ROCKY MOUNTAIN POWER
A DIVISION OF PACIFICORP

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June 26, 2014

VIA ELECTRONIC FILING
AND OVERNIGHT DELIVERY

Utah Public Service Commission
Heber M. Wells Building, 4th Floor
160 East 300 South
Salt Lake City, Utah 84114

Attn: Gary Widerburg
Commission Secretary

RE: Docket No. 13-035-184
Cost of Service Rebuttal Testimony & Exhibits

Rocky Mountain Power hereby submits for filing an original and twelve copies of its Rebuttal Testimony and Exhibits in the Cost of Service phase in Docket No. 13-035-184. The Company will also provide an electronic version of this filing, which includes copies of the testimony, exhibits, and workpapers in the file formats in which they were created, to psc@utah.gov. Exhibits provided in pdf format were provided from a published report, document or authored outside the company.

It is respectfully requested that all formal correspondence and requests for additional information regarding this filing be addressed to the following:

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Sincerely,

Jeffrey K. Larsen
Vice President, Regulation and Government Affairs

Enclosures

cc: Service List

CERTIFICATE OF SERVICE

I hereby certify that on this 26th day of June, 2014, a true copy of the foregoing document was sent via Email to the following:

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Rocky Mountain Power
Docket No. 13-035-184
Witness: A. Richard Walje

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF UTAH

ROCKY MOUNTAIN POWER

Rebuttal Testimony of A. Richard Walje

June 2014

Q. Are you the same A. Richard Walje who submitted direct and rebuttal testimony in the revenue requirement portion of this proceeding on behalf of PacifiCorp dba Rocky Mountain Power ("the Company")?

A. Yes.

Q. What is the purpose of your rebuttal testimony?

A. My rebuttal testimony introduces the Company rebuttal witnesses that support the Company's revised request to recover $4.65 monthly through a facilities charge from residential customers using the net metering rate with their photovoltaic ("PV") distributed generation.

Q. What areas will be covered by Company witnesses?

A. Ms. Joelle R. Steward will present information supporting the $4.65 per month facilities charge to recover some of the costs net metering customers no longer pay for their use of the local distribution network and customer services. Mr. Douglas Marx will describe the impacts that distributed PV generation has on the distribution network and that the contribution from PV generation to meet the Company's daily summer peak load serving requirement is negligible. Finally, Mr. Gregory N. Duvall will show that the value of net metering PV solar energy should not be valued higher than the value given to Public Utility Regulatory Policies Act ("PURPA") qualifying facility solar projects under the approved avoided cost methodology in place in Utah.

Q. **Why has the requested amount of the net metering facility charge changed?**

A. The amount increased from the $4.25 in the Company's initial filing due to the lower residential customer charge of $6.00 agreed to by parties in the settlement, which is $2.00 less than the customer charge the Company recommended in its direct case. This is consistent with the direct testimony of Ms. Steward in which she indicated this amount would increase if the residential customer charge decreased.

Q. Will the Company collect additional revenues from the $4.65 per month net metering facility charge, and therefore make a larger profit?

A. No. As explained in Ms. Steward's testimony the charge is revenue neutral to the Company. The charge is also revenue neutral within the residential class. Therefore the Company does not additionally profit from the charge.

Q. **Why is a net metering facility charge necessary?**

A. As presented by Ms. Steward, the charge is meant to recover some of the distribution system and customer service costs that do not go away when a customer installs distributed generation. Because of how the current net metering tariff works, net metering customers pay less for their use of the distribution system and customer services than they did before they installed distributed generation. In essence, that portion of those distribution system and customer service costs that are not paid for by net metering customers still exist for the Company and are therefore recovered from non-net metering residential customers.

Q. Are there other methods to establish a facilities charge or a different net metering tariff that would be better than the one currently used in Utah?

A. Yes, Ms. Steward's testimony describes an alternative way to determine a facilities charge based on the capacity of the PV solar installation. She also describes how a rate structure with three parts is a better design for residential partial requirements customers with distributed generation.

Q. Some parties in this rate case have presented information supporting a "value of solar" above the costs and benefits typically considered in a general rate case. How do you respond?

A. Mr. Duvall's testimony shows that the range of credits net metering customers receive for their PV generation is well above the value of PV solar determined in the Qualifying Facilities docket. And that this value is applicable to distributed solar generation provided by net metering customers.

Q. Some say because of the minimal number of Utah customers currently taking advantage of net metering rates and the number of issues described in the net metering testimony filed by all parties, the Commission should not grant the Company's request for a facilities charge and should address the request in a future docket. How do you respond?

A. I believe the Company's witnesses have made an irrefutable case that net metering rates, as currently structured, do not adequately recover costs from net metering customers for their use of the distribution network and customers services compared to what other residential customers pay. There are no compelling reasons not to address this specific situation now.

Net metering has become a particular concern in the western United States where, based on Solar Electric Power Association data, approximately 70 percent of the rooftop systems in the United States are located. The passionate debates on these issues affect tens of thousands of net metering customers. The Company wants to arrive at solutions before the issues reach the magnitude of those being experienced in other areas.

Q. Because of the Company's position in this case, it is being accused of being anti-renewable energy, anti-solar, and anti-net metering. How do you respond?

A. I disagree with these contentions for the following reasons. We have the second largest portfolio of owned wind generation by a rate regulated utility in the country. We developed one of the first geothermal plants outside of California. Our Blue Sky tariff is one of the oldest and best, as recognized by federal agencies, for its support of renewable energy and has funded over 100 community renewable energy projects. Over 30,000 Utah customers voluntarily participate in Blue Sky. We recently announced a plan to build a solar project that would be available to all customers through the Blue Sky program. Our holding company is developing several of the largest photovoltaic projects in the world and we will be delighted to introduce that expertise into Utah when it is economically feasible. As far as net metering goes, we want a rate structure that will assure that those using the system pay a fair amount for that use and that we have adequate understanding of the impacts on the distribution system, and funding, to assure we can effectively connect more distributed generation to the grid.

Q. Please summarize the Company's testimony regarding net metering.

A. The Company's proposed net metering facilities charge is meant to assure that all customers equitably pay for their use of the distribution system and for customer services. Ms. Steward's testimony shows that a $4.65 monthly net metering facilities charge is a fair amount and near the amount net metering customers previously paid for using the distribution system before they installed their generation. Though many other issues and approaches to determining distributed generation costs and benefits can continue to be debated, the Company believes implementing this facilities charge now is a good first step in that process.

Q. Does this conclude your rebuttal testimony?

A. Yes.

Rocky Mountain Power
Docket No. 13-035-184
Witness: Joelle R. Steward

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF UTAH

ROCKY MOUNTAIN POWER

Rebuttal Testimony of Joelle R. Steward

June 2014

Q. Are you the same Joelle R. Steward who submitted direct testimony in this proceeding on behalf of PacifiCorp dba Rocky Mountain Power ("the Company")?

