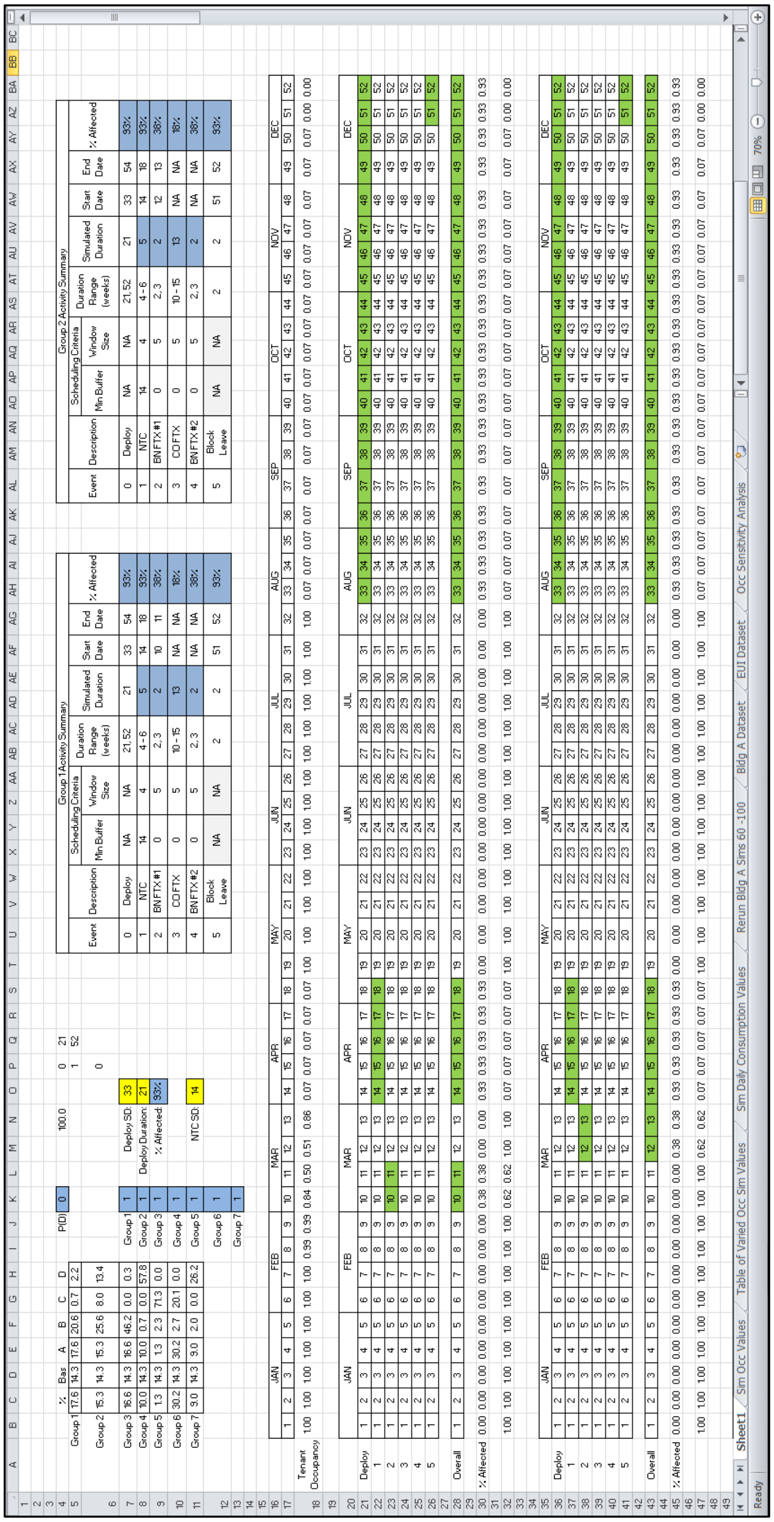
Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Jul-12	1,198	1,687	3,858	1,106	7,849	4,580	55.6
2-Jul-12	1,185	1,409	3,705	1,065	7,365	3,430	56.0
3-Jul-12	1,181	1,297	3,428	1,063	6,969	3,100	55.5
4-Jul-12	1,141	1,540	3,353	1,127	7,161	3,340	55.7
5-Jul-12	1,171	1,349	3,977	1,275	7,772	3,740	58.4
6-Jul-12	1,183	1,380	4,065	1,078	7,707	3,180	60.7
7-Jul-12	1,152	1,765	4,026	1,178	8,122	4,060	59.9
8-Jul-12	1,197	1,673	4,124	1,068	8,061	4,800	63.1
9-Jul-12	1,199	1,451	4,197	1,084	7,931	4,620	61.6
10-Jul-12	1,230	1,335	4,298	1,057	7,920	5,470	58.0
11-Jul-12	1,202	1,469	4,334	1,029	8,033	5,180	61.7
12-Jul-12	1,191	1,324	4,675	1,188	8,377	5,240	63.9
13-Jul-12	1,183	1,419	4,669	1,535	8,806	4,810	64.0
14-Jul-12	1,139	1,374	4,878	1,505	8,895	4,490	63.4
15-Jul-12	1,101	1,729	3,978	1,551	8,360	5,900	63.3
16-Jul-12	1,104	1,603	4,620	1,660	8,987	5,730	59.9
17-Jul-12	1,097	1,203	4,900	1,537	8,737	4,870	66.7
18-Jul-12	1,034	1,193	4,427	1,472	8,126	3,930	63.8
19-Jul-12	1,107	955	4,429	1,718	8,209	3,740	62.7
20-Jul-12	1,160	1,382	4,408	1,615	8,565	3,920	65.1
21-Jul-12	1,109	1,545	4,466	1,834	8,954	4,460	63.6
22-Jul-12	1,145	1,938	3,843	1,676	8,602	7,910	59.8
23-Jul-12	1,165	988	3,783	1,733	7,669	3,660	55.6
24-Jul-12	1,145	947	3,771	1,557	7,421	1,580	57.7
25-Jul-12	1,067	958	4,007	1,747	7,779	1,670	62.7
26-Jul-12	954	1,418	3,780	2,153	8,305	3,890	65.7
27-Jul-12	930	1,313	3,434	1,624	7,301	4,440	60.7
28-Jul-12	928	1,518	3,793	1,108	7,348	5,520	59.8
29-Jul-12	927	1,828	3,826	1,075	7,656	6,630	60.4
30-Jul-12	953	1,409	3,539	1,105	7,006	4,950	59.7
31-Jul-12	955	1,389	3,702	1,761	7,808	4,960	59.0

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Aug-12	949	1,467	3,619	1,703	7,738	5,340	58.8
2-Aug-12	982	1,478	3,712	1,746	7,917	4,880	59.2
3-Aug-12	1,002	1,409	4,235	1,655	8,301	3,650	60.6
4-Aug-12	990	1,516	5,108	1,599	9,213	4,030	69.4
5-Aug-12	993	1,727	6,075	1,579	10,375	5,270	75.2
6-Aug-12	1,045	1,537	5,052	1,444	9,078	4,750	71.2
7-Aug-12	1,043	1,524	4,256	1,328	8,152	4,480	62.7
8-Aug-12	1,006	1,373	4,220	1,446	8,044	4,390	63.9
9-Aug-12	1,004	1,124	4,079	1,633	7,840	3,470	62.1
10-Aug-12	1,004	1,418	4,225	1,472	8,119	4,080	62.9
11-Aug-12	990	1,383	4,429	1,468	8,270	4,260	64.6
12-Aug-12	990	1,635	5,134	1,710	9,470	5,770	67.1
13-Aug-12	1,049	1,369	4,550	1,597	8,566	4,780	68.4
14-Aug-12	1,111	1,538	4,809	1,500	8,959	5,620	64.6
15-Aug-12	1,161	1,581	5,243	1,727	9,713	5,430	66.5
16-Aug-12	1,092	1,677	6,121	1,772	10,662	6,160	73.9
17-Aug-12	1,049	1,041	5,956	1,590	9,637	2,900	74.8
18-Aug-12	1,016	1,011	4,195	1,755	7,976	2,610	66.0
19-Aug-12	1,014	1,114	4,311	1,492	7,931	4,560	63.1
20-Aug-12	1,038	1,931	4,601	1,713	9,284	11,150	63.8
21-Aug-12	1,069	1,907	3,955	1,536	8,467	10,610	62.6
22-Aug-12	1,060	1,868	4,152	1,614	8,693	9,640	59.7
23-Aug-12	1,055	1,868	3,702	1,912	8,536	9,610	59.4
24-Aug-12	1,057	2,173	3,810	2,684	9,725	11,480	57.8
25-Aug-12	1,037	2,025	4,049	2,512	9,623	9,560	59.7
26-Aug-12	1,085	2,045	4,445	2,349	9,924	11,490	64.6
27-Aug-12	1,080	1,901	4,614	2,432	10,026	11,220	64.1
28-Aug-12	1,084	1,831	4,115	2,579	9,609	8,930	63.2
29-Aug-12	1,078	1,804	4,143	2,452	9,476	8,100	61.0
30-Aug-12	1,085	1,579	4,123	2,762	9,549	8,140	60.6
31-Aug-12	1,059	2,266	3,977	2,581	9,883	11,110	57.7

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Sep-12	1,053	2,300	3,764	1,865	8,982	10,640	59.2
2-Sep-12	1,062	2,475	3,957	1,882	9,375	10,930	57.4
3-Sep-12	1,071	2,943	3,984	2,044	10,042	13,850	58.6
4-Sep-12	1,060	2,060	4,188	2,210	9,518	10,200	60.2
5-Sep-12	1,091	2,113	4,481	2,405	10,091	11,190	62.8
6-Sep-12	1,053	1,998	4,787	2,352	10,189	10,560	63.5
7-Sep-12	1,074	2,000	5,093	2,519	10,686	10,200	68.3
8-Sep-12	1,081	2,623	5,085	2,190	10,979	12,160	70.0
9-Sep-12	1,059	2,862	4,106	2,171	10,198	14,600	61.8
10-Sep-12	1,084	2,308	3,343	2,248	8,983	10,230	57.3
11-Sep-12	1,103	2,071	3,350	2,364	8,889	8,660	55.4
12-Sep-12	1,082	2,175	3,344	2,504	9,105	10,020	54.5
13-Sep-12	1,091	1,987	3,965	2,736	9,779	9,000	58.6
14-Sep-12	1,060	2,064	4,107	2,272	9,502	9,450	62.8
15-Sep-12	1,056	2,425	3,780	1,700	8,961	11,460	62.1
16-Sep-12	1,045	3,015	4,044	1,751	9,855	13,840	59.5
17-Sep-12	1,058	2,163	4,306	1,820	9,346	9,990	63.3
18-Sep-12	1,094	2,068	4,268	1,857	9,287	8,540	66.2
19-Sep-12	1,092	2,012	3,656	2,352	9,112	10,640	61.6
20-Sep-12	1,066	2,340	3,514	2,667	9,588	10,870	58.4
21-Sep-12	1,081	2,072	3,269	2,308	8,730	9,570	57.0
22-Sep-12	1,109	2,467	3,617	1,734	8,928	10,820	57.5
23-Sep-12	1,110	2,833	3,212	1,892	9,047	14,680	56.6
24-Sep-12	1,092	2,580	3,242	2,308	9,222	11,810	57.7
25-Sep-12	1,078	2,518	3,294	2,293	9,183	12,630	55.6
26-Sep-12	1,067	2,549	3,384	2,549	9,549	12,780	54.6
27-Sep-12	1,057	2,468	3,719	2,595	9,839	11,560	56.2
28-Sep-12	1,054	3,715	3,997	2,449	11,215	15,940	61.3
29-Sep-12	1,086	1,880	3,327	2,295	8,588	6,110	58.5
30-Sep-12	1,036	2,036	3,344	2,559	8,976	5,720	54.2

Date	Electricity Consumption (kBtu)					Water Consumption (gal)	Actual 24-hr Average Daily Temperature (°F)
	Meter 1	Meter 2	Meter 3	Meter 4	Total		
1-Oct-12	1,051	1,755	3,851	2,326	8,983	5,100	58.5
2-Oct-12	1,037	1,666	3,388	2,705	8,796	4,700	55.6
3-Oct-12	1,059	1,606	3,490	2,675	8,830	5,350	51.5
4-Oct-12	1,043	1,872	3,520	1,601	8,036	6,190	52.0
5-Oct-12	1,047	1,320	3,486	1,639	7,493	3,440	52.6
6-Oct-12	1,028	1,128	3,457	1,519	7,132	3,110	54.8
7-Oct-12	1,022	1,182	3,430	1,567	7,201	2,870	57.2
8-Oct-12	1,019	1,231	3,390	1,700	7,341	4,000	58.0
9-Oct-12	1,035	1,123	3,472	1,619	7,249	3,810	53.7
10-Oct-12	1,033	1,107	3,474	1,585	7,198	1,630	49.8
11-Oct-12	1,026	1,173	3,391	1,701	7,290	1,370	49.3
12-Oct-12	1,028	1,168	3,340	1,704	7,240	1,100	49.9
13-Oct-12	1,014	1,087	3,235	1,594	6,931	1,240	55.8
14-Oct-12	1,016	1,199	3,356	1,794	7,365	1,460	60.2
15-Oct-12	1,051	1,179	3,239	1,052	6,521	1,630	56.5
16-Oct-12	1,041	1,195	3,210	958	6,404	1,460	55.1
17-Oct-12	1,052	947	3,239	967	6,205	1,450	49.6
18-Oct-12	1,029	850	3,208	970	6,057	1,520	52.1
19-Oct-12	1,020	931	3,196	1,046	6,194	1,180	53.2
20-Oct-12	1,011	926	3,157	1,030	6,124	1,210	46.1
21-Oct-12	1,013	1,043	3,186	1,002	6,245	2,140	45.4
22-Oct-12	1,036	1,007	3,300	911	6,254	3,020	42.2
23-Oct-12	1,045	921	3,241	1,018	6,225	3,840	44.5
24-Oct-12	1,036	900	3,263	1,008	6,207	3,320	44.9
25-Oct-12	1,051	936	3,333	967	6,286	3,530	46.2
26-Oct-12	1,026	944	3,369	1,061	6,400	2,970	46.6
27-Oct-12	1,015	915	3,285	1,469	6,684	2,880	49.6
28-Oct-12	1,016	1,066	3,270	1,568	6,920	4,720	54.3
29-Oct-12	1,046	961	3,396	1,606	7,009	3,750	56.1
30-Oct-12	1,029	1,082	3,354	1,620	7,086	3,440	55.6
31-Oct-12	1,037	977	3,295	1,499	6,809	3,620	56.8