A. Yes.

Purpose and Summary of Rebuttal Testimony

Q. What is the purpose of your rebuttal testimony?

A. My rebuttal testimony responds to the direct testimonies of parties responding to the Company's proposal to implement a net metering facilities charge. Specifically, I respond to testimony on this issue submitted by Mr. Daniel E. Gimble for the Office of Consumer Services ("OCS"), Mr. Artie Powell and Mr. Stan Faryniarz for the Division of Public Utilities ("DPU"), Mr. Nathanael Miksis for The Alliance for Solar Choice ("TASC"), Mr. Rick Gilliam and Ms. Sarah Wright for Utah Clean Energy ("UCE"), Mr. Dustin Mulvaney for the Sierra Club, and Mr. Michael D. Rossetti for Utah Citizens Advocating Renewable Energy ("UCARE"). Both the DPU and the OCS support implementation of a new charge for net metering customers at this time based on the principles of cost causation. TASC, UCE, the Sierra Club, and UCARE all oppose the implementation of a separate charge for net metering customers.

Q. Has the Company modified its proposal for the net metering facilities charge in this rebuttal filing?

A. Yes, the Company has modified the proposed net metering facilities charge to reflect the updated revenue requirement and residential customer charge agreed to by parties in this proceeding. With these changes, the Company's proposed facilities charge is now $4.65 per month. Page one of Exhibit RMP___(JRS-1R) shows this calculation. Alternatively, the Company is agreeable to the facilities charge proposal from OCS that recovers the costs through a $ per installed kilowatt ("kW") rather than a flat monthly charge.

Proposed Net Metering Facilities Charge

Q. Please explain why the proposed net metering facilities charge changed from $4.25 to $4.65 per month.

A. As I noted in my direct testimony, the calculation for the facilities charge takes into account the level of the residential customer charge; the $4.25 proposed in my direct testimony was based on a customer charge of $8.00. Since the customer charge agreed to in the stipulation in this case ("Stipulation") is less than the $8.00 per month reflected in my direct testimony, the proposed Net Metering Facilities Charge increases in order to recover the fixed costs not in the customer charge and will not be recovered through net metering customers' energy usage. The Company also took into account the reduced revenue requirement increase by proportioning downward the distribution and customer service costs in the calculation. The result is that an average of $4.65 per month for distribution and customer service related costs will not be recovered through rates from average net metering customers. This amount continues to reflect only a portion of the fixed costs, with the remaining fixed costs recovered through the energy rates.

Q. Please explain OCS's proposal for a facilities charge based on a $ per installed kW.

A. While the OCS states that it generally supports the proposed facilities charge, Mr. Gimble recommends implementing the charge on a $ per kW basis so that the monthly amount paid by individual net metering customers would reflect the rated production capability of each facility.[1] The $ per kW charge is calculated by taking the same fixed cost revenue deficiency identified for net metering customers as in the Company's calculation (after taking into account the proposed customer charge) and dividing it by the kW of installed customer generation for participants in the net metering program.

Q. Does the Company agree that this is a reasonable alternative for recovering fixed costs from net metering customers?

A. Yes, at this time the Company is not opposed to the adoption of this alternative rate design. Based on the updated revenue requirement, this alternative results in a charge of $1.55 per installed kW, or approximately $4.96 per month for a customer with the average installation size of 3.2 kW. Page two of Exhibit RMP___(JRS-1R) shows the calculation for the alternative.

Q. Is the proposed net metering charge revenue neutral for the Company?

A. Yes. The revenue from the charge is reflected in the overall allocation to the residential class agreed to by the parties in the Stipulation. In the absence of the charge, the target revenue from that charge must be recovered through higher energy rates from all residential customers, not just NEM customers, in order to achieve the allocated revenue target for the residential class.

[1] Mr. Daniel Gimble COS/RD Direct, ll. 661-663.

Response to Opposing Parties

Q. UCE, Sierra Club, TASC, and UCARE argue that the Commission should not adopt a charge for net metering customers because the Company did not present a cost benefit analysis for net metering, as required by Senate Bill 208. Do you agree?

A. No. First, the Company's filing shows through the rebuttal testimony of Mr. Gregory N. Duvall that the value of solar generation is approximately three cents per kilowatt-hour ("kWh"), based on the avoided cost valuation methodology already adopted by the Commission for solar resources. This is considerably less than the retail energy rates that range from 8.8 cents and 14.4 cents per kWh that net metering customers avoid by offsetting usage with distributed generation and are credited with for excess generation.

Second, the Company's proposal is limited to recovering costs for only distribution and customer service costs. These are costs that are incurred for facilities and services necessary for the provision of service to all customers today, including net metering customers. However, as I explained in my direct testimony, as a result of the residential rate structure, which was developed for full requirements service and places a significant portion of these costs in the volumetric energy charges, these costs will not be fairly recovered from net metering customers who rely on the Company for partial requirements service. As a result, absent the charge, these distribution and customer service costs will be shifted to other residential customers through higher energy rates. The Company's proposal is intended to minimize this cost shifting, regardless of the introduction and passage of Senate Bill 208.

Q. Please explain why the distribution and customer service costs should be reflected in a fixed charge to net metering customers.

A. These are not costs that go away with the existence of or growth in customer generation; however, as a result of the rate structure, customers will no longer adequately pay for these costs when they install distributed generation. These are costs for distribution infrastructure and services that are currently used and useful and known and measurable, serving all customers today including net metering customers. The rebuttal testimony of Mr. Douglas L. Marx addresses how solar distributed generation does not offset the costs and needs of the distribution system for net metering customers.

This was also recognized by both the DPU and OCS in direct testimony. Mr. Gimble states: "the Office does not believe that evidence can be produced to show that the residential NM output provides enough value to offset distribution costs."[2] Mr. Powell states:

> The Division views the net metering charge as a cost causation issue. The principle of cost causation indicates that those customers causing the costs, in this case all customers using the infrastructure, should pay for those costs. Net metering customers, while decreasing their energy consumption taken from the Company, still utilize the infrastructure put in place to deliver energy when needed.[3]

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[2] *Id.*, at ll. 621-623.
[3] Powell COS/RD Direct, ll. 182-187.

Customer service expenses likewise are not diminished with the existence of customer generation or changes in usage. Net metering customers as much as any other residential customer receive customer service support such as billing, metering, answering and responding to customer phone calls, providing customers with online access to their accounts, customer and community communications and outreach, payment processing, providing pay stations, and handling collections; individual usage levels or usage patterns in no way impact the occurrence of these costs, and therefore, should be reflected in a rate structure that fairly captures these costs for all customers.

Notably, the proposed net metering charge does not recover *all* distribution and customer service costs through a fixed charge. The calculation, shown in Exhibit RMP___ (JRS-1R), continues to reflect that 75 percent of these costs not included in the customer charge are recovered through the customer's net billed energy consumption charges. The net metering facilities charge, in conjunction with the customer charge, merely recognizes a minimum level of contribution for the facilities and services available that are not being fully recovered through the current rate structure.

Q. UCE argues that because the current number of net metering customers is very low and significant growth is not projected by the Company, urgent action by the Commission is not warranted at this time.[4] Do you agree?

A. No. The Company believes that now, while the number of impacted customers is small, is precisely the time to ensure rates are consistent with cost causation in order to minimize any further cost shifting as the number of customer generators

[4] Gilliam, COS/RD Direct, ll.105-109; Wright COS/RD Direct, ll. 559-565.

grows and before more customers undertake long-term commitments. As Mr. Gimble noted in his direct testimony:

> [I]t is important for the Commission to send a clear policy signal in this proceeding on the NM facilities charge so that potential NM customers can make an informed economic decision when evaluating whether or not to invest in a solar PV system. Delaying a decision on the NM facilities charge would create uncertainty for prospective NM customers while leaving the current cost shift issue unresolved.[5]

Additionally, it's not clear what constitutes significant growth to UCE that would warrant action. As noted in my direct testimony, the number of customers installing facilities and participating in net metering has grown by over 30 percent annually. In just the five months since my direct testimony was prepared, the total number of net metering customers has grown by a nearly additional 20 percent. Nearly 90 percent of net metering customers are residential. Given the climate and solar potential in Utah, this growth is expected to continue.

Q. UCE, TASC, and UCARE argue that the net metering facilities charge is unfairly targeting net metering customers.[6] Do you agree?

A. No. Net metering customers are a distinctly different type of customer than customers that rely on the Company for all electricity needs, or full requirements service. The graphs below show a typical load profile on the summer distribution peak day (Diagram A) and the winter distribution peak day (Diagram B) for (1) an average residential customer without distributed generation facilities and (2)

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[5] Gimble COS/RD Direct, ll. 724-729.
[6] Gilliam COS/RD Direct, ll. 399-413; Miksis COS/RD Direct, 27:5-28:9; Rossetti COS/RD Direct, ll. 164.

the load profile for residential customer with a rooftop solar facility, based on a generation profile from National Renewable Energy Labs ("NREL") PVWatts calculator for a 3.2 kW facility in Salt Lake City.

Diagram A

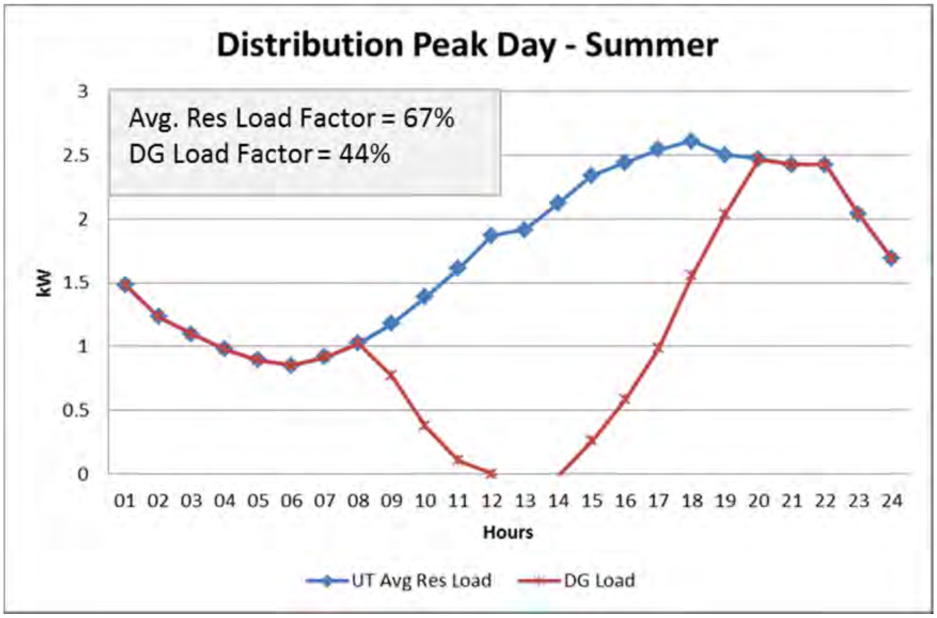
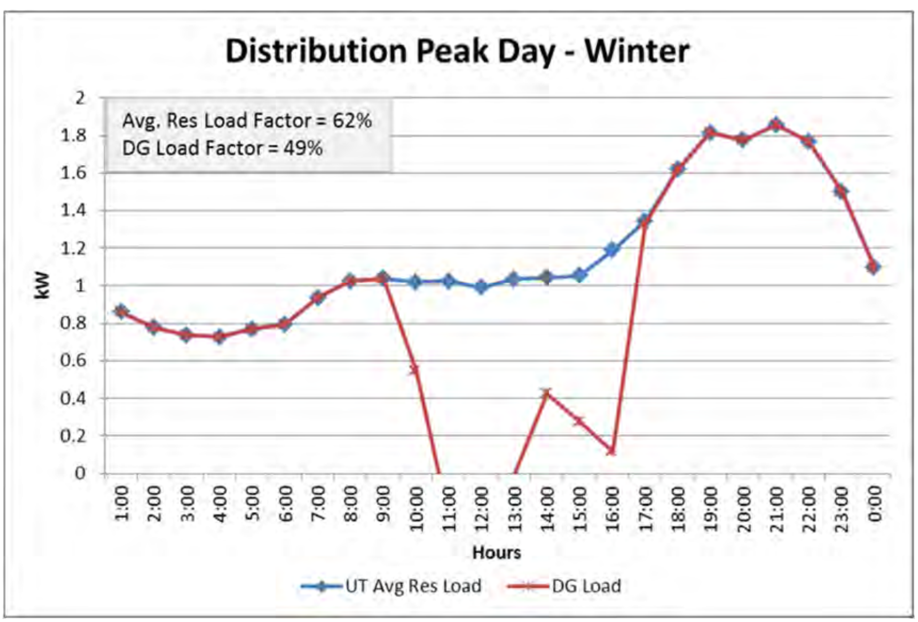


Diagram B



Historically, rates for residential customers have been designed on the premise that the customers had no other viable choice when buying and using electricity but to pay regulated rates. This allowed the energy component of two-component, full requirements service rates to be loaded with fixed costs not reflecting more complex cost causation. The residential rate was developed for a customer that receives full requirements service for energy from the grid and delivers no energy back to the grid.

Moreover, since the load characteristics of the majority of residential customers were very similar, rates have been developed for the average residential customer with an average load factor (frequency and stability of usage), an average load curve (usage pattern), and average billing determinants. But when the net metering customer’s generator operates, the customer has a markedly different load curve and load factor than the average residential customer for whom the residential rate was designed; however, as shown in the graphs above, the customer peak usage remains relatively unchanged. Accordingly, residential net metering, or partial requirements, customers are not *similarly situated* to other residential customers, as UCE contends.[7]

As I explained in my direct testimony for cost of service, distribution system costs are incurred and allocated to customer classes based on customers' contribution to either the distribution system peak (substations and primary lines), the non-coincidental peak (line transformers and secondary lines) or by the number of customers (service lines and meters). Customer service costs are driven by the number of customers and are generally allocated to customer classes

[7] Gilliam, COS/RD Direct, ll. 412.

using weighted customer factors. This means that distribution and customer service costs are allocated to the residential class on maximum or peak usage and number of customers. As Diagrams A and B show, solar distributed generation does not reduce the contribution to the distribution peaks. However, in the current residential rate structure a significant portion of these costs are recovered through energy rates. As a result, the reduction in billed consumption for net metering customers does not fully recover the costs that their usage imposes on the distribution system so other residential customers pay those costs. Furthermore, since net metering customers are credited for excess production at the rate block the customer is able to avoid paying as a consequence of that production, their billed consumption is even lower than what they have actually taken from the grid. For non-residential customers with onsite generation rates include demand charges and/or backup facilities charges that better capture the costs of serving these customers.