APPENDIX G – LONG VACANCY OCCUPANT MODEL SCREENSHOT



APPENDIX H – TABLE OF VALUES ILLUSTRATING

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Jan	13,542	13,891	19,039	20,900	20,968	21,133	21,458	21,804
2-Jan	14,139	14,350	20,401	22,145	22,082	22,092	22,201	22,429
3-Jan	18,017	17,585	33,606	32,756	32,797	34,568	34,370	34,203
4-Jan	23,589	22,462	33,420	33,185	33,038	34,158	34,100	33,998
5-Jan	17,565	17,402	27,140	26,487	26,294	25,402	25,483	25,672
6-Jan	19,083	18,715	28,537	28,416	28,463	27,872	27,907	27,980
7-Jan	17,670	17,411	21,317	25,474	25,630	25,818	26,062	26,427
8-Jan	15,751	15,561	21,830	23,788	23,881	23,833	24,046	24,365
9-Jan	21,946	21,154	32,646	31,323	31,322	31,961	31,796	31,703
10-Jan	18,182	18,032	25,995	25,312	25,357	25,142	25,188	25,414
11-Jan	16,874	16,543	24,979	24,937	25,008	24,764	24,947	25,215
12-Jan	15,412	15,230	21,372	21,377	21,566	21,914	22,202	22,546
13-Jan	13,945	13,935	20,709	20,680	20,778	20,499	20,614	20,720
14-Jan	17,847	17,220	20,645	27,316	27,321	27,455	27,658	27,941
15-Jan	18,290	18,040	23,094	26,759	26,840	26,860	27,111	27,420
16-Jan	20,164	19,480	31,928	28,682	28,646	28,923	29,076	29,258
17-Jan	18,672	18,417	26,799	26,039	26,101	26,051	26,106	26,262
18-Jan	17,047	16,757	24,801	24,732	24,798	24,615	24,878	25,228
19-Jan	16,554	16,219	25,929	25,779	25,821	25,588	25,623	25,745
20-Jan	25,039	24,260	32,669	32,562	32,505	33,639	33,548	33,540
21-Jan	26,116	25,490	23,786	36,997	36,891	36,828	36,799	36,817
22-Jan	21,979	21,514	24,227	31,140	31,172	31,182	31,294	31,350
23-Jan	26,610	26,000	34,362	32,886	32,916	34,352	34,294	34,223
24-Jan	23,435	22,917	33,393	31,903	31,626	31,794	31,780	31,718
25-Jan	27,624	27,007	34,736	33,590	33,574	35,013	34,938	34,869
26-Jan	21,775	21,434	31,576	30,322	30,027	29,958	29,944	29,905
27-Jan	18,544	18,177	27,693	27,030	27,013	27,104	27,179	27,310
28-Jan	17,721	17,535	21,468	25,179	25,236	25,315	25,641	26,013
29-Jan	29,173	28,129	25,806	39,392	39,295	39,199	39,066	38,907
30-Jan	16,946	16,851	28,929	22,036	22,344	22,838	23,170	23,534
31-Jan	13,974	14,060	20,779	20,093	20,135	19,820	19,910	20,137

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Feb	15,901	15,794	25,746	25,551	25,535	24,970	24,987	25,023
2-Feb	20,099	19,107	29,754	29,611	29,554	29,911	29,974	30,159
3-Feb	19,018	18,741	26,989	26,809	26,876	26,546	26,576	26,800
4-Feb	16,485	16,253	20,984	24,458	24,627	24,832	25,124	25,472
5-Feb	15,524	15,404	21,900	23,388	23,360	23,312	23,531	23,797
6-Feb	15,818	15,529	24,163	22,249	22,465	22,669	22,856	23,120
7-Feb	13,485	13,620	17,783	17,981	18,265	18,276	18,673	18,994
8-Feb	14,443	14,444	22,071	21,728	21,588	21,208	21,121	21,189
9-Feb	15,220	15,241	21,959	22,056	22,317	22,568	22,936	23,414
10-Feb	13,303	13,490	17,313	17,349	17,541	17,682	18,053	18,385
11-Feb	13,039	13,274	16,023	17,355	17,665	17,716	17,996	18,397
12-Feb	12,658	12,924	15,190	15,384	15,745	16,091	16,444	16,845
13-Feb	16,432	16,095	27,624	26,392	25,957	26,953	26,789	26,616
14-Feb	30,175	28,149	34,585	34,579	34,571	36,848	36,817	36,773
15-Feb	32,706	31,899	35,124	35,156	35,283	36,920	36,803	36,720
16-Feb	24,729	24,281	33,955	33,656	33,440	33,340	33,164	32,958
17-Feb	16,059	16,017	23,058	22,559	22,270	21,652	21,910	22,273
18-Feb	15,516	15,510	20,098	23,873	23,922	23,718	23,907	24,201
19-Feb	19,664	18,748	23,791	30,838	30,883	30,750	30,667	30,639
20-Feb	22,064	21,540	24,025	32,744	32,875	32,936	32,908	33,130
21-Feb	18,752	18,550	31,392	26,078	26,151	26,202	26,239	26,377
22-Feb	16,076	15,854	24,299	22,818	22,928	23,019	23,326	23,725
23-Feb	14,307	14,412	19,101	19,293	19,659	19,987	20,352	20,778
24-Feb	13,441	13,594	17,536	17,407	17,583	17,661	18,114	18,593
25-Feb	13,474	13,669	17,272	18,352	18,471	18,450	18,795	19,213
26-Feb	13,320	13,551	18,261	18,200	18,353	18,572	18,630	18,866
27-Feb	15,878	15,648	26,238	25,137	24,948	25,192	25,080	24,751
28-Feb	19,450	18,414	29,521	29,366	29,251	29,854	30,002	30,195

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Mar	18,113	17,651	25,238	25,072	25,115	25,514	25,625	25,841
2-Mar	25,760	24,825	31,730	31,863	31,928	33,537	33,483	33,544
3-Mar	34,890	34,248	35,744	35,647	35,568	37,603	37,610	37,532
4-Mar	22,336	22,076	24,002	32,315	31,925	30,147	30,080	30,046
5-Mar	13,909	14,018	20,573	18,440	18,867	19,230	19,657	20,102
6-Mar	13,527	13,622	20,437	17,812	17,787	17,868	18,175	18,549
7-Mar	14,422	14,445	20,226	20,150	20,296	20,535	20,540	20,575
8-Mar	13,927	14,027	18,931	19,095	19,248	19,344	19,698	19,967
9-Mar	12,872	13,031	15,747	15,808	16,167	16,319	16,732	17,118
10-Mar	13,611	13,737	19,072	18,811	18,659	18,216	18,535	18,959
11-Mar	14,584	14,527	19,606	22,545	22,707	22,861	22,758	22,583
12-Mar	14,604	14,694	20,571	21,407	21,419	21,535	21,814	22,046
13-Mar	14,857	14,870	22,785	21,448	21,478	21,402	21,476	21,697
14-Mar	15,483	15,447	23,454	23,324	23,339	23,327	23,525	23,669
15-Mar	17,236	16,865	26,695	26,613	26,625	26,506	26,641	26,825
16-Mar	15,874	15,738	21,753	21,865	22,140	22,620	22,975	23,411
17-Mar	12,774	12,969	15,940	16,094	16,350	16,448	16,877	17,314
18-Mar	12,348	12,695	13,315	13,966	14,394	14,914	15,511	16,117
19-Mar	12,997	13,320	15,421	15,863	16,092	16,389	16,937	17,480
20-Mar	12,576	12,804	15,332	14,954	15,462	15,773	16,114	16,543
21-Mar	12,478	12,763	13,845	14,005	14,493	14,947	15,522	16,083
22-Mar	12,616	12,910	13,892	14,238	14,812	15,221	15,860	16,509
23-Mar	13,825	13,758	21,692	20,914	20,264	20,317	20,256	20,418
24-Mar	13,828	13,930	22,477	22,385	22,373	22,143	21,984	21,979
25-Mar	13,610	13,700	17,121	18,485	18,890	19,373	19,972	20,448
26-Mar	12,906	13,166	15,609	16,024	16,414	16,790	17,199	17,614
27-Mar	12,616	12,855	15,141	14,479	14,825	15,173	15,720	16,341
28-Mar	12,415	12,706	13,644	13,977	14,538	15,035	15,628	16,209
29-Mar	12,414	12,706	13,700	14,119	14,710	15,146	15,732	16,349
30-Mar	12,049	12,329	12,952	13,302	13,746	14,177	14,639	15,069
31-Mar	11,792	12,067	12,711	13,075	13,471	13,792	14,156	14,503

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Apr	12,994	13,355	13,985	14,777	15,471	16,102	16,836	17,553
2-Apr	12,780	13,078	15,301	15,598	15,798	16,129	16,494	16,880
3-Apr	15,342	15,283	26,471	25,129	24,756	25,004	24,740	24,277
4-Apr	14,009	14,206	20,757	20,780	21,026	21,419	21,834	22,307
5-Apr	12,980	13,212	17,085	17,156	17,414	17,514	17,819	18,229
6-Apr	12,554	12,789	14,662	14,832	15,189	15,290	15,705	16,096
7-Apr	12,300	12,585	13,266	13,665	14,215	14,639	15,176	15,683
8-Apr	13,021	13,336	15,055	16,422	16,635	16,875	17,283	17,814
9-Apr	12,982	13,222	16,857	16,518	16,800	17,268	17,870	18,295
10-Apr	12,775	12,983	16,207	15,337	15,756	16,012	16,439	16,800
11-Apr	12,562	12,821	14,399	14,619	14,959	15,219	15,789	16,341
12-Apr	12,991	13,200	15,264	15,336	15,611	16,070	16,455	16,931
13-Apr	13,099	13,289	15,736	15,893	16,384	16,694	17,223	17,637
14-Apr	13,433	13,598	16,624	16,519	16,888	17,387	17,756	18,300
15-Apr	13,287	13,485	15,718	16,905	17,332	17,617	18,141	18,704
16-Apr	12,748	13,004	14,951	15,341	15,727	16,065	16,489	16,952
17-Apr	12,977	13,220	15,784	15,211	15,575	15,805	16,377	16,979
18-Apr	13,541	13,653	18,156	17,747	18,044	18,321	18,560	18,853
19-Apr	13,044	13,288	16,674	16,590	16,512	17,086	17,629	18,139
20-Apr	12,443	12,714	14,022	14,252	14,613	14,926	15,457	15,947
21-Apr	12,409	12,700	13,531	13,904	14,511	14,952	15,508	16,072
22-Apr	12,151	12,497	13,232	13,719	14,256	14,764	15,314	15,840
23-Apr	12,089	12,437	13,608	13,642	14,147	14,631	15,122	15,595
24-Apr	12,204	12,496	13,772	13,688	14,197	14,598	15,091	15,557
25-Apr	12,253	12,544	13,301	13,714	14,254	14,657	15,183	15,684
26-Apr	12,457	12,755	13,704	14,096	14,719	15,147	15,759	16,369
27-Apr	12,729	13,012	13,920	14,179	14,669	15,144	15,761	16,400
28-Apr	12,320	12,617	13,726	13,950	14,395	14,818	15,413	15,941
29-Apr	12,104	12,456	12,973	13,691	14,216	14,720	15,257	15,766
30-Apr	12,201	12,553	14,205	13,800	14,329	14,827	15,350	15,852

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-May	12,627	12,927	14,646	14,064	14,634	15,205	15,866	16,472
2-May	12,407	12,702	13,665	14,085	14,721	15,157	15,739	16,298
3-May	12,353	12,647	13,326	13,715	14,241	14,666	15,203	15,720
4-May	12,558	12,856	13,619	14,024	14,527	15,027	15,597	16,157
5-May	12,412	12,718	13,871	14,070	14,632	15,064	15,710	16,281
6-May	12,351	12,709	13,660	14,025	14,620	15,187	15,808	16,386
7-May	11,994	12,350	13,223	14,126	14,688	15,187	15,642	16,069
8-May	11,840	12,122	13,297	13,349	13,763	14,150	14,527	14,886
9-May	12,901	13,191	13,558	13,909	14,473	15,071	15,654	16,267
10-May	12,349	12,641	13,211	13,649	14,186	14,623	15,164	15,658
11-May	12,093	12,376	12,869	13,236	13,660	14,082	14,520	14,943
12-May	12,254	12,550	13,362	13,815	14,399	14,796	15,326	15,796
13-May	12,935	13,295	13,733	14,734	15,417	16,110	16,878	17,627
14-May	12,921	13,280	14,610	14,799	15,333	15,976	16,667	17,335
15-May	12,831	13,112	15,147	14,993	15,214	15,527	15,919	16,323
16-May	12,843	13,123	15,053	15,268	15,623	15,887	16,237	16,685
17-May	12,444	12,709	14,317	14,650	15,027	15,348	15,758	16,155
18-May	12,043	12,325	12,856	13,243	13,689	14,112	14,558	14,972
19-May	12,193	12,487	13,470	13,940	14,487	14,797	15,298	15,755
20-May	12,044	12,391	12,901	13,619	14,113	14,564	15,048	15,511
21-May	12,036	12,389	13,906	13,840	14,325	14,760	15,216	15,654
22-May	12,042	12,336	14,329	13,651	14,090	14,546	14,966	15,363
23-May	11,701	11,990	12,901	13,183	13,492	13,948	14,254	14,550
24-May	11,848	12,139	13,420	13,780	14,186	14,587	14,941	15,270
25-May	12,394	12,694	13,668	14,176	14,844	15,240	15,808	16,344
26-May	12,925	13,225	13,512	13,966	14,564	15,240	15,880	16,490
27-May	12,157	12,506	12,883	13,690	14,206	14,720	15,267	15,785
28-May	11,746	12,098	12,655	13,885	14,328	14,737	15,139	15,517
29-May	11,705	12,057	12,811	14,048	14,475	14,841	15,206	15,556
30-May	11,939	12,223	13,752	13,511	13,952	14,279	14,654	15,020
31-May	12,336	12,629	13,453	13,725	14,289	14,683	15,211	15,715

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Jun	12,359	12,653	13,803	14,173	14,518	15,176	15,533	15,895
2-Jun	12,378	12,685	14,098	14,476	14,835	15,414	15,788	16,161
3-Jun	12,356	12,706	13,230	14,288	14,807	15,263	15,746	16,226
4-Jun	12,324	12,655	13,113	13,608	14,022	14,457	14,885	15,320
5-Jun	12,330	12,600	13,204	13,510	13,892	14,283	14,639	14,999
6-Jun	12,378	12,685	13,925	14,296	14,641	15,291	15,645	16,004
7-Jun	12,380	12,684	13,253	13,618	13,968	14,556	14,911	15,271
8-Jun	12,388	12,711	13,781	14,154	14,507	15,094	15,454	15,824
9-Jun	12,385	12,697	13,756	14,141	14,509	15,136	15,510	15,885
10-Jun	12,440	12,864	13,329	16,451	16,926	17,430	17,950	18,466
11-Jun	12,519	13,060	13,954	16,928	17,409	17,897	18,395	18,894
12-Jun	12,542	12,951	15,022	15,046	15,410	16,188	16,553	16,917
13-Jun	12,322	12,585	13,152	13,425	13,744	14,084	14,396	14,712
14-Jun	12,319	12,585	13,005	13,335	13,672	14,026	14,360	14,692
15-Jun	12,356	12,645	13,642	14,019	14,401	14,992	15,354	15,712
16-Jun	12,393	12,715	14,079	14,434	14,763	15,507	15,869	16,231
17-Jun	12,489	12,966	13,476	16,668	17,138	17,611	18,110	18,611
18-Jun	12,516	13,030	13,817	16,769	17,261	17,750	18,236	18,719
19-Jun	12,334	12,607	13,734	13,787	14,155	14,573	14,918	15,267
20-Jun	12,357	12,641	13,352	13,727	14,109	14,573	14,966	15,355
21-Jun	12,365	12,659	13,741	14,108	14,461	14,976	15,328	15,695
22-Jun	12,390	12,704	13,693	14,065	14,415	15,076	15,433	15,798
23-Jun	12,423	12,756	14,182	14,534	14,871	15,657	16,029	16,408
24-Jun	12,558	13,184	13,522	16,710	17,188	17,680	18,184	18,688
25-Jun	12,835	13,380	13,996	16,624	17,120	17,608	18,088	18,583
26-Jun	12,695	13,125	15,093	14,695	15,086	15,841	16,202	16,570
27-Jun	12,685	13,113	14,546	14,867	15,228	15,929	16,312	16,706
28-Jun	13,107	13,729	14,776	15,154	15,548	16,208	16,604	17,006
29-Jun	12,979	13,502	14,824	15,199	15,573	16,292	16,679	17,072
30-Jun	12,956	13,510	14,692	15,063	15,425	16,144	16,515	16,892

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Jul	12,442	12,880	13,600	16,043	16,534	16,928	17,379	17,833
2-Jul	12,998	13,558	13,920	16,963	17,429	17,950	18,483	19,017
3-Jul	13,168	13,676	15,458	15,730	16,099	16,891	17,271	17,653
4-Jul	12,976	13,548	14,116	17,349	17,848	18,266	18,757	19,253
5-Jul	12,437	12,785	14,814	14,446	14,869	15,494	15,844	16,208
6-Jul	12,400	12,727	14,000	14,324	14,686	15,426	15,795	16,169
7-Jul	12,518	12,874	14,204	14,545	14,885	15,647	16,014	16,390
8-Jul	12,360	12,712	13,346	14,594	15,098	15,541	15,999	16,457
9-Jul	12,363	12,724	13,372	14,770	15,251	15,714	16,160	16,609
10-Jul	12,614	13,086	14,620	14,698	15,032	15,836	16,211	16,590
11-Jul	12,398	12,713	14,557	14,911	15,275	15,909	16,269	16,629
12-Jul	12,745	13,141	14,372	14,723	15,080	15,872	16,264	16,653
13-Jul	12,663	13,067	14,732	15,096	15,459	16,242	16,622	17,000
14-Jul	12,571	12,961	14,555	14,941	15,330	16,017	16,391	16,777
15-Jul	12,392	12,795	13,399	15,186	15,723	16,127	16,602	17,082
16-Jul	12,805	13,387	13,726	16,466	16,929	17,435	17,943	18,451
17-Jul	13,354	13,879	15,521	15,329	15,731	16,512	16,881	17,248
18-Jul	13,459	14,041	15,424	15,717	16,085	16,821	17,208	17,600
19-Jul	13,381	13,887	15,371	15,732	16,080	16,863	17,252	17,645
20-Jul	12,444	12,797	14,531	14,912	15,319	15,882	16,276	16,680
21-Jul	12,408	12,736	14,039	14,440	14,821	15,413	15,817	16,224
22-Jul	12,433	12,885	13,430	15,467	16,124	16,563	17,097	17,609
23-Jul	12,496	13,119	14,033	16,224	16,724	17,232	17,755	18,261
24-Jul	12,480	12,957	15,415	14,902	15,427	16,148	16,563	16,954
25-Jul	12,387	12,697	14,070	14,169	14,636	15,092	15,533	15,978
26-Jul	12,421	12,792	14,280	14,607	14,978	15,640	16,055	16,468
27-Jul	12,389	12,705	13,924	14,400	14,909	15,405	15,840	16,268
28-Jul	12,399	12,728	14,000	14,372	14,740	15,383	15,752	16,137
29-Jul	12,462	12,961	13,397	16,147	16,654	17,127	17,604	18,092
30-Jul	12,585	13,197	14,029	16,054	16,569	17,054	17,523	18,002
31-Jul	12,478	12,857	14,633	14,418	14,781	15,457	15,830	16,214

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Aug	12,974	13,482	14,672	15,018	15,399	16,182	16,600	17,014
2-Aug	13,108	13,646	15,327	15,700	16,072	16,813	17,207	17,604
3-Aug	12,604	12,998	14,849	15,240	15,635	16,267	16,647	17,036
4-Aug	12,327	12,588	13,023	13,370	13,719	14,036	14,390	14,751
5-Aug	12,335	12,668	13,048	13,702	14,172	14,642	15,108	15,594
6-Aug	12,400	12,792	13,333	15,842	16,382	16,927	17,436	17,924
7-Aug	12,411	12,751	14,456	14,455	14,793	15,581	15,939	16,297
8-Aug	12,488	12,908	14,515	14,871	15,229	16,022	16,411	16,801
9-Aug	12,618	13,099	14,747	15,117	15,474	16,252	16,631	17,010
10-Aug	12,530	12,964	14,680	15,077	15,467	16,194	16,595	16,967
11-Aug	12,398	12,703	13,981	14,416	14,847	15,386	15,795	16,207
12-Aug	12,381	12,761	13,302	14,696	15,218	15,706	16,200	16,703
13-Aug	12,330	12,661	13,243	13,676	14,120	14,578	15,024	15,476
14-Aug	12,322	12,585	13,035	13,298	13,622	13,964	14,305	14,652
15-Aug	12,348	12,635	13,191	13,598	14,010	14,457	14,858	15,261
16-Aug	12,372	12,665	13,323	13,752	14,158	14,709	15,091	15,485
17-Aug	12,387	12,702	14,136	14,483	14,813	15,566	15,934	16,301
18-Aug	12,405	12,732	14,286	14,649	15,005	15,721	16,094	16,468
19-Aug	12,401	12,797	13,447	15,931	16,439	16,834	17,293	17,755
20-Aug	12,374	12,733	13,766	14,203	14,690	15,181	15,663	16,146
21-Aug	12,377	12,683	13,812	14,036	14,383	14,996	15,350	15,713
22-Aug	12,386	12,695	13,778	14,134	14,489	15,104	15,468	15,842
23-Aug	12,400	12,723	13,782	14,153	14,498	15,103	15,461	15,825
24-Aug	12,409	12,735	14,141	14,490	14,819	15,566	15,929	16,297
25-Aug	12,446	12,861	14,232	14,601	14,965	15,741	16,116	16,493
26-Aug	12,434	12,868	13,315	15,556	16,073	16,508	16,933	17,378
27-Aug	12,399	12,797	13,538	15,513	16,017	16,501	16,981	17,454
28-Aug	12,371	12,667	14,010	14,065	14,404	15,046	15,400	15,757
29-Aug	12,450	12,818	14,127	14,444	14,769	15,522	15,882	16,242
30-Aug	12,752	13,167	14,327	14,680	15,032	15,842	16,218	16,593
31-Aug	12,353	12,633	13,868	14,241	14,616	15,112	15,461	15,812

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Sep	12,394	12,702	13,884	14,270	14,650	15,270	15,654	16,047
2-Sep	12,430	12,863	13,398	15,448	16,009	16,500	16,999	17,509
3-Sep	12,466	12,976	13,848	16,302	16,802	17,292	17,785	18,279
4-Sep	12,378	12,750	13,808	15,017	15,529	15,983	16,436	16,898
5-Sep	12,429	12,797	14,362	14,450	14,772	15,552	15,903	16,261
6-Sep	12,445	12,812	14,257	14,584	14,934	15,729	16,100	16,470
7-Sep	12,582	12,968	14,360	14,712	15,073	15,875	16,255	16,636
8-Sep	12,342	12,613	13,221	13,579	13,931	14,267	14,585	14,920
9-Sep	12,306	12,633	12,987	13,413	13,776	14,146	14,510	14,884
10-Sep	12,316	12,642	13,019	13,464	13,840	14,220	14,619	15,033
11-Sep	12,299	12,564	13,074	13,271	13,539	13,814	14,091	14,369
12-Sep	12,302	12,560	13,171	13,421	13,665	13,915	14,174	14,443
13-Sep	12,300	12,564	13,039	13,311	13,589	13,887	14,172	14,454
14-Sep	12,335	12,596	13,021	13,311	13,620	13,973	14,297	14,609
15-Sep	12,351	12,613	13,216	13,594	13,962	14,444	14,850	15,263
16-Sep	12,362	12,709	13,156	14,857	15,361	15,828	16,299	16,751
17-Sep	12,378	12,752	13,378	15,412	15,894	16,367	16,836	17,298
18-Sep	12,395	12,706	14,431	14,434	14,775	15,539	15,903	16,266
19-Sep	12,359	12,643	13,566	13,918	14,278	14,887	15,246	15,609
20-Sep	12,351	12,631	13,253	13,601	13,933	14,432	14,792	15,155
21-Sep	12,318	12,581	12,947	13,266	13,586	13,928	14,250	14,575
22-Sep	12,329	12,596	13,060	13,374	13,693	14,073	14,414	14,757
23-Sep	12,303	12,630	12,984	13,408	13,775	14,141	14,507	14,878
24-Sep	12,359	12,707	13,117	14,091	14,646	15,198	15,738	16,237
25-Sep	12,346	12,626	13,383	13,654	14,003	14,507	14,847	15,189
26-Sep	12,345	12,626	13,438	13,779	14,121	14,583	14,934	15,282
27-Sep	12,351	12,637	13,517	13,883	14,227	14,807	15,178	15,545
28-Sep	12,359	12,642	13,468	13,833	14,183	14,886	15,245	15,606
29-Sep	12,350	12,632	13,479	13,827	14,168	14,695	15,045	15,401
30-Sep	12,390	12,781	13,283	15,662	16,158	16,631	17,110	17,575