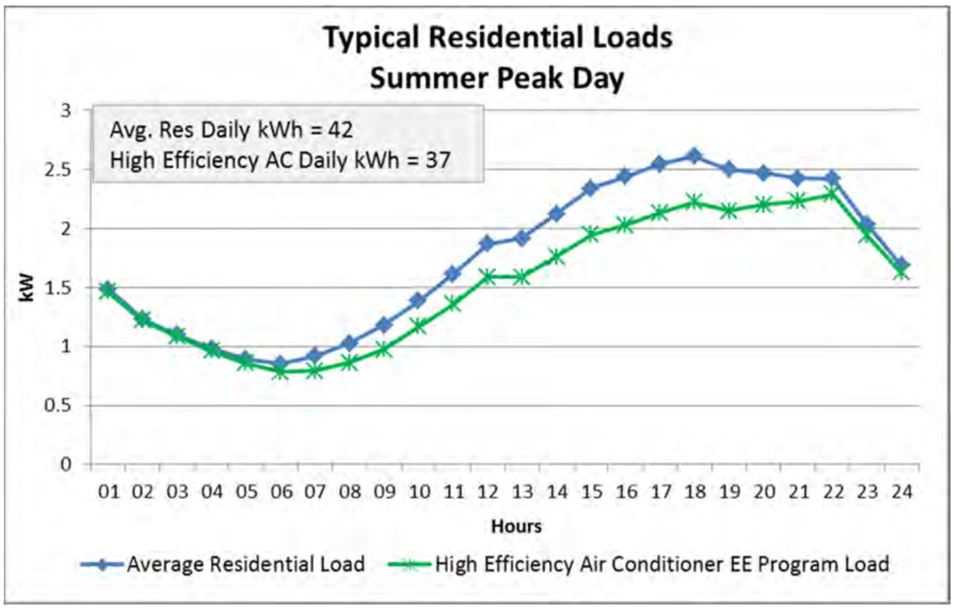
Q. Is the reduction in usage by customers with distributed generation similar to other customer behaviors such as those who adopt energy efficiency, as asserted by TASC and UCARE?[8]

A. No. Net metering customers are not equivalent to the average residential customer who reduces consumption through energy efficiency or reduces peak usage through demand response programs. A net metering customer's avoidance of a kWh *purchase* from the grid is not the same as a residential customer's permanent avoidance of a kWh of *consumption* via energy efficiency or demand-side management. When a residential customer adopts energy efficient appliances or

[8] Miksis COS/RD Direct, 15:9–19; Rossetti COS/RD Direct, ll. 280-298.

behaviors, both energy consumption and energy purchases from the grid are reduced. They also reduce energy consumption at the time of the system peak, improving load shape and load factor and ultimately the class and system load factor. Diagram C below shows an average profile for a residential customer compared to a customer that installs a high efficiency air conditioner. This shows that in addition to overall lower usage, the customer's usage at the peak is reduced.

Diagram C



In contrast, when a customer adds distributed generation, energy purchases by the customer from the grid are reduced but that customer's total energy consumption may remain unchanged. So if there are any interferences with the output of a customer's generation facility, such as cloud cover or an outage, then the Company must stand ready to serve the customer.

Similarly, most residential demand-side measures result in the customer reducing energy consumption at the time of the system peak, improving load shape and load factor and ultimately the class and system load factor. In contrast, when a customer adds distributed generation, the customer's peak energy production may not be coincident with the peak usage of the grid.

Q. How do you respond to UCE's argument that the cost shifting the Company claims applies to any customer with lower than average consumption?[9]

A. The Company has raised concerns about intra-class cross-subsidization between high use customers and low use customers as a result of the low monthly customer charge in every rate case for several years. In the current case the Company again raised this argument in support of the proposed customer charge of $8.00 per month. While the issue is similar, low usage full requirements customers are distinct from net metering or partial requirements customers in that their load shape and load factor are more consistent with the residential class, for which rates are designed. Also, with net metering customers the cost shifting is exacerbated by the fact that the full retail energy rate is applied to the excess generation that is sold back to the Company, thus shifting additional costs to other customers because of the fixed cost recovery that is embedded in the full retail energy.

[9] Gilliam COS/RD Direct, ll. 552-553.

Q. UCE witness Sarah Wright recognizes a constraint in the current residential rate structure and states: "in order to make cost recovery for 'fixed' costs equitable, non-customer charge fees should be based on consumption *and demand* to better reflect contributions to peak and cost causation."[10] (emphasis added). She notes that non-residential customers pay a demand fee and recommends that the Commission investigate practicable options for residential rate design.[11] Do you agree with these statements?

A. I generally agree with her statements, particularly in regards to a potential approach for rates that better facilitate cost recovery with cost causation for the relatively new but growing sub-class of residential customers that rely on the Company for partial requirements service. The Company is exploring the development of a new rate schedule class for these customers by deploying a load research study to gather specific time-based data that will allow the development of allocation factors and billing determinants for residential customers with distributed generation. As Ms. Wright notes, residential customers are not currently equipped with meters that allow the Company to measure customers' peak kW demand. The load research study will allow us to measure these customers' usage at the time of the system coincident peaks, which is the driver for allocations of transmission and generation costs.

Since the current number of customers in this sub-class is still relatively small, the Company could install meters capable of measuring demand and develop a three-part rate structure with customer, demand, and energy charges,

[10] Wright COS/RD Direct, ll. 254-256.
[11] *Id*., at ll. 263-264.

similar to rate structures for non-residential customers. The three-part rate structure would better reflect cost recovery with cost causation by having: 1) costs necessary for the provision of service to all customers (i.e., customer service and distribution facilities) recovered through monthly fixed charges; 2) costs driven by system peak demand recovered through kW charges; and 3) costs driven by overall energy consumption recovered through kWh charges. Three-part rates better capture variations between customer load shapes and load factors, which is why they are more readily used for non-residential customer classes, which display a considerably wider range of usage patterns and load factors by individual customers than the residential class. With net metering customers being a new type of partial requirements customer, with significantly different load pattern and load factor than the typical residential customer for which the current two-part rates are designed, a three-part rate is a better rate design. Additionally, a separate rate structure for this sub-class could reflect time of use differentiation in rates that will provide more accurate price signals than the current tier block rate structures and provide better incentives to customers with distributed generation to maximize the benefits to the grid and the customers it serves.

Q. Should the Commission wait and see the outcome of the load study the Company has initiated before adopting a net metering facilities charge in this proceeding?

A. No. There is sufficient evidence presented in this case that shows that the negligible benefits, if any, do not offset the costs incurred for the distribution system and customer services to support the proposed net metering facilities charge at this time. Moreover, a sizable portion of these costs are still being recovered through energy charges even after implementation of the net metering facilities charge. While the new study will help refine future rates for a potential new class of residential customers requiring partial requirements service, adopting the proposed net metering facilities charge now will help transition net metering customers to new rates and rate designs. In fact, the alternative structure proposed by OCS for a $ per installed kW may help residential customers become familiar with a kW demand-based charge.

Q. How do you respond to UCE's argument that the net metering facilities charge does not distinguish between exported energy and solar energy consumed onsite[12] and that the application is inconsistent with the rationale[13]?

A. The premise for these arguments—that the Company's rationale for the net metering facilities charge is based on the time during which solar generation exceeds consumption—is incorrect. The rationale for the charge is that the residential rate structure recovers a significant portion of fixed costs through energy rates and therefore does not adequately reflect cost causation.[14] See my discussion above for how cost causation for distribution and customer service costs is inconsistent with the residential rate structure.

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[12] Gilliam, COS/RD Direct, ll. 231-285.
[13] *Id.*, at ll. 384-396.
[14] Steward Direct, ll. 493-495.