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Oct	11,952	12,305	13,628	13,787	14,276	14,722	15,188	15,635
2-Oct	12,741	13,040	14,751	13,901	14,474	15,159	15,771	16,393
3-Oct	12,871	13,170	13,885	14,212	14,620	15,194	15,807	16,389
4-Oct	12,094	12,372	13,340	13,634	13,913	14,182	14,488	14,827
5-Oct	12,298	12,581	13,240	13,591	14,124	14,501	15,029	15,533
6-Oct	12,467	12,763	14,110	14,261	14,636	15,013	15,609	16,187
7-Oct	12,411	12,762	13,415	14,107	14,617	15,176	15,794	16,383
8-Oct	12,373	12,731	14,287	14,255	14,736	15,317	15,970	16,573
9-Oct	12,299	12,601	13,871	13,859	14,419	14,864	15,413	15,955
10-Oct	12,101	12,393	13,086	13,482	13,977	14,446	14,936	15,378
11-Oct	11,688	11,964	12,599	12,929	13,263	13,659	13,985	14,297
12-Oct	12,042	12,330	13,123	13,516	13,977	14,337	14,781	15,211
13-Oct	12,146	12,445	13,589	14,002	14,436	14,887	15,313	15,715
14-Oct	11,883	12,226	13,195	13,402	13,856	14,272	14,705	15,126
15-Oct	12,865	13,211	14,021	14,535	15,145	15,746	16,443	17,138
16-Oct	13,199	13,373	20,192	19,476	19,118	18,950	19,160	19,517
17-Oct	13,697	13,682	24,291	24,166	24,136	24,505	24,364	24,233
18-Oct	13,769	13,876	23,198	23,044	23,135	23,305	23,488	23,737
19-Oct	13,366	13,551	18,890	19,015	19,384	19,880	20,406	20,934
20-Oct	12,623	12,831	15,009	15,249	15,695	15,699	16,120	16,515
21-Oct	12,305	12,650	13,323	13,785	14,347	14,890	15,465	16,021
22-Oct	12,354	12,701	13,784	13,970	14,557	15,111	15,717	16,294
23-Oct	12,359	12,650	13,986	13,922	14,486	14,924	15,496	16,055
24-Oct	12,360	12,656	13,604	13,993	14,606	15,052	15,666	16,231
25-Oct	12,146	12,428	12,963	13,317	13,778	14,213	14,679	15,123
26-Oct	12,684	12,977	13,901	14,362	15,008	15,453	16,051	16,642
27-Oct	13,068	13,308	15,212	15,153	15,301	15,874	16,559	17,253
28-Oct	12,805	13,066	15,240	15,980	16,332	16,334	16,724	17,171
29-Oct	14,069	14,089	18,975	24,075	23,563	23,232	23,014	22,809
30-Oct	13,891	14,093	26,728	23,084	23,185	23,363	23,689	24,036
31-Oct	13,755	13,660	19,053	19,155	19,466	19,325	19,675	20,037

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Nov	12,553	12,818	14,832	14,989	15,295	15,613	16,033	16,380
2-Nov	12,460	12,752	14,153	14,422	14,847	15,088	15,618	16,165
3-Nov	12,585	12,869	14,564	14,692	14,972	15,388	15,899	16,376
4-Nov	12,576	12,884	14,228	15,204	15,662	15,911	16,354	16,911
5-Nov	12,775	13,101	14,518	14,794	15,228	15,765	16,427	17,112
6-Nov	12,704	12,990	15,558	15,015	15,306	15,528	16,017	16,496
7-Nov	13,197	13,354	17,046	16,850	17,257	17,451	17,743	17,955
8-Nov	13,665	13,781	19,478	19,036	18,543	18,670	19,092	19,591
9-Nov	13,528	13,626	19,955	20,025	20,249	19,642	19,356	19,767
10-Nov	13,374	13,558	18,543	18,508	18,623	18,759	18,950	19,163
11-Nov	13,049	13,282	16,230	16,972	17,269	17,423	17,807	18,258
12-Nov	13,023	13,221	16,759	17,164	17,398	17,603	17,805	18,213
13-Nov	13,204	13,371	17,495	16,341	16,592	16,677	17,097	17,505
14-Nov	13,248	13,357	18,823	18,686	18,603	18,217	18,367	18,756
15-Nov	18,303	17,800	29,444	29,251	29,116	30,143	30,044	29,375
16-Nov	18,822	18,308	29,752	29,438	29,285	29,457	29,588	29,732
17-Nov	18,875	17,805	28,008	27,893	27,885	27,809	27,875	28,015
18-Nov	18,318	17,960	21,475	26,141	26,245	26,357	26,618	26,976
19-Nov	14,377	14,482	20,289	19,761	20,079	20,331	20,654	21,096
20-Nov	13,233	13,422	18,597	17,450	17,660	17,576	17,882	18,352
21-Nov	13,050	13,231	16,969	17,007	17,262	17,382	17,630	17,913
22-Nov	13,502	13,588	18,956	18,671	18,666	18,445	18,671	19,080
23-Nov	15,121	14,968	20,087	24,267	24,247	24,316	24,309	23,950
24-Nov	15,642	15,691	25,996	23,734	23,771	23,555	23,853	24,261
25-Nov	17,242	16,843	21,823	28,154	28,248	28,183	28,283	28,394
26-Nov	22,485	21,193	23,853	33,701	33,764	33,721	33,854	34,071
27-Nov	23,528	22,881	33,837	31,605	31,551	32,428	32,344	32,371
28-Nov	20,220	19,886	31,617	28,796	28,724	28,660	28,642	28,655
29-Nov	20,450	19,863	29,957	29,438	29,403	29,565	29,576	29,660
30-Nov	18,630	18,396	27,210	27,098	27,174	26,897	26,981	27,124

	Occupancy Values							
	0%	5%	10%	15%	20%	25%	30%	35%
1-Dec	17,744	17,400	25,352	25,291	25,348	25,548	25,626	25,802
2-Dec	14,467	14,530	17,798	19,862	20,158	20,461	20,853	21,371
3-Dec	14,178	14,293	18,758	20,384	20,379	20,576	20,843	21,070
4-Dec	15,439	15,330	24,691	23,270	23,330	23,060	23,233	23,475
5-Dec	13,140	13,304	16,891	17,083	17,451	17,595	17,996	18,326
6-Dec	12,731	12,953	16,114	16,191	16,410	16,587	16,854	17,208
7-Dec	12,761	13,009	16,404	16,458	16,698	16,308	16,755	17,160
8-Dec	12,990	13,146	17,516	17,586	17,903	17,997	18,152	18,437
9-Dec	13,175	13,352	17,164	18,375	18,459	18,359	18,460	18,679
10-Dec	12,733	12,972	16,400	16,266	16,489	16,695	17,037	17,416
11-Dec	13,041	13,186	17,737	17,117	17,330	17,524	17,747	18,012
12-Dec	14,331	14,327	22,892	22,686	22,593	22,079	21,977	21,762
13-Dec	15,340	15,107	23,679	23,558	23,582	23,618	23,865	24,128
14-Dec	16,369	16,050	25,299	25,201	25,205	25,490	25,659	25,891
15-Dec	17,497	16,871	25,726	25,542	25,516	25,839	26,006	26,173
16-Dec	17,274	16,826	20,595	25,037	25,107	25,124	25,312	25,560
17-Dec	20,941	20,202	23,869	31,753	31,812	31,728	31,716	31,818
18-Dec	19,977	19,612	31,759	28,067	28,035	28,005	28,005	28,068
19-Dec	15,380	15,217	22,226	21,229	21,398	21,016	21,309	21,781
20-Dec	12,930	13,088	16,010	16,331	16,803	17,160	17,547	17,898
21-Dec	14,346	14,269	22,625	22,165	21,926	22,043	22,032	22,143
22-Dec	24,458	23,212	32,311	32,314	32,322	33,734	33,694	33,703
23-Dec	28,755	28,086	25,227	38,667	38,402	37,984	37,957	37,763
24-Dec	25,827	25,320	24,923	34,654	34,635	34,604	34,593	34,531
25-Dec	19,077	18,806	23,497	28,137	28,235	28,257	28,416	28,587
26-Dec	25,149	24,450	34,365	32,625	32,585	33,770	33,701	33,623
27-Dec	24,949	24,386	33,803	32,436	32,297	33,420	33,373	33,325
28-Dec	26,629	26,058	34,089	33,025	32,894	34,169	34,111	34,053
29-Dec	23,749	23,303	32,364	31,844	31,641	31,984	31,978	31,885
30-Dec	15,228	15,251	20,353	20,145	20,495	20,754	21,123	21,645
31-Dec	19,984	19,249	22,293	31,826	31,601	31,408	31,398	31,323
Total:	5,254,077	5,297,481	6,501,708	6,734,606	6,835,291	6,970,615	7,090,060	7,215,269
EUI	34.4	34.7	42.6	44.1	44.8	45.7	46.4	47.3

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Jan	22,266	24,083	24,516	25,012	25,431	25,871	26,366	26,893
2-Jan	22,672	23,754	24,061	24,450	24,850	25,337	25,828	26,322
3-Jan	34,115	34,282	34,131	38,355	38,285	38,099	37,591	37,120
4-Jan	34,038	34,120	34,145	38,509	38,543	38,555	38,638	38,706
5-Jan	25,971	27,070	27,257	28,308	28,569	28,799	29,106	29,375
6-Jan	28,172	28,924	29,131	30,292	30,507	30,675	30,942	31,199
7-Jan	26,886	27,620	27,898	28,201	28,578	28,966	29,448	29,979
8-Jan	24,667	26,053	26,300	26,513	26,746	27,277	27,861	28,370
9-Jan	31,631	32,164	32,135	35,269	35,183	35,026	34,963	34,433
10-Jan	25,810	26,610	26,860	28,334	28,523	28,824	29,225	29,650
11-Jan	25,481	26,254	26,464	27,679	27,948	28,210	28,598	28,883
12-Jan	22,842	23,601	23,908	25,058	25,396	25,707	25,969	26,425
13-Jan	20,832	21,574	21,640	22,179	22,509	22,764	23,069	23,387
14-Jan	28,222	30,123	30,223	30,127	30,100	30,157	30,244	30,694
15-Jan	27,735	28,787	29,063	29,435	29,785	30,166	30,503	30,698
16-Jan	29,483	30,178	30,177	31,981	32,028	32,088	32,244	32,339
17-Jan	26,565	27,342	27,615	29,020	29,290	29,516	29,896	30,291
18-Jan	25,582	26,270	26,411	27,529	27,883	28,215	28,688	29,021
19-Jan	25,851	26,728	26,815	27,355	27,416	27,456	27,680	27,987
20-Jan	33,568	33,671	33,691	36,821	36,696	36,654	36,663	36,607
21-Jan	36,928	38,111	38,174	38,255	38,309	38,367	38,462	38,629
22-Jan	31,530	32,727	32,812	32,947	33,122	33,339	33,562	33,879
23-Jan	34,246	34,330	34,347	38,416	38,435	38,430	38,427	38,434
24-Jan	31,762	32,344	32,373	34,870	34,920	34,986	35,132	35,174
25-Jan	34,846	34,893	34,915	38,598	38,608	38,579	38,662	38,589
26-Jan	29,928	30,596	30,761	32,569	32,849	33,079	33,376	33,562
27-Jan	27,538	28,528	28,697	29,777	29,907	30,059	30,287	30,495
28-Jan	26,593	27,651	27,959	28,343	28,731	29,083	29,530	30,023
29-Jan	38,907	39,570	39,531	39,585	39,573	39,546	39,618	39,690
30-Jan	24,013	24,766	25,144	26,531	26,910	27,252	27,672	28,129
31-Jan	20,401	21,240	21,565	22,258	22,674	23,080	23,596	24,039

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Feb	25,126	26,321	26,430	27,181	27,244	27,455	27,777	28,082
2-Feb	30,393	31,069	31,022	32,908	32,838	32,768	32,501	32,374
3-Feb	27,128	27,905	28,178	29,625	29,788	30,052	30,474	30,862
4-Feb	25,774	26,667	27,002	27,357	27,760	28,179	28,637	29,080
5-Feb	24,099	25,457	25,649	25,845	26,131	26,703	27,161	27,631
6-Feb	23,412	24,201	24,422	25,663	26,015	26,180	26,722	27,211
7-Feb	19,277	20,075	20,527	21,156	21,562	21,890	22,302	22,742
8-Feb	21,515	22,511	22,813	23,376	23,654	23,938	24,406	24,941
9-Feb	23,725	24,220	24,286	25,175	25,801	26,390	26,949	27,431
10-Feb	18,859	19,614	20,048	20,648	21,063	21,466	22,158	22,615
11-Feb	18,912	19,632	20,092	20,612	21,424	22,110	22,703	23,273
12-Feb	17,306	17,791	18,323	19,008	19,635	20,265	20,888	21,529
13-Feb	26,385	26,365	26,304	27,671	27,521	27,286	27,129	27,105
14-Feb	36,786	36,890	36,878	41,098	41,036	40,947	40,926	40,907
15-Feb	36,574	36,580	36,578	40,776	40,810	40,812	40,879	40,901
16-Feb	32,778	33,104	33,097	34,903	35,042	35,147	35,332	35,495
17-Feb	22,674	23,846	24,198	25,090	25,441	25,802	26,171	26,520
18-Feb	24,568	25,946	26,168	26,178	26,599	27,126	27,662	28,176
19-Feb	30,705	32,187	32,254	32,417	32,528	32,601	32,885	33,280
20-Feb	33,369	34,972	35,017	35,098	35,191	35,324	35,384	35,507
21-Feb	26,688	27,367	27,642	29,113	29,286	29,490	29,907	30,292
22-Feb	24,067	24,852	25,011	25,965	26,302	26,628	27,051	27,327
23-Feb	21,146	22,079	22,424	23,094	23,590	24,133	24,662	25,127
24-Feb	19,094	19,794	20,249	20,850	21,463	22,123	22,885	23,505
25-Feb	19,726	20,486	20,967	21,396	22,097	22,943	23,752	24,480
26-Feb	19,396	20,294	20,779	21,264	21,796	22,433	23,047	23,630
27-Feb	24,600	25,419	25,245	26,461	26,705	26,782	26,841	26,848
28-Feb	30,313	30,951	30,800	33,243	33,142	32,849	32,551	32,511

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Mar	26,171	27,027	27,260	29,234	29,448	29,653	29,997	30,306
2-Mar	33,575	33,617	33,597	38,089	38,010	37,952	38,005	38,025
3-Mar	37,496	37,611	37,658	41,976	41,997	41,961	42,008	42,027
4-Mar	30,169	31,098	31,462	31,682	31,998	32,310	32,614	33,017
5-Mar	20,433	21,484	21,705	21,957	22,289	22,812	23,340	23,775
6-Mar	18,953	19,474	19,865	20,494	20,984	21,480	22,208	22,984
7-Mar	20,878	21,903	22,264	23,127	23,521	23,852	24,159	24,627
8-Mar	20,166	21,104	21,584	22,349	22,818	23,413	23,782	23,944
9-Mar	17,531	17,977	18,552	19,434	19,892	20,277	20,771	21,293
10-Mar	19,406	20,075	20,372	20,825	21,346	21,817	22,348	23,025
11-Mar	22,544	24,037	24,644	25,099	25,442	25,812	26,214	26,673
12-Mar	22,173	22,955	23,409	23,961	24,445	24,939	25,411	25,939
13-Mar	21,960	22,766	22,834	23,459	23,875	24,203	24,598	24,966
14-Mar	23,878	24,938	24,816	25,430	25,810	26,160	26,602	27,085
15-Mar	27,062	27,929	27,922	28,843	28,782	29,111	29,557	29,892
16-Mar	23,860	24,657	24,908	25,948	26,225	26,349	26,924	27,504
17-Mar	17,773	18,325	18,748	19,474	19,934	20,317	20,786	21,208
18-Mar	16,697	17,268	17,886	18,536	19,097	19,670	20,204	20,729
19-Mar	18,202	18,877	19,600	20,413	21,241	22,093	22,943	23,791
20-Mar	16,954	17,355	17,875	18,554	19,050	19,487	19,998	20,478
21-Mar	16,618	17,180	17,660	18,307	18,799	19,243	19,743	20,194
22-Mar	17,165	17,721	18,311	19,093	19,673	20,179	20,684	21,160
23-Mar	20,614	21,483	21,561	21,630	21,948	22,419	23,030	23,651
24-Mar	22,077	23,324	23,707	24,795	25,251	25,599	26,054	26,454
25-Mar	20,868	21,914	22,153	22,664	23,356	23,971	24,631	25,494
26-Mar	18,019	18,551	19,179	19,926	20,523	21,174	21,866	22,576
27-Mar	16,972	17,592	18,116	18,801	19,296	19,709	20,239	20,711
28-Mar	16,790	17,385	17,888	18,481	18,951	19,390	19,908	20,365
29-Mar	16,906	17,450	17,939	18,534	19,009	19,444	19,931	20,378
30-Mar	15,508	15,924	16,333	16,793	17,198	17,566	18,008	18,429
31-Mar	14,847	15,204	15,545	15,914	16,232	16,505	16,832	17,122

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Apr	18,286	18,977	19,714	20,479	21,261	22,126	22,983	23,840
2-Apr	17,400	17,963	18,662	19,383	20,039	20,697	21,344	22,003
3-Apr	24,160	25,184	25,311	26,173	26,180	26,159	26,228	26,481
4-Apr	22,525	23,014	23,313	24,255	24,756	25,370	26,056	26,653
5-Apr	18,686	19,516	19,878	20,583	20,978	21,422	21,930	22,405
6-Apr	16,585	17,201	17,775	18,374	18,884	19,364	19,881	20,355
7-Apr	16,226	16,717	17,169	17,674	18,112	18,506	18,958	19,378
8-Apr	18,404	19,075	19,858	20,680	21,456	22,233	23,005	23,777
9-Apr	18,788	19,256	19,447	20,079	20,820	21,648	22,346	23,033
10-Apr	17,346	18,055	18,540	19,278	19,799	20,262	20,807	21,319
11-Apr	16,931	17,535	18,063	18,736	19,252	19,717	20,252	20,757
12-Apr	17,428	17,882	18,487	19,287	19,999	20,602	21,231	21,775
13-Apr	18,213	19,099	19,550	20,180	20,858	21,428	22,030	22,521
14-Apr	18,866	19,684	20,279	21,046	21,478	22,080	22,736	23,361
15-Apr	19,333	20,151	20,814	21,465	22,059	22,824	23,612	24,361
16-Apr	17,522	18,084	18,590	19,258	19,955	20,602	21,224	21,832
17-Apr	17,678	18,375	19,016	19,843	20,534	21,124	21,699	22,184
18-Apr	19,101	19,687	20,084	20,526	21,142	21,962	22,792	23,543
19-Apr	18,770	19,628	19,903	20,680	21,049	21,092	21,577	22,174
20-Apr	16,516	17,055	17,556	18,176	18,661	19,108	19,638	20,105
21-Apr	16,649	17,185	17,677	18,334	18,820	19,271	19,792	20,275
22-Apr	16,363	16,905	17,425	17,983	18,475	18,970	19,440	19,916
23-Apr	16,070	16,581	17,055	17,597	18,046	18,493	18,926	19,364
24-Apr	16,024	16,485	16,908	17,395	17,818	18,200	18,630	19,011
25-Apr	16,191	16,694	17,151	17,617	18,034	18,415	18,861	19,251
26-Apr	17,009	17,683	18,242	18,915	19,448	19,920	20,424	20,890
27-Apr	17,054	17,718	18,271	19,049	19,575	20,051	20,607	21,102
28-Apr	16,476	16,990	17,481	18,095	18,562	18,990	19,481	19,938
29-Apr	16,263	16,803	17,270	17,805	18,309	18,821	19,318	19,821
30-Apr	16,361	16,907	17,416	17,990	18,484	18,995	19,479	19,959

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-May	17,084	17,748	18,318	19,101	19,650	20,143	20,713	21,247
2-May	16,876	17,429	17,935	18,476	18,927	19,334	19,814	20,249
3-May	16,180	16,713	17,180	17,861	18,329	18,754	19,256	19,719
4-May	16,724	17,257	17,802	18,559	19,056	19,538	20,110	20,614
5-May	16,862	17,396	17,835	18,549	19,043	19,494	20,032	20,507
6-May	16,970	17,610	18,179	18,804	19,378	19,952	20,492	21,033
7-May	16,496	17,103	17,505	17,963	18,362	18,780	19,153	19,546
8-May	15,232	15,581	15,894	16,196	16,509	16,774	17,103	17,399
9-May	16,887	17,483	18,034	19,053	19,646	20,165	20,746	21,269
10-May	16,171	16,687	17,159	17,858	18,334	18,760	19,273	19,745
11-May	15,372	15,770	16,181	16,748	17,155	17,536	18,002	18,422
12-May	16,276	16,761	17,206	17,682	18,122	18,524	18,989	19,375
13-May	18,410	19,311	20,114	21,011	21,853	22,636	23,347	24,018
14-May	18,047	18,804	19,613	20,475	21,267	22,067	22,899	23,692
15-May	16,982	17,593	18,136	19,146	19,754	20,268	20,824	21,328
16-May	17,096	17,723	18,332	19,119	19,699	20,246	20,826	21,361
17-May	16,612	16,931	17,429	18,071	18,543	18,978	19,476	19,934
18-May	15,391	15,818	16,237	16,702	17,093	17,454	17,887	18,270
19-May	16,201	16,634	17,037	17,459	17,850	18,191	18,594	18,945
20-May	15,982	16,458	16,935	17,453	17,929	18,408	18,872	19,339
21-May	16,095	16,648	17,074	17,563	17,979	18,400	18,808	19,223
22-May	15,765	16,209	16,580	16,961	17,346	17,696	18,117	18,488
23-May	14,846	15,214	15,502	16,310	16,583	16,821	17,124	17,390
24-May	15,587	15,962	16,264	16,607	16,895	17,132	17,425	17,690
25-May	16,872	17,383	17,846	18,279	18,699	19,099	19,583	19,989
26-May	17,110	17,692	18,309	19,352	20,065	20,731	21,386	22,001
27-May	16,321	16,834	17,372	18,012	18,587	19,150	19,684	20,206
28-May	15,890	16,408	16,763	17,185	17,536	17,891	18,235	18,582
29-May	15,905	16,461	16,792	17,190	17,518	17,853	18,168	18,491
30-May	15,384	15,832	16,162	16,546	16,866	17,152	17,485	17,783
31-May	16,216	16,697	17,125	17,703	18,135	18,544	19,012	19,413

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Jun	16,253	16,591	16,948	17,792	18,137	18,443	18,814	19,150
2-Jun	16,532	16,865	17,237	17,927	18,271	18,580	18,961	19,308
3-Jun	16,697	17,069	17,509	17,999	18,429	18,862	19,272	19,689
4-Jun	15,746	16,090	16,488	16,959	17,353	17,749	18,128	18,510
5-Jun	15,352	15,619	15,954	16,423	16,757	17,051	17,412	17,731
6-Jun	16,360	16,690	17,055	18,059	18,402	18,710	19,082	19,423
7-Jun	15,632	15,926	16,278	17,128	17,483	17,797	18,177	18,520
8-Jun	16,190	16,474	16,834	17,549	17,902	18,219	18,608	18,959
9-Jun	16,256	16,583	16,949	17,609	17,955	18,264	18,646	18,991
10-Jun	18,980	19,606	20,149	20,778	21,318	21,842	22,406	22,950
11-Jun	19,397	20,019	20,549	21,177	21,709	22,228	22,781	23,322
12-Jun	17,280	17,702	18,077	20,049	20,416	20,751	21,140	21,496
13-Jun	15,027	15,252	15,543	15,788	16,095	16,371	16,725	17,043
14-Jun	15,025	15,293	15,613	16,045	16,366	16,646	16,990	17,294
15-Jun	16,060	16,396	16,750	17,631	17,963	18,257	18,622	18,951
16-Jun	16,591	17,021	17,405	19,214	19,597	19,917	20,310	20,673
17-Jun	19,108	19,724	20,256	20,830	21,379	21,903	22,477	23,031
18-Jun	19,210	19,860	20,353	20,961	21,515	22,018	22,547	23,063
19-Jun	15,608	15,883	16,194	16,723	17,046	17,327	17,666	17,974
20-Jun	15,731	16,040	16,407	16,993	17,353	17,671	18,064	18,417
21-Jun	16,061	16,283	16,633	17,267	17,608	17,915	18,291	18,629
22-Jun	16,160	16,449	16,809	17,698	18,044	18,355	18,735	19,076
23-Jun	16,782	17,184	17,570	19,374	19,754	20,090	20,510	20,885
24-Jun	19,193	19,844	20,352	20,833	21,329	21,834	22,301	22,802
25-Jun	19,068	19,656	20,079	20,568	20,999	21,489	21,942	22,426
26-Jun	16,937	17,287	17,685	18,871	19,262	19,619	20,049	20,443
27-Jun	17,097	17,453	17,839	18,864	19,240	19,581	19,991	20,366
28-Jun	17,404	17,768	18,181	19,651	20,035	20,395	20,818	21,217
29-Jun	17,458	17,801	18,196	19,355	19,743	20,096	20,519	20,907
30-Jun	17,278	17,620	18,022	19,339	19,718	20,074	20,488	20,886