Q. Do you agree with the Sierra Club that the proposed net metering facilities charge will impact energy usage or decisions to make energy efficiency investments?[15]

A. No. A significant portion of the customer's bill will still be based on volumetric energy rates. As previously noted, the proposed charge recovers only a portion of the distribution and customer service costs with the remaining costs in the energy rates, along with *all* of the costs related to generation and transmission. Accordingly, a significant incentive remains with the current residential rates to encourage and reward energy efficiency.

Additionally, the combined monthly fixed charge of $10.65 with the customer charge and the facilities charge is still less than other utilities, including the neighboring Dixie Escalante, which has $14.00 monthly residential customer charge plus a $30.00 per month charge for net metering customers.

Q. OCS recommends that the Company develop stronger messaging to provide current and potential future residential net metering customers on the Commission's net metering policy and how rates for net metering customers may change over time.[16] Do you agree with this recommendation?

A. Yes. Following a Commission decision in this proceeding, the Company is willing to work with parties to craft appropriate messaging for current and potential net metering customers on the potential for rate changes over time.

[15] Mulvaney, COS/RD Direct, 34:9-19.
[16] Gimble, COS/RD Direct, ll. 764-783.

Q. While DPU supports the net metering facilities charge and it calculates the charge to be $4.81 based on its proposed $5.00 customer charge, DPU recommends that the charge not be higher than $4.25 per month at this time based on the principle of gradualism.[17] Do you agree?

A. No. Since DPU appears to agree that the charge reflects cost causation, it is inconsistent to hold back $0.40 in the name of gradualism. Based on the rationale discussed in my testimony and that of the other Company witness, the Company recommends that the Commission implement the $4.65 charge in this proceeding.

Q. UCARE argues that there is a considerable financial benefit realized by the Company as a result of the excess generation being used to serve a net metering customer's neighbor and through the expiration of the excess credits at the end of the net metering program year.[18] Do you agree?

A. No. This argument overlooks the fact that the cost to those neighboring customers for that non-dispatchable energy is between 8.8 cents to 14.4 cents per kWh which, as I previously noted, is considerably higher than the Company's avoided cost of energy. Since that rate includes fixed costs, that neighbor essentially ends up paying for the fixed costs required to serve the net metering customer that the net metering customer does not pay by virtue of the rate structure. UCARE also acknowledges and identifies this cost shift, which it characterizes as "straining at gnats."[19]

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[17] Faryniarz, COS/RD Direct, ll. 323-374.
[18] Rossetti, COS/RD Direct, ll. 77-91.
[19] *Id.*, at ll. 198-207.

Regarding the expiration of the excess credits at the end of the net metering program year, as UCARE points out, Senate Bill 208 provides that these excess credits will be valued at avoided cost and granted to the Company's low income assistance program, or other use as directed by the Commission. As a result, there will be no financial benefit to the Company in the test period from any expiring credits. It is also interesting to note that the legislature has valued the credits at avoided cost, which is the same valuation discussed in Mr. Gregory N. Duvall's rebuttal testimony.

Q. Have you identified other errors in UCARE's analysis and assertions?

A. Yes. On page nine, UCARE claims a reduction of emissions based on his claim that "residential NEM customers produced 13,012,995 kWh of excess electricity for the reporting period."[20] However, this figure that it characterizes as excess electricity, which appears in Exhibit RMP___(JRS-8), is not excess electricity produced by net metering customers; instead, 13,012,995 kWh is the annual net billed *usage* by net metering customers.

Q. Do you have other comments on the direct testimony of UCARE?

A. Possibly. However, the Company was not served a copy of UCARE's direct testimony at the time it was filed, May 22, 2014. The Company did not become aware of UCARE's testimony until June 24, 2014. Accordingly, the Company has not had an opportunity to thoroughly review the testimony, has not received any workpapers, and has not been able to issue any data requests prior to filing this rebuttal testimony. Therefore, the Company reserves the right to provide any additional rebuttal to UCARE's direct testimony with the surrebuttal filing.

[20] *Id.*, at ll. 167-168.

Q. Please summarize your recommendation.

A. The Company's proposed net metering facilities charge, which has been revised to $4.65 per month, or alternatively, $1.55 per installed kW, is necessary in order to better reflect the costs of serving net metering customers and to minimize cost shifting. The proposed charge recovers costs related to the distribution system and customer services that net metering customers require for service but are not fairly captured through the current residential rate structure. As such, the proposed charge is an improvement in the balance between cost recovery and cost causation. Future steps towards further improving this balance may include the development of three-part rates for residential customers, but until that time, the current proposed charge is a reasonable and cost based solution.

Q. Does this conclude your rebuttal testimony?

A. Yes, it does.

Rocky Mountain Power
Exhibit RMP___(JRS-1R)
Docket No. 13-035-184
Witness: Joelle R. Steward

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF UTAH

ROCKY MOUNTAIN POWER

Exhibit Accompanying Rebuttal Testimony of Joelle R. Steward

Net Metering Facilities Charge

June 2014

Rocky Mountain Power - State of Utah
Calculation of Net Metering Facilities Charge

		Residential	
Line	**Classified Rev Req**	**COS**	**Cost/ Customers**
1	Distribution - Substation	$35,093,157	$3.95
2	Distribution - Meter	$7,787,112	$0.88
3	Distribution - Service	$22,529,139	$2.53
4	Retail Total	$30,221,466	$3.40
5	Distribution - P&C	$84,726,925	$9.53
6	Distribution - Transformer	$34,603,508	$3.89
7	Total Distribution/Retail Costs	$214,961,307	$24.19
8	Proposed Customer Charge	$52,813,074	$6.00
9	Total Dist./Retail Fixed Cost not recovered in Customer Charge	$162,148,233	$18.19
10	Total kWh	6,203,851,850	
11	Net Metering kWh	13,012,995	
12	Total Bills	8,887,629	
13	Forecasted Net Metering Bills	25,117	
14	Average $/kWh for remaining Dist./Retail costs	0.026137	
15	Net Metering Dist/Retail Costs	$340,117	$13.54
16	**Net Metering Facilities Charge**		**$4.65**
17	Original Proposed COS (Filed)	$1,924,076,079	
18	Settlement COS	1,882,823,978	
19	COS Reduction Ratio	97.86%	

Formula Notes

Line 7	1+2+3+4+5+6
Line 9	7-8
Line 14	9/10
Line 15	14x11 or 15/13
Line 16	9-15
Line 17	18/17

Rocky Mountain Power - State of Utah
Estimated Resdential Net Metering Facilities Charge

Proposed Net Metering Facilities Charge		Estimated Net Metering Facilities Charge	
Price ($/month)	Revenue	NM Generation kW (as of 12/31/2013)	Price ($/kW)
$4.65	$116,794	6,294	$1.55

Rocky Mountain Power
Docket No. 13-035-184
Witness: Douglas L. Marx

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF UTAH

ROCKY MOUNTAIN POWER

Rebuttal Testimony of Douglas L. Marx

June 2014

Q. Please state your name, business address, and position with PacifiCorp dba Rocky Mountain Power ("the Company").

A. My name is Douglas L. Marx. My business address is 1407 West North Temple, Salt Lake City, UT 84095. I am director of Engineering Standards and Technical Services for Rocky Mountain Power ("RMP").