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Jul	18,282	18,818	19,258	19,548	19,968	20,417	20,826	21,259
2-Jul	19,555	20,308	20,873	21,573	22,162	22,705	23,207	23,811
3-Jul	18,036	18,561	18,952	21,096	21,493	21,851	22,262	22,669
4-Jul	19,750	20,297	20,752	20,937	21,379	21,856	22,297	22,776
5-Jul	16,560	16,787	17,137	18,186	18,541	18,867	19,255	19,612
6-Jul	16,543	16,872	17,239	18,383	18,725	19,038	19,419	19,766
7-Jul	16,763	17,128	17,513	19,320	19,681	20,013	20,421	20,794
8-Jul	16,903	17,244	17,662	18,072	18,487	18,910	19,314	19,723
9-Jul	17,050	17,447	17,871	18,368	18,784	19,207	19,611	20,024
10-Jul	16,972	17,456	17,867	19,990	20,452	20,865	21,398	21,875
11-Jul	16,985	17,283	17,629	18,231	18,553	18,844	19,198	19,519
12-Jul	17,044	17,503	17,907	20,030	20,477	20,874	21,376	21,818
13-Jul	17,377	17,747	18,128	19,047	19,403	19,727	20,124	20,485
14-Jul	17,162	17,476	17,854	19,213	19,584	19,923	20,324	20,693
15-Jul	17,554	17,983	18,435	18,930	19,380	19,836	20,269	20,713
16-Jul	18,962	19,575	20,072	20,642	21,117	21,614	22,090	22,576
17-Jul	17,625	18,099	18,517	20,388	20,796	21,164	21,605	22,013
18-Jul	17,993	18,425	18,841	20,415	20,846	21,223	21,681	22,094
19-Jul	18,039	18,434	18,840	20,060	20,427	20,774	21,185	21,566
20-Jul	17,072	17,156	17,514	18,176	18,547	18,887	19,292	19,663
21-Jul	16,630	17,052	17,465	18,115	18,536	18,919	19,387	19,815
22-Jul	18,157	18,661	19,198	19,693	20,216	20,748	21,252	21,769
23-Jul	18,784	19,310	19,772	20,355	20,897	21,447	21,974	22,501
24-Jul	17,351	17,684	18,115	19,257	19,710	20,124	20,613	21,069
25-Jul	16,405	16,712	17,113	17,655	18,053	18,414	18,850	19,251
26-Jul	16,879	17,339	17,786	18,587	19,036	19,442	19,934	20,383
27-Jul	16,717	17,065	17,427	17,894	18,287	18,641	19,063	19,447
28-Jul	16,511	16,778	17,146	17,974	18,326	18,643	19,030	19,379
29-Jul	18,569	19,098	19,587	20,140	20,620	21,110	21,575	22,059
30-Jul	18,465	18,940	19,380	19,934	20,410	20,901	21,359	21,831
31-Jul	16,593	16,871	17,246	18,249	18,613	18,944	19,344	19,708

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Aug	17,425	17,924	18,362	20,191	20,619	21,005	21,473	21,898
2-Aug	17,999	18,425	18,842	20,458	20,886	21,269	21,742	22,162
3-Aug	17,418	17,603	17,957	18,767	19,113	19,430	19,810	20,167
4-Aug	15,108	15,376	15,721	16,142	16,493	16,802	17,184	17,522
5-Aug	16,076	16,458	16,893	17,382	17,795	18,208	18,603	19,001
6-Aug	18,410	18,966	19,462	20,052	20,548	21,035	21,532	22,021
7-Aug	16,659	17,033	17,406	19,483	19,875	20,227	20,650	20,999
8-Aug	17,194	17,645	18,053	20,202	20,664	21,042	21,532	21,970
9-Aug	17,395	17,731	18,125	19,307	19,673	20,018	20,430	20,812
10-Aug	17,380	17,787	18,213	19,145	19,575	19,966	20,436	20,868
11-Aug	16,613	16,912	17,288	17,603	18,000	18,360	18,783	19,172
12-Aug	17,199	17,610	18,067	18,579	19,031	19,492	19,930	20,378
13-Aug	15,923	16,285	16,704	17,195	17,604	18,015	18,408	18,802
14-Aug	14,994	15,267	15,593	16,040	16,369	16,658	17,019	17,344
15-Aug	15,661	15,937	16,296	16,827	17,182	17,498	17,885	18,229
16-Aug	15,865	16,128	16,492	17,117	17,478	17,803	18,192	18,541
17-Aug	16,665	17,061	17,444	18,947	19,315	19,635	20,036	20,403
18-Aug	16,839	17,172	17,543	18,926	19,278	19,608	20,013	20,380
19-Aug	18,207	18,722	19,172	19,647	20,101	20,563	20,999	21,445
20-Aug	16,627	17,057	17,507	18,038	18,478	18,923	19,349	19,783
21-Aug	16,070	16,336	16,682	17,513	17,855	18,159	18,531	18,864
22-Aug	16,209	16,479	16,834	17,553	17,898	18,206	18,580	18,918
23-Aug	16,186	16,444	16,805	17,619	17,965	18,274	18,649	18,987
24-Aug	16,658	17,026	17,405	18,952	19,315	19,637	20,036	20,402
25-Aug	16,873	17,242	17,613	19,228	19,601	19,935	20,343	20,710
26-Aug	17,823	18,269	18,709	19,175	19,622	20,082	20,514	20,959
27-Aug	17,917	18,508	18,969	19,519	19,981	20,444	20,891	21,340
28-Aug	16,110	16,429	16,777	17,711	18,046	18,347	18,709	19,036
29-Aug	16,600	16,990	17,361	18,983	19,367	19,688	20,083	20,442
30-Aug	16,970	17,377	17,763	20,026	20,459	20,862	21,341	21,715
31-Aug	16,155	16,374	16,699	17,219	17,520	17,793	18,121	18,424

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Sep	16,426	16,760	17,142	17,848	18,216	18,544	18,942	19,303
2-Sep	18,021	18,515	19,018	19,599	20,102	20,614	21,101	21,600
3-Sep	18,774	19,407	19,909	20,508	21,013	21,514	22,015	22,518
4-Sep	17,354	17,835	18,269	18,792	19,228	19,673	20,090	20,519
5-Sep	16,621	16,977	17,354	19,290	19,681	20,031	20,455	20,817
6-Sep	16,842	17,218	17,601	19,558	19,969	20,335	20,784	21,156
7-Sep	17,019	17,423	17,813	19,311	19,681	20,014	20,412	20,774
8-Sep	15,246	15,476	15,786	16,379	16,724	17,027	17,398	17,728
9-Sep	15,260	15,580	15,953	16,385	16,753	17,127	17,494	17,864
10-Sep	15,434	15,773	16,160	16,628	17,019	17,412	17,790	18,166
11-Sep	14,647	14,883	15,162	15,518	15,804	16,054	16,376	16,659
12-Sep	14,725	14,989	15,257	15,582	15,848	16,083	16,388	16,662
13-Sep	14,728	14,966	15,244	15,590	15,872	16,118	16,437	16,716
14-Sep	14,929	15,201	15,542	15,988	16,371	16,721	17,140	17,490
15-Sep	15,637	15,925	16,280	17,058	17,405	17,713	18,092	18,432
16-Sep	17,187	17,708	18,134	18,629	19,049	19,479	19,875	20,294
17-Sep	17,753	18,309	18,773	19,319	19,771	20,224	20,671	21,121
18-Sep	16,627	16,978	17,348	18,883	19,244	19,569	19,964	20,320
19-Sep	15,965	16,231	16,574	17,359	17,700	18,003	18,372	18,703
20-Sep	15,509	15,817	16,164	16,849	17,186	17,493	17,867	18,200
21-Sep	14,900	15,168	15,484	15,885	16,200	16,477	16,826	17,135
22-Sep	15,090	15,348	15,663	16,153	16,466	16,739	17,084	17,391
23-Sep	15,253	15,574	15,946	16,381	16,751	17,125	17,489	17,852
24-Sep	16,734	17,285	17,769	18,342	18,795	19,245	19,662	20,088
25-Sep	15,528	15,805	16,135	16,826	17,155	17,447	17,806	18,128
26-Sep	15,627	15,903	16,236	16,865	17,191	17,478	17,836	18,155
27-Sep	15,906	16,214	16,568	17,340	17,683	17,988	18,360	18,698
28-Sep	15,960	16,268	16,617	17,494	17,842	18,152	18,525	18,859
29-Sep	15,748	16,022	16,360	17,029	17,358	17,649	18,012	18,335
30-Sep	18,039	18,625	19,097	19,638	20,099	20,559	21,009	21,469

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Oct	16,087	16,685	17,107	17,590	18,007	18,418	18,814	19,202
2-Oct	17,059	17,752	18,373	19,265	19,844	20,339	20,902	21,435
3-Oct	16,995	17,546	18,169	19,211	19,884	20,471	21,093	21,627
4-Oct	15,251	15,614	16,011	16,595	17,004	17,382	17,847	18,286
5-Oct	16,043	16,555	17,059	17,730	18,194	18,569	19,011	19,438
6-Oct	16,780	17,377	17,885	18,643	19,135	19,593	20,127	20,594
7-Oct	17,017	17,655	18,312	18,964	19,557	20,140	20,716	21,263
8-Oct	17,242	17,921	18,501	19,127	19,684	20,240	20,764	21,296
9-Oct	16,450	16,933	17,370	17,853	18,271	18,654	19,096	19,491
10-Oct	15,826	16,244	16,652	17,109	17,515	17,884	18,325	18,755
11-Oct	14,605	14,947	15,240	15,572	15,857	16,108	16,423	16,708
12-Oct	15,647	16,083	16,495	16,919	17,311	17,681	18,100	18,463
13-Oct	16,121	16,558	16,934	17,395	17,751	18,087	18,482	18,851
14-Oct	15,553	16,024	16,433	16,892	17,310	17,728	18,117	18,499
15-Oct	17,851	18,614	19,340	20,171	20,934	21,647	22,272	22,894
16-Oct	19,944	20,830	21,141	21,561	21,869	22,232	22,848	23,455
17-Oct	24,201	25,484	25,508	26,276	26,501	26,940	27,341	27,650
18-Oct	24,019	25,353	25,581	26,996	27,077	27,041	27,030	27,256
19-Oct	21,422	22,553	22,751	23,390	23,774	24,141	24,545	25,035
20-Oct	16,934	17,484	18,073	18,650	19,160	19,620	20,165	20,668
21-Oct	16,600	17,169	17,724	18,356	18,913	19,451	19,976	20,484
22-Oct	16,891	17,533	18,104	18,727	19,270	19,798	20,311	20,803
23-Oct	16,593	17,113	17,591	18,186	18,654	19,087	19,584	20,025
24-Oct	16,776	17,318	17,801	18,375	18,852	19,296	19,795	20,246
25-Oct	15,571	15,977	16,423	16,968	17,411	17,807	18,268	18,694
26-Oct	17,252	17,819	18,344	19,069	19,602	20,063	20,577	21,059
27-Oct	18,021	18,850	19,598	20,465	21,168	21,786	22,435	23,028
28-Oct	17,761	18,496	19,144	19,846	20,594	21,265	21,931	22,579
29-Oct	23,189	24,665	24,798	25,043	25,390	25,751	26,138	26,583
30-Oct	24,023	24,488	24,708	25,955	26,272	26,433	27,039	27,622
31-Oct	20,361	21,305	21,569	22,064	22,609	23,065	23,526	23,927

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Nov	16,781	17,124	17,475	18,067	18,473	18,967	19,484	19,954
2-Nov	16,764	17,430	18,037	18,674	19,179	19,615	20,121	20,589
3-Nov	17,035	17,740	18,376	19,078	19,652	20,162	20,698	21,194
4-Nov	17,378	17,941	18,558	19,314	19,924	20,535	21,127	21,692
5-Nov	17,803	18,513	19,234	20,027	20,714	21,437	22,142	22,819
6-Nov	17,032	17,587	18,269	18,987	19,627	20,167	20,736	21,216
7-Nov	18,230	18,590	18,945	19,625	20,359	21,081	21,807	22,416
8-Nov	19,965	20,521	20,729	21,005	21,192	21,612	22,402	23,154
9-Nov	20,449	21,774	22,312	23,053	23,495	23,885	24,128	24,386
10-Nov	19,618	20,495	20,920	21,464	21,947	22,419	22,936	23,446
11-Nov	18,783	19,491	19,996	20,801	21,479	22,101	22,707	23,323
12-Nov	18,686	19,413	20,028	20,501	21,008	21,547	22,082	22,651
13-Nov	17,949	18,494	19,123	19,978	20,706	21,401	22,109	22,700
14-Nov	19,090	19,699	19,899	20,368	20,658	21,024	21,465	21,935
15-Nov	28,742	29,223	29,196	30,824	30,773	30,560	30,465	30,283
16-Nov	29,841	30,464	30,504	31,930	32,102	32,187	32,255	32,322
17-Nov	28,263	28,927	28,995	29,947	30,099	30,285	30,552	30,760
18-Nov	27,390	28,320	28,631	29,014	29,431	29,838	30,338	30,788
19-Nov	21,529	22,575	22,891	23,395	24,016	24,663	25,263	25,857
20-Nov	18,818	19,459	19,844	20,524	20,913	21,327	21,945	22,522
21-Nov	18,369	19,043	19,432	19,912	20,327	20,946	21,533	21,941
22-Nov	19,508	20,188	20,530	20,872	21,355	21,971	22,778	23,509
23-Nov	23,591	25,181	25,663	26,054	26,429	26,636	26,762	27,067
24-Nov	24,648	25,256	25,119	25,822	26,350	26,876	27,481	27,854
25-Nov	28,502	29,778	29,952	29,988	29,961	30,425	30,844	31,226
26-Nov	34,323	36,099	36,108	36,226	36,171	36,044	35,921	35,621
27-Nov	32,414	32,672	32,718	35,315	35,268	35,295	35,392	35,497
28-Nov	28,793	29,627	29,796	31,160	31,401	31,504	31,757	32,046
29-Nov	29,824	30,549	30,604	32,320	32,357	32,384	32,548	32,698
30-Nov	27,366	28,211	28,422	29,598	29,836	30,065	30,379	30,706

	Occupancy Values							
	40%	45%	50%	55%	60%	65%	70%	75%
1-Dec	26,085	26,959	27,152	28,360	28,500	28,649	29,002	29,402
2-Dec	21,847	23,125	23,399	23,664	23,966	24,424	25,116	25,685
3-Dec	21,372	22,334	22,694	23,235	23,742	24,220	24,814	25,431
4-Dec	23,600	24,328	24,519	25,590	25,964	26,325	26,729	27,106
5-Dec	18,698	19,290	19,778	20,438	20,895	21,305	21,728	22,179
6-Dec	17,615	18,113	18,508	19,034	19,400	19,875	20,538	21,027
7-Dec	17,624	18,112	18,619	19,077	19,626	20,474	21,165	21,658
8-Dec	18,938	19,741	20,134	20,589	21,237	21,626	22,028	22,320
9-Dec	19,123	19,996	20,450	20,713	21,256	21,921	22,558	23,170
10-Dec	17,939	18,470	18,868	19,439	20,003	20,552	21,105	21,746
11-Dec	18,427	18,906	19,284	19,936	20,402	20,993	21,565	22,013
12-Dec	21,693	22,961	23,297	24,098	24,383	24,368	24,686	25,178
13-Dec	24,086	24,565	24,415	25,124	25,564	25,941	26,203	26,193
14-Dec	26,147	27,241	27,051	28,433	27,951	27,986	28,481	28,927
15-Dec	26,443	27,570	27,637	29,256	29,465	29,454	29,494	29,358
16-Dec	25,842	27,325	27,667	28,066	28,423	28,765	29,111	29,544
17-Dec	31,965	32,979	33,071	33,278	33,503	33,746	34,009	34,292
18-Dec	28,252	28,959	29,124	30,696	30,866	31,089	31,342	31,606
19-Dec	22,236	23,324	23,574	24,608	24,802	25,080	25,519	25,839
20-Dec	18,272	18,854	19,288	19,825	20,197	20,579	20,975	21,331
21-Dec	22,332	23,166	22,923	23,465	23,778	24,062	24,422	24,676
22-Dec	33,699	33,715	33,733	37,659	37,545	37,403	37,329	36,894
23-Dec	37,867	38,644	38,745	38,908	39,018	39,137	39,269	39,476
24-Dec	34,533	35,573	35,792	36,077	36,294	36,501	36,713	36,956
25-Dec	28,812	30,177	30,416	30,831	31,190	31,543	31,894	32,190
26-Dec	33,644	33,703	33,710	36,873	36,804	36,666	36,565	36,561
27-Dec	33,343	33,407	33,443	36,603	36,630	36,618	36,648	36,661
28-Dec	33,991	34,047	34,073	36,756	36,764	36,801	36,921	36,935
29-Dec	31,808	32,231	32,319	34,298	34,478	34,625	34,855	35,059
30-Dec	22,199	23,362	23,846	24,369	24,886	25,404	25,847	26,317
31-Dec	31,314	33,472	33,345	33,270	33,002	32,727	32,745	32,950

Total:	7,350,596	7,569,887	7,699,273	8,024,351	8,163,441	8,297,879	8,450,923	8,595,289
EUI	48.1	49.6	50.4	52.6	53.5	54.3	55.3	56.3

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Jan	27,331	27,818	28,319	28,807	29,295
2-Jan	26,876	27,533	28,292	29,318	30,192
3-Jan	36,587	36,547	36,550	36,686	36,700
4-Jan	38,730	38,807	38,829	38,793	38,787
5-Jan	29,700	30,034	30,348	30,626	30,899
6-Jan	31,444	31,728	31,985	32,150	32,323
7-Jan	30,416	30,877	31,405	31,997	32,569
8-Jan	28,778	29,301	29,860	30,470	31,357
9-Jan	33,982	34,021	34,207	34,364	34,523
10-Jan	30,001	30,280	30,438	30,495	30,868
11-Jan	29,050	29,437	29,791	30,129	30,483
12-Jan	26,798	27,140	27,434	27,728	28,059
13-Jan	23,738	24,146	24,515	24,948	25,378
14-Jan	31,057	31,348	31,592	31,833	32,226
15-Jan	30,897	31,387	31,905	32,411	32,928
16-Jan	32,337	31,784	32,049	32,303	32,543
17-Jan	30,619	30,893	30,816	30,986	31,375
18-Jan	29,175	29,584	29,972	30,353	30,660
19-Jan	28,193	28,403	28,627	28,838	29,116
20-Jan	36,525	36,460	36,364	36,136	36,358
21-Jan	38,750	38,971	39,206	39,224	39,128
22-Jan	34,245	34,617	34,977	35,401	35,800
23-Jan	38,400	38,418	38,443	38,464	38,486
24-Jan	35,230	35,381	35,574	35,761	35,943
25-Jan	38,624	38,673	38,710	38,744	38,780
26-Jan	33,698	33,932	34,165	34,405	34,642
27-Jan	30,686	30,927	31,022	31,250	31,560
28-Jan	30,499	31,062	31,634	32,246	32,830
29-Jan	39,689	39,749	39,733	39,728	39,982
30-Jan	28,556	28,953	29,307	29,614	29,753
31-Jan	24,409	24,799	25,218	25,697	26,090

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Feb	28,404	28,752	29,020	29,229	29,616
2-Feb	32,558	32,767	33,016	33,228	33,410
3-Feb	31,048	31,212	31,475	31,807	32,201
4-Feb	29,491	30,082	30,645	31,262	31,939
5-Feb	28,031	28,601	29,285	30,290	30,990
6-Feb	27,621	27,947	28,299	28,652	28,822
7-Feb	23,189	23,594	23,951	24,332	24,670
8-Feb	25,423	25,934	26,351	26,873	27,459
9-Feb	27,675	28,098	28,435	28,859	29,168
10-Feb	22,960	23,367	23,748	24,173	24,626
11-Feb	23,866	24,546	25,200	25,823	26,435
12-Feb	22,050	22,625	23,170	23,694	24,165
13-Feb	27,173	27,313	27,443	27,780	28,251
14-Feb	40,851	40,845	40,837	40,839	40,809
15-Feb	40,888	40,931	40,974	41,032	41,101
16-Feb	35,618	35,783	35,878	36,031	36,225
17-Feb	26,895	27,284	27,669	28,139	28,538
18-Feb	28,584	29,106	29,696	30,445	31,365
19-Feb	33,674	34,062	34,425	34,845	35,242
20-Feb	35,634	35,990	36,398	36,778	37,157
21-Feb	30,618	30,790	30,782	30,975	31,353
22-Feb	27,745	28,218	28,596	28,986	29,332
23-Feb	25,407	25,771	26,116	26,549	27,102
24-Feb	24,149	24,837	25,453	26,052	26,574
25-Feb	25,154	25,929	26,629	27,316	27,969
26-Feb	24,052	24,608	25,282	25,936	26,561
27-Feb	26,941	27,188	27,318	27,459	27,670
28-Feb	32,719	32,766	32,947	33,179	33,446

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Mar	30,428	30,632	30,411	30,633	30,971
2-Mar	37,982	37,989	37,993	37,793	36,941
3-Mar	42,024	42,074	42,145	42,207	42,278
4-Mar	33,376	33,829	34,354	34,864	35,381
5-Mar	24,177	24,826	25,355	25,783	26,249
6-Mar	23,682	24,397	25,005	25,604	26,157
7-Mar	24,981	25,367	25,750	26,207	26,772
8-Mar	24,306	24,727	25,110	25,447	25,788
9-Mar	21,734	22,235	22,664	23,131	23,573
10-Mar	23,706	24,334	24,972	25,568	26,114
11-Mar	27,319	27,895	28,402	29,025	29,823
12-Mar	26,461	27,187	27,835	28,343	28,654
13-Mar	25,255	25,757	26,269	26,727	27,212
14-Mar	27,422	27,599	27,867	28,302	28,733
15-Mar	30,187	30,493	30,715	30,902	31,085
16-Mar	28,002	28,387	28,780	29,195	29,543
17-Mar	21,596	22,057	22,457	22,897	23,352
18-Mar	21,170	21,676	22,177	22,677	23,149
19-Mar	24,559	25,359	26,104	26,787	27,380
20-Mar	20,871	21,325	21,764	22,192	22,587
21-Mar	20,586	21,047	21,490	21,913	22,317
22-Mar	21,582	22,050	22,491	22,905	23,285
23-Mar	24,294	25,060	25,743	26,387	26,999
24-Mar	26,702	26,915	27,194	27,381	27,677
25-Mar	26,192	26,845	27,359	27,959	28,451
26-Mar	23,140	23,776	24,361	24,927	25,462
27-Mar	21,118	21,571	22,028	22,483	22,927
28-Mar	20,745	21,170	21,577	21,977	22,362
29-Mar	20,754	21,197	21,606	22,013	22,403
30-Mar	18,778	19,192	19,590	19,951	20,313
31-Mar	17,354	17,642	17,930	18,216	18,501

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Apr	24,618	25,411	26,146	26,835	27,481
2-Apr	22,567	23,180	23,787	24,388	24,960
3-Apr	26,719	27,148	27,696	28,217	28,775
4-Apr	27,092	27,428	27,758	28,106	28,438
5-Apr	22,761	23,161	23,554	23,958	24,419
6-Apr	20,754	21,214	21,680	22,127	22,559
7-Apr	19,711	20,101	20,465	20,830	21,193
8-Apr	24,540	25,484	26,411	27,346	28,169
9-Apr	23,669	24,350	24,968	25,590	26,137
10-Apr	21,748	22,229	22,707	23,171	23,631
11-Apr	21,174	21,650	22,092	22,535	22,957
12-Apr	22,256	22,783	23,322	23,835	24,335
13-Apr	22,958	23,502	23,996	24,431	24,856
14-Apr	23,926	24,537	25,127	25,672	26,214
15-Apr	25,013	25,713	26,368	27,014	27,574
16-Apr	22,362	22,984	23,525	24,077	24,594
17-Apr	22,635	23,144	23,641	24,098	24,540
18-Apr	24,144	24,778	25,414	26,024	26,604
19-Apr	22,696	23,256	23,807	24,351	24,873
20-Apr	20,505	20,967	21,394	21,810	22,199
21-Apr	20,687	21,120	21,541	21,953	22,348
22-Apr	20,334	20,828	21,296	21,766	22,203
23-Apr	19,732	20,176	20,599	21,015	21,421
24-Apr	19,335	19,691	20,042	20,394	20,749
25-Apr	19,598	19,968	20,323	20,680	21,035
26-Apr	21,322	21,800	22,234	22,640	23,012
27-Apr	21,536	22,004	22,467	22,922	23,383
28-Apr	20,337	20,757	21,183	21,599	21,982
29-Apr	20,242	20,723	21,174	21,618	22,033
30-Apr	20,348	20,799	21,235	21,658	22,066

	Occupancy Values				
	80%	85%	90%	95%	100%
1-May	21,724	22,265	22,796	23,310	23,812
2-May	20,603	21,006	21,382	21,752	22,117
3-May	20,124	20,545	20,972	21,371	21,764
4-May	21,060	21,500	21,963	22,374	22,786
5-May	20,928	21,379	21,814	22,251	22,663
6-May	21,502	22,039	22,555	23,025	23,465
7-May	19,850	20,222	20,588	20,959	21,324
8-May	17,637	17,931	18,227	18,523	18,818
9-May	21,713	22,211	22,663	23,124	23,587
10-May	20,132	20,555	20,976	21,371	21,762
11-May	18,782	19,184	19,562	19,929	20,300
12-May	19,704	20,065	20,425	20,773	21,121
13-May	24,542	25,111	25,643	26,135	26,625
14-May	24,320	24,980	25,545	26,084	26,560
15-May	21,796	22,309	22,767	23,237	23,693
16-May	21,836	22,351	22,831	23,281	23,740
17-May	20,314	20,751	21,184	21,609	22,011
18-May	18,578	18,931	19,282	19,629	19,961
19-May	19,240	19,599	19,950	20,293	20,635
20-May	19,723	20,154	20,565	20,974	21,373
21-May	19,562	19,969	20,365	20,753	21,131
22-May	18,781	19,132	19,478	19,810	20,137
23-May	17,598	17,855	18,113	18,383	18,648
24-May	17,902	18,166	18,440	18,713	18,985
25-May	20,324	20,678	21,033	21,388	21,730
26-May	22,541	23,123	23,685	24,199	24,698
27-May	20,644	21,144	21,629	22,070	22,503
28-May	18,861	19,209	19,550	19,885	20,217
29-May	18,749	19,076	19,396	19,717	20,035
30-May	18,026	18,326	18,629	18,931	19,230
31-May	19,746	20,115	20,484	20,851	21,207