Q. Please briefly describe your educational and professional background.

A. I've worked for RMP for 33 years in various engineering, operations and management positions. I hold a bachelor's degree in electrical engineering from the University of Utah and a master's degree in business administration from Utah State University.

Q. Please describe your present duties.

A. I oversee all non-routine technical studies including distributed generation, power quality and smart grid reports. I am responsible for the development of all material and equipment specifications and standards used in the construction and maintenance of the transmission and distribution systems.

Q. What is the purpose of your rebuttal testimony?

A. The purpose of my rebuttal testimony is to show the operational effects of rooftop solar, primarily through engineering studies the Company has performed in the Salt Lake Valley. I will demonstrate that conventional rooftop solar does not significantly reduce the need for the Company to add capacity to its system and that customers with rooftop solar do in fact utilize the full benefit of the local electric distribution system.

Q. What experience does Rocky Mountain Power have with large penetrations of solar or other renewable resources?

A. Presently, there are not high levels of Net Energy Metered ("NEM") solar penetration on RMP's distribution system. To understand the potential impacts and prepare for the future, we work closely with industry associations as well as perform our own studies. Several studies have shown that, depending on the electrical characteristics of the distribution system, a high penetration of NEM will require infrastructure upgrades to maintain safe and reliable electrical service to our customers. RMP operates a complex electrical infrastructure in a safe, reliable and cost-effective manner, and it remains in the best interest of our customers for us to continue to do so. Though we encourage solar NEM on our system, we also realize that there are technical challenges, sometimes subtle and unintended, caused by the increasing interconnection of solar NEM systems.

Q. Has Rocky Mountain Power studied the impacts or potential benefits or impacts of large penetrations of conventional rooftop solar in its service area?

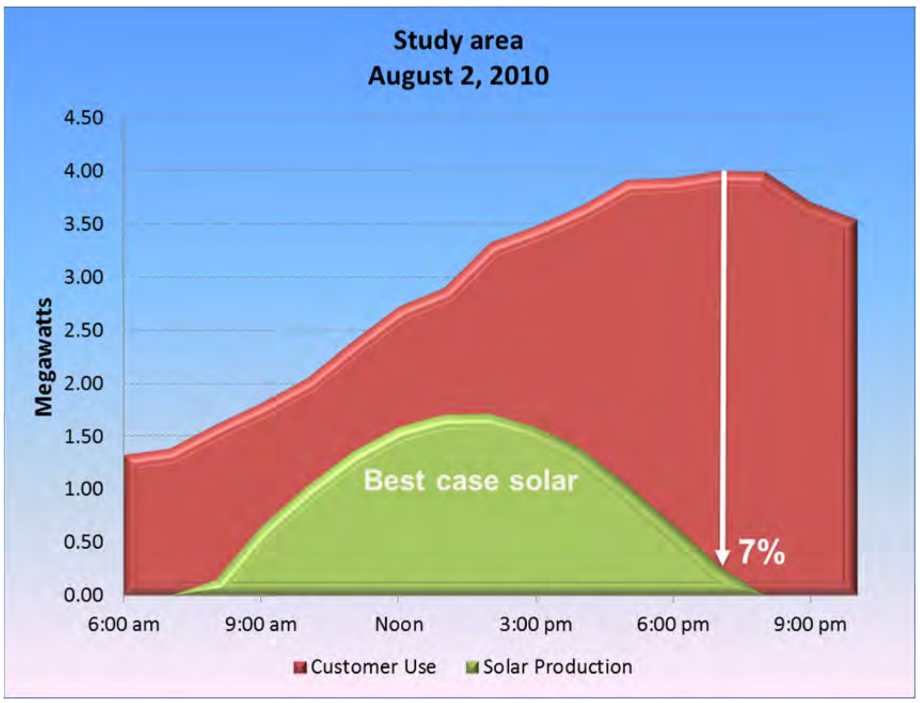
A. Yes. In 2011, the Company completed a study to evaluate the viability of rooftop solar and its ability to offset utility infrastructure upgrades, attached hereto as RMP Exhibit___(DLM-1R). We selected a single distribution circuit located near the University of Utah campus in Salt Lake City, Utah for the study. This area has a very modest annual load growth of two percent and was an ideal candidate as it has a diverse mixture of residential and commercial customers. The study is unique as it utilizes detailed data that takes into account the true viability of available roof space by accounting for the roof angle, shape and impeding items such as chimneys or dormers. The model also accounted for the impact on solar output caused by shading from nearby trees and other structures adjacent to the subject roof. Further, the model was developed for the various weather conditions throughout the year including clear sky conditions, partly cloudy skies and overcast days. The study evaluated each roof independently to determine the viability of that roof to accommodate solar photovoltaic ("PV") systems. The study placed high efficiency solar panels on every viable roof space and the total generation potential from all roofs was calculated.

Q. Why was this study initiated?

A. In 2010 the Company was in the process of seeking permits for a substation expansion project to address load growth in the area. The Company had shifted all loads that it could to adjacent substations with capacity, and in order to address the continual load growth the substation expansion was needed. During the permitting process for the Northeast Substation expansion the Salt Lake City council and local residents raised the issue of the potential to eliminate a substation expansion by use of distributed solar generation.

Q. Did this study align with the common belief that roof top solar concentrated in a given area could defer or eliminate distribution system capacity upgrades?

A. No. The study considered various critical factors such as roof aspects, shading characteristics, interference caused by rooftop objects such as chimneys, and accurately estimated the total number of solar PV panels that could be practically installed on each rooftop. The study found that on the day when the highest annual demand on the circuit under consideration was recorded, the best case solar generation only offset seven percent at the hour when the demand on the circuit was the highest. Thus, the utility had to provide 93 percent of the customer's demand. But more importantly, the peak demand continues for an hour even as the solar production continues to drop requiring more power from the utility. This is shown in the study area figure below.



The seven percent contribution of solar generation would be reduced if served by similar generation remote to the study area due to additional power delivery losses.

Q. Do you have other data that supports the detailed study given above?

A. Yes. In an effort to validate the model, we installed interval meters on several NEM customers to measure their total solar production, energy delivered to RMP and energy received by the customer from RMP. The data was collected for a calendar year that included the summer of 2012. This coincidental data validated the model in as much as the customer's generation peaked between 1:00 and 2:00 p.m. and the peak energy received from RMP occurred at 4:00 p.m. or later.

Additionally, Mr. Nathanael Miksis, on behalf of The Alliance for Solar Choice, cites a study completed by Crossborder Energy. Figure 1 of his testimony shows the typical energy production and consumption of a customer with solar PV production as derived by Crossborder Energy. The data from that study correlates nicely with the results of our study. The customers' peak energy requirements are between the hours of 5:00 p.m. and 7:00 p.m. extending well past the end of the solar generation. We need to design the distribution system for this peak time of energy consumption to ensure reliable electric service for these customers.

Q. Do NEM customers rely on RMP's electric grid?

A. Absolutely. NEM customers use the electric grid to store power at times when their generation units produce more energy than they need and then return that energy from the grid when their systems are not producing. From a customer's viewpoint, the electric grid is the cheapest form of energy storage available. Due to the high cost of energy storage devices such as batteries with corresponding charge controllers and special inverters, nearly all NEM customers refrain from installing energy storage systems. Even the grid-connected customers who do install energy storage systems tend to not use them regularly, preferring instead to use the grid for storage because it is less costly and will extend the life of their batteries. For instance, NEM customers rely on RMP's electric system during night times when the sun is not shining. Further, during daytime when there are rapid cloud transients, NEM customers rely on RMP's grid to help support their voltage and thus maintain a high level of reliability and power quality at their location.