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Jun	19,419	19,754	20,089	20,427	20,764
2-Jun	19,585	19,932	20,279	20,629	20,977
3-Jun	20,023	20,443	20,852	21,265	21,676
4-Jun	18,815	19,201	19,574	19,953	20,329
5-Jun	17,985	18,301	18,615	18,930	19,242
6-Jun	19,698	20,040	20,384	20,728	21,072
7-Jun	18,793	19,134	19,475	19,817	20,157
8-Jun	19,242	19,595	19,948	20,302	20,655
9-Jun	19,269	19,615	19,960	20,305	20,649
10-Jun	23,387	23,969	24,551	25,159	25,767
11-Jun	23,779	24,378	24,989	25,609	26,243
12-Jun	21,767	22,132	22,485	22,858	23,238
13-Jun	17,297	17,614	17,927	18,238	18,544
14-Jun	17,537	17,839	18,138	18,436	18,731
15-Jun	19,212	19,538	19,865	20,192	20,519
16-Jun	20,970	21,339	21,718	22,102	22,470
17-Jun	23,504	24,115	24,729	25,348	25,978
18-Jun	23,487	24,049	24,621	25,209	25,803
19-Jun	18,221	18,528	18,834	19,140	19,444
20-Jun	18,701	19,057	19,412	19,766	20,119
21-Jun	18,900	19,238	19,576	19,913	20,250
22-Jun	19,350	19,692	20,033	20,373	20,713
23-Jun	21,185	21,564	21,956	22,357	22,744
24-Jun	23,224	23,774	24,296	24,822	25,352
25-Jun	22,817	23,315	23,804	24,307	24,820
26-Jun	20,760	21,155	21,550	21,947	22,345
27-Jun	20,668	21,045	21,423	21,801	22,180
28-Jun	21,540	21,947	22,361	22,783	23,207
29-Jun	21,221	21,613	22,005	22,399	22,793
30-Jun	21,205	21,608	22,020	22,440	22,873

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Jul	21,609	22,055	22,504	22,960	23,417
2-Jul	24,377	25,084	25,767	26,448	27,137
3-Jul	23,000	23,411	23,835	24,262	24,697
4-Jul	23,161	23,652	24,148	24,663	25,186
5-Jul	19,898	20,252	20,605	20,959	21,311
6-Jul	20,044	20,389	20,735	21,081	21,425
7-Jul	21,091	21,464	21,844	22,225	22,605
8-Jul	20,051	20,465	20,866	21,272	21,676
9-Jul	20,355	20,774	21,182	21,595	22,008
10-Jul	22,259	22,762	23,171	23,623	24,119
11-Jul	19,779	20,103	20,444	20,781	21,115
12-Jul	22,163	22,602	23,022	23,451	23,871
13-Jul	20,777	21,142	21,513	21,889	22,267
14-Jul	20,989	21,356	21,725	22,094	22,462
15-Jul	21,067	21,515	21,949	22,390	22,829
16-Jul	22,968	23,474	23,980	24,499	25,021
17-Jul	22,344	22,763	23,195	23,637	24,081
18-Jul	22,430	22,858	23,290	23,732	24,180
19-Jul	21,891	22,308	22,736	23,170	23,609
20-Jul	19,961	20,330	20,698	21,067	21,437
21-Jul	20,156	20,581	21,002	21,425	21,850
22-Jul	22,184	22,709	23,225	23,748	24,271
23-Jul	22,926	23,465	23,995	24,545	25,102
24-Jul	21,436	21,896	22,358	22,829	23,311
25-Jul	19,573	19,974	20,372	20,770	21,168
26-Jul	20,741	21,189	21,636	22,094	22,554
27-Jul	19,754	20,132	20,509	20,886	21,264
28-Jul	19,660	20,010	20,359	20,708	21,056
29-Jul	22,446	22,938	23,434	23,932	24,430
30-Jul	22,210	22,691	23,161	23,639	24,117
31-Jul	20,002	20,368	20,733	21,099	21,464

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Aug	22,243	22,683	23,125	23,579	24,034
2-Aug	22,516	22,959	23,408	23,865	24,331
3-Aug	20,447	20,800	21,154	21,511	21,868
4-Aug	17,790	18,124	18,454	18,785	19,111
5-Aug	19,319	19,721	20,112	20,507	20,901
6-Aug	22,411	22,921	23,446	23,983	24,521
7-Aug	21,307	21,678	22,071	22,467	22,865
8-Aug	22,287	22,715	23,167	23,600	24,061
9-Aug	21,127	21,519	21,911	22,307	22,713
10-Aug	21,215	21,650	22,084	22,521	22,967
11-Aug	19,482	19,866	20,250	20,633	21,016
12-Aug	20,737	21,191	21,634	22,083	22,531
13-Aug	19,116	19,511	19,895	20,284	20,671
14-Aug	17,605	17,930	18,251	18,571	18,888
15-Aug	18,502	18,841	19,178	19,516	19,852
16-Aug	18,820	19,166	19,511	19,858	20,205
17-Aug	20,696	21,061	21,433	21,801	22,163
18-Aug	20,674	21,039	21,407	21,766	22,131
19-Aug	21,802	22,249	22,687	23,129	23,583
20-Aug	20,132	20,573	21,000	21,434	21,862
21-Aug	19,131	19,465	19,798	20,132	20,464
22-Aug	19,189	19,526	19,862	20,199	20,534
23-Aug	19,258	19,597	19,934	20,273	20,610
24-Aug	20,695	21,060	21,424	21,789	22,163
25-Aug	21,001	21,362	21,729	22,101	22,472
26-Aug	21,316	21,767	22,204	22,648	23,092
27-Aug	21,698	22,154	22,614	23,078	23,551
28-Aug	19,299	19,627	19,955	20,283	20,610
29-Aug	20,736	21,104	21,482	21,865	22,208
30-Aug	22,046	22,447	22,935	23,566	24,068
31-Aug	18,669	18,971	19,286	19,592	19,895

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Sep	19,591	19,947	20,300	20,652	21,003
2-Sep	22,001	22,509	23,006	23,511	24,020
3-Sep	22,923	23,459	24,003	24,547	25,095
4-Sep	20,862	21,295	21,716	22,142	22,569
5-Sep	21,112	21,501	21,878	22,279	22,642
6-Sep	21,459	21,850	22,237	22,650	23,065
7-Sep	21,075	21,450	21,835	22,224	22,611
8-Sep	17,988	18,308	18,626	18,943	19,259
9-Sep	18,161	18,536	18,898	19,265	19,631
10-Sep	18,465	18,843	19,209	19,578	19,947
11-Sep	16,886	17,170	17,452	17,736	18,023
12-Sep	16,883	17,160	17,436	17,723	18,012
13-Sep	16,949	17,243	17,543	17,832	18,114
14-Sep	17,748	18,065	18,388	18,713	19,034
15-Sep	18,693	19,019	19,342	19,666	19,984
16-Sep	20,628	21,049	21,460	21,876	22,291
17-Sep	21,480	21,936	22,397	22,883	23,350
18-Sep	20,609	20,964	21,327	21,677	22,035
19-Sep	18,966	19,295	19,623	19,950	20,275
20-Sep	18,463	18,789	19,114	19,439	19,762
21-Sep	17,381	17,684	17,986	18,287	18,586
22-Sep	17,638	17,942	18,245	18,546	18,845
23-Sep	18,145	18,515	18,872	19,234	19,594
24-Sep	20,420	20,840	21,250	21,665	22,080
25-Sep	18,383	18,699	19,012	19,324	19,635
26-Sep	18,410	18,727	19,042	19,355	19,667
27-Sep	18,965	19,296	19,624	19,952	20,280
28-Sep	19,126	19,456	19,784	20,113	20,440
29-Sep	18,593	18,911	19,228	19,545	19,862
30-Sep	21,836	22,301	22,785	23,266	23,746

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Oct	19,505	19,859	20,202	20,550	20,896
2-Oct	21,930	22,477	23,006	23,509	23,998
3-Oct	22,107	22,650	23,183	23,690	24,188
4-Oct	18,651	19,050	19,434	19,812	20,179
5-Oct	19,791	20,157	20,495	20,816	21,140
6-Oct	21,003	21,457	21,922	22,373	22,790
7-Oct	21,724	22,247	22,771	23,240	23,713
8-Oct	21,732	22,219	22,693	23,178	23,682
9-Oct	19,805	20,188	20,554	20,921	21,289
10-Oct	19,106	19,514	19,884	20,243	20,596
11-Oct	16,934	17,216	17,499	17,780	18,061
12-Oct	18,758	19,088	19,417	19,747	20,077
13-Oct	19,149	19,488	19,827	20,164	20,488
14-Oct	18,801	19,178	19,545	19,918	20,286
15-Oct	23,444	24,027	24,579	25,110	25,640
16-Oct	24,007	24,707	25,384	26,020	26,623
17-Oct	27,846	27,968	28,097	28,160	28,229
18-Oct	27,756	28,271	28,686	29,047	29,365
19-Oct	25,358	25,747	26,095	26,428	26,711
20-Oct	21,094	21,557	22,003	22,429	22,855
21-Oct	20,909	21,413	21,887	22,335	22,771
22-Oct	21,226	21,705	22,167	22,629	23,074
23-Oct	20,406	20,844	21,250	21,649	22,033
24-Oct	20,624	21,056	21,490	21,899	22,287
25-Oct	19,062	19,492	19,909	20,316	20,704
26-Oct	21,484	21,925	22,349	22,738	23,128
27-Oct	23,568	24,169	24,742	25,296	25,823
28-Oct	23,161	23,792	24,410	25,001	25,587
29-Oct	27,147	27,889	28,611	29,335	30,185
30-Oct	28,064	28,388	28,740	29,142	29,441
31-Oct	24,262	24,615	25,128	25,558	25,903

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Nov	20,342	20,766	21,165	21,560	21,949
2-Nov	20,977	21,421	21,835	22,233	22,613
3-Nov	21,634	22,124	22,599	23,022	23,430
4-Nov	22,159	22,696	23,207	23,705	24,184
5-Nov	23,420	24,047	24,642	25,202	25,728
6-Nov	21,632	22,107	22,553	22,975	23,373
7-Nov	22,905	23,468	24,032	24,566	25,065
8-Nov	23,741	24,362	24,942	25,520	26,046
9-Nov	24,561	24,848	25,426	25,990	26,519
10-Nov	23,839	24,279	24,636	25,174	25,676
11-Nov	23,952	24,620	25,273	25,886	26,460
12-Nov	23,256	23,902	24,509	25,091	25,658
13-Nov	23,197	23,751	24,292	24,780	25,251
14-Nov	22,461	23,017	23,584	24,110	24,598
15-Nov	29,979	29,805	29,632	29,444	29,501
16-Nov	32,382	32,256	32,504	32,784	33,059
17-Nov	30,933	31,146	31,245	31,310	31,608
18-Nov	31,181	31,725	32,283	32,876	33,510
19-Nov	26,372	26,915	27,632	28,387	28,990
20-Nov	22,943	23,404	23,926	24,404	24,851
21-Nov	22,329	22,846	23,341	23,812	24,281
22-Nov	24,167	24,772	25,359	25,937	26,478
23-Nov	27,481	27,917	28,434	29,064	29,936
24-Nov	27,977	28,309	28,703	29,175	29,330
25-Nov	31,585	31,990	32,360	32,722	33,194
26-Nov	35,889	36,301	36,646	36,948	37,218
27-Nov	35,417	35,295	35,244	34,878	35,101
28-Nov	32,264	32,514	32,788	33,037	33,120
29-Nov	32,792	32,943	33,122	33,269	33,276
30-Nov	30,950	31,257	31,535	31,778	32,019

	Occupancy Values				
	80%	85%	90%	95%	100%
1-Dec	29,709	29,847	30,084	30,348	30,701
2-Dec	26,167	26,713	27,257	27,843	28,549
3-Dec	26,126	27,189	28,242	29,112	29,861
4-Dec	27,441	27,684	27,746	28,021	28,279
5-Dec	22,550	22,935	23,303	23,644	24,003
6-Dec	21,439	21,891	22,327	22,737	23,096
7-Dec	22,068	22,542	23,019	23,449	23,847
8-Dec	22,750	23,264	23,775	24,254	24,644
9-Dec	23,759	24,473	25,156	25,815	26,410
10-Dec	22,302	22,939	23,517	24,091	24,643
11-Dec	22,460	22,966	23,461	23,932	24,359
12-Dec	25,369	25,587	26,150	26,833	27,487
13-Dec	26,158	26,577	26,666	26,648	26,858
14-Dec	29,290	29,397	29,482	29,740	29,861
15-Dec	29,595	29,969	30,275	30,552	30,818
16-Dec	29,813	30,390	30,946	31,476	32,096
17-Dec	34,427	34,823	35,253	35,760	36,185
18-Dec	31,811	31,869	31,785	32,110	32,425
19-Dec	26,058	26,432	26,758	27,064	27,370
20-Dec	21,697	22,114	22,531	22,940	23,353
21-Dec	24,920	25,321	25,720	26,074	26,495
22-Dec	36,110	35,897	35,937	36,068	36,247
23-Dec	39,624	39,823	40,012	40,138	40,289
24-Dec	37,231	37,576	37,961	38,329	38,642
25-Dec	32,568	33,045	33,538	34,013	34,476
26-Dec	36,501	36,502	36,500	36,507	36,341
27-Dec	36,674	36,734	36,797	36,849	36,902
28-Dec	36,884	37,009	37,142	37,297	37,478
29-Dec	35,112	35,277	35,501	35,687	35,839
30-Dec	26,733	27,269	27,922	28,542	29,140
31-Dec	33,199	33,526	33,814	34,090	34,410

Total:	8,717,723	8,864,336	9,008,746	9,154,196	9,298,602
EUI	57.1	58.1	59.0	60.0	60.9

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