The examples illustrated above clearly show that NEM customers heavily rely on the grid to meet their total energy needs in a reliable way.

Q. How could the solar generation peak be shifted to better align with the system load peak shown in the above figure?

A. In the absence of time-of-use rates, customers design their rooftop solar installations to maximize annual energy production. For optimal energy production from rooftop solar installations, the solar panels are installed on the south-facing roof. Ignoring this basic design criterion, there are three ways to align these peaks, each with tradeoffs. First, the modules on the rooftops could be turned or tilted to a more optimal angle to align with the system load peak in the late afternoon. To get the highest level of solar production coinciding with RMP's system peak, panels would need to be mounted on the south-facing roof and have an approximate 60-80 degree orientation towards the west. For rooftop solar installations, this would be a structurally impractical and cost prohibitive endeavor. Irrespective of the higher rooftop installation cost, if all the panels were oriented for output at 5:00 p.m., the total annual energy production would decrease about 40-50 percent compared with south-facing panels. Furthermore, the maximum output level would drop nearly 70 percent due to the lower number of panels caused by shading and the reduced angle of incidence from the sun.

Second, tracking systems could be added to the systems. This would allow the panels to follow the sun throughout the day, but is a more expensive installation requiring more space and usually requiring ground-mounted pedestals to hold the arrays. Third, energy storage systems could be added; this adds significant cost, and regular use would reduce the life of batteries, but also add resiliency to each home generation system in case of a power outage.

Q. What other experience does Rocky Mountain Power have with large penetrations of solar or other renewable resources?

A. In addition to the study referenced above, RMP monitors closely the activities in Pacific Power. Pacific Power operates in Oregon, California and Washington and is owned by the same parent company as RMP. Pacific Power has incurred the cost of replacing distribution system transformers to accommodate the increasing levels of NEM customers in its service territory. The primary reason for the need to replace transformers was the absence of a primary neutral connection on the existing transformers. A line to neutral transformer connection is needed on the transformer bank's primary and secondary sides to meet the "effectively grounded" requirement as stated in the IEEE standards for customer generation.

Pacific Power also found that two solar customer generation units in Oregon with installed capacities of 500 kilowatts ("kW") and 363 kW each were having issues with line protection devices. This led to rapid voltage fluctuation of 5.3 percent every 15 seconds. These two projects are interconnected to Pacific Power's 12.5 kilovolt distribution circuit serving a total of 1760 customers. The voltage fluctuations triggered by these solar projects propagated into Pacific

Power's distribution system, causing operational issues to not only the distribution circuit they were connected to, but also the adjacent circuit. A total of 2515 customers were affected by this event, several of whom complained about voltage fluctuation and light flicker. On investigation, we determined that the customer generation reclosing device was operating incorrectly and was the root cause of the problem. Further, a significant amount of time, effort and money was spent by the Company to identify and mitigate the problem. The existing rules do not allow RMP to recover costs associated with such procedures from the owner of the customer generation unit. Such instances are not widespread; however, when they do occur, the costs associated with investigating and mitigating the problem is borne by our customers.

As I have previously mentioned, RMP operates a complex electrical infrastructure in a safe, reliable and cost-effective manner, and it remains in the best interest of our customers for us to continue to do so.

Q. Do voltage fluctuations caused by these solar systems affect other customers? Why do industry voltage limits exist?

A. Customers' electrical equipment can typically only operate reliably if the voltage is steady and within five percent of its normal level. These normal levels and their tolerances have been standardized for the United States in ANSI C84.1. RMP, along with nearly every other utility in America, implements this standard very rigorously. Voltage variations outside these limits may present operational problems or damage to customer and utility equipment. Also, for rapid voltage changes caused by the customer's load/generation, RMP requires customers to maintain strict levels that are listed in the Company's voltage fluctuation and light flicker standards.

Q. How does Rocky Mountain Power currently manage voltage regulation without NEM customers to meet ANSI voltage standards?

A. Usually RMP meets the ANSI C84.1 voltage standards by deploying voltage regulating equipment at substation transformers or distributed along the distribution system to keep voltage within the specified tolerances. This equipment works well for normal changes in load, such as when homes and businesses turn on appliances and equipment over the course of the day. Fast changes in large load or generation, such as sudden changes in customer generation, must be handled with other equipment if the voltage is to stay within range.

Q. Do you have any observations regarding the testimony filed by Mr. Dustin Mulvaney representing the Sierra Club?

A. Yes. Mr. Mulvaney summarizes his review of several studies discussing the beneficial attributes of distributed generation. It is important to note that distributed generation includes, but is not limited to, synchronous generators, reciprocating engines, micro turbines, combustion gas turbines, fuel cells and wind turbines as well as solar PV. Each of these technologies presents different characteristics to the local distribution system. Precisely defining the form of distributed generation being cited is necessary to avoid confusion when stating system benefits.

Our studies are based on rooftop solar PV, by far the most popular form of customer generation, and are based on data from actual customer load profiles and local atmospheric conditions and solar insolation levels. They are not based on simplified hypothetical examples. Mr. Mulvaney presents data from models developed by his team but does not offer any actual or measured data for solar installations in Utah, and he does not acknowledge that the peak demand occurs when the solar production is very low and declining fast. He states that "PV capacity value is directly tied [to] its capacity for peak shaving". As our studies demonstrate, PV systems do not significantly shave the peak. He further states that "the Commission should assume that there is a benefit to the system from NEM installations". This is an erroneous assumption. I have demonstrated with a detailed case study as well as actual measured data that this is not the case.

Q. What are your thoughts regarding the impact of NEM on maintaining reliable and safe voltage levels on the distribution system?

A. Considering PV systems, and even wind systems, variability in customer generation output will cause voltage fluctuations that will trigger increased automated operations in line equipment (e.g., line voltage regulator) reducing life of the equipment, thus leading to larger maintenance costs to the Company. It has been found that voltage regulating devices can operate about 70 to 80 times on a cloudy day as compared to 12 to 19 operations during clear-sky days on systems with high levels of solar generation. It is a known fact that increased operations in any switching device leads to increased maintenance and will shorten its life expectancy.

Though I agree with Mr. Mulvaney that modern inverters can regulate voltage to ensure proper voltage is maintained on the system, the IEEE 1547 standard for interconnecting distributed resources with electric power systems, presently does not allow NEM installations to regulate voltage at the point of interconnection. Until the current standards are updated by IEEE and these devices become commercially available, RMP would not expect NEM customers to own inverters with advanced functionalities. Furthermore, Mr. Mulvaney states "End of line voltage will be increased resulting in lower energy consumption for end users' equipment as well." This is simply not true. It violates Ohms law and is contrary to the findings from studies of conservation voltage reduction.

In addition, Figure 1 in Mr. Miksis' testimony demonstrates a condition that can create a transient overvoltage condition. When the distributed generation exceeds the load on the circuit and events occur that require RMP's protective equipment to isolate that circuit, the delay in the inverters to disconnect from the system will create an overvoltage condition. This condition could have damaging effects on customer's equipment throughout the circuit if not properly mitigated, especially electronic-based devices. Due to these factors, RMP continues to maintain its concern regarding voltage fluctuation issues caused by a high penetration of NEM customers.

Q. What value do energy storage devices play in the role of NEM customers?

A. As Mr. Mulvaney describes in his testimony, proper planning can overcome some of the technical challenges triggered by high penetration of NEM on a utility's network. As I have previously mentioned, RMP remains concerned about voltage fluctuation issues on its distribution system. However, we also believe that energy storage could play a significant role in solving some of these issues.

Various techniques can be employed to reduce the impacts of sudden voltage fluctuations caused by clouds passing over the PV panels of the NEM customer. One technique is to install smart inverters that enable voltage control and help maintain a constant voltage irrespective of the rapid movement of cloud cover. Another technique is to install energy storage devices at the customer site (batteries or similar) to help bridge the gap in power flow caused by moving clouds. The current costs of energy storage devices are very high and have thus led most customers to not use this technology. This is the fastest moving area of research and development in the electric utility industry and RMP is following developments in energy storage very closely.

Q. What are the relative impacts of customer generation as compared to energy efficiency upgrades?

A. Energy requirements are predicated by the load characteristics at the customer's premise, and the end-use device will use the exact same energy regardless of the energy source. Solar generation does not reduce the customer’s energy requirements, it only shifts and divides the source of energy between the distribution system and the solar system. When the solar system is not available, the total energy requirements must be met by the distribution system. In contrast, energy efficiency reduces the actual energy requirements for the end-use device. For instance, a 100 watt incandescent lamp produces about 1400 lumens. A fluorescent lamp producing the same lumen output consumes only 22 watts. This reduction in energy requirement will be seen for the entire life of the lamp, Energy efficiency contributes to a reduction in the customer's peak demand whereas customer generation does not.

Q. Please summarize your testimony.

A. RMP believes that customers should have the ability to install their own generation mix and to be subject to the benefits and costs resulting from their choices. However, with its continuing mandate to serve its customers safely and reliably at the lowest reasonable cost, the Commission must consider the evidence offered by RMP about some of the impacts of customer solar generation that are not often seen by the public and not discussed by solar advocates. These impacts are (1) little, if any, change in a customer’s need for the RMP distribution system to supply energy; (2) customer solar generation does not reduce the distribution system's peak load; (3) continued capital investments in distribution infrastructure are required as load levels increase, even with significant penetration of customer generation; (4) increased labor to implement new standards and carefully study the distribution system to assure that customer generation can be accommodated; (5) increased capital cost for adjustments indicated by such study, where needed; (6) unintended additional operations and maintenance costs from an increased number of interconnections to RMP’s system; and (7) increased wear and tear on equipment caused by the intermittent nature of customer generation.

These impacts are real and must be addressed, but they are not insurmountable. The application of proper engineering techniques for a known disruptive technology will enable RMP, working with regulators and customers, to maintain a safe and reliable electrical system while transitioning from a traditional grid to a grid integrated with more customer generation.

Q. Does this conclude your rebuttal testimony?

A. Yes.

Rocky Mountain Power
Exhibit RMP___(DLM-1R)
Docket No. 13-035-184
Witness: Douglas L. Marx

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF UTAH

ROCKY MOUNTAIN POWER

Exhibit Accompanying Rebuttal Testimony of Douglas L. Marx

Smart Grid Pilot Solar Energy Study

June 2014

SMART GRID

Pilot Solar Energy Study

Prepared by:
PacifiCorp GIS Solutions
Juan Luna, Senior GIS Analyst
Lisa Laakso, GIS Analyst/Editor
Lindy Palmberg, Project Manager

January 19, 2011

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Contents

Introduction

Solar insolation modeling is used by many entities around the world to estimate the potential for rooftop solar power generation. Rocky Mountain Power's GIS Solutions group performed a solar insolation study to support ongoing Rocky Mountain Power Smart Grid planning in the Salt Lake City area.

This study identifies rooftops which are estimated to meet the minimum criteria for acceptable area and annual solar radiation received to allow for the installation of solar panels.

According to the National Renewable Electricity Laboratory (NREL), Salt Lake City is estimated to average between 5 and 5.8 kilowatthours per square meter per day (kWh/m²/day.) NREL's estimate considers direct normal insolation modeled across a 10-degree grid for the entire United States. The model input values are taken from insolation measurements provided by a network of hundreds of meteorological stations. In Utah, Salt Lake County insolation potential is considered just above average. Solar insolation intensity increases with southward direction. Figure 1shows NREL's annual solar potential map for Utah.

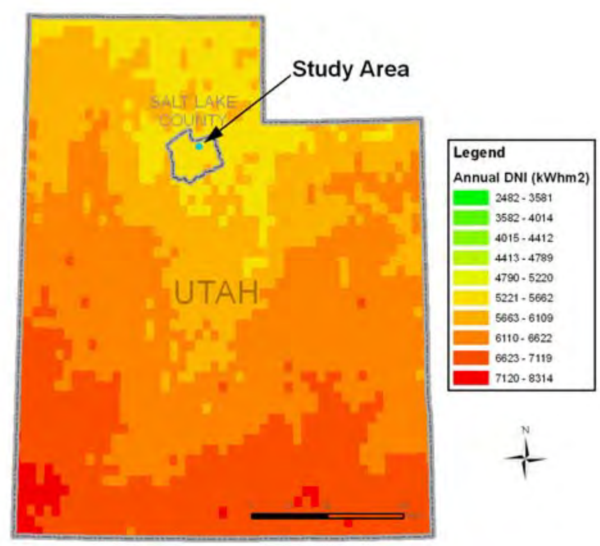

Figure 1: NREL Direct Normal Insolation 10-Degree GRID for Utah (kW/h/m²).

Factors such as slope, aspect, shading, changing solar positions, and weather conditions must be considered in order to generate useful estimates for individual roof surfaces. Rocky Mountain Power's GIS Solutions team has developed monthly solar insolation models using the ArcGIS Area Solar Insolation tool. The model was developed using recently collected high-resolution LiDAR data. This approach yields high-resolution results that identify which roof faces have the best characteristics for installation of photovoltaic (PV) panels based on roof slope, shading, area, sky conditions (clear, cloudy and partly cloudy), and estimated solar insolation. Our model's input values were calibrated against measured solar insolation values published by a NOAA weather station located fewer than 25 kilometers from the study area.

The study area includes those customers served by the Northeast #16 distribution circuit. This area comprises two neighborhoods representing a mix of business, institutional, and commercial land uses near the University of Utah (see Figure 2). The 51-acre area closest to the

University of Utah covers seven blocks bounded on the east by University Street, on the west by Elizabeth Street and 1200 East, on the north by 200 South, and on the south by 300 South and 400 South. A 16-acre area to the west covers two full blocks and one partial block, with the northern two blocks bounded by 1000 East to the east, 300 East to the west, South Temple Street to the north, and 100 South to the south. The partial block in this area is bounded by 1000 East to the east, Lincoln Street to the west (the boundary does not extend as far west as the street), 100 South to the north and 200 South to the south.

While only roofs within the study area were evaluated for solar potential, modeling was performed on a larger area incorporating a 250-foot buffer to account for potential shading effect of large trees or buildings adjacent to the pilot study area.

The study area encompasses 356 buildings on 290 tax lots which range in size from 89.3 square meters to over 4,645 square meters (1.15 acres).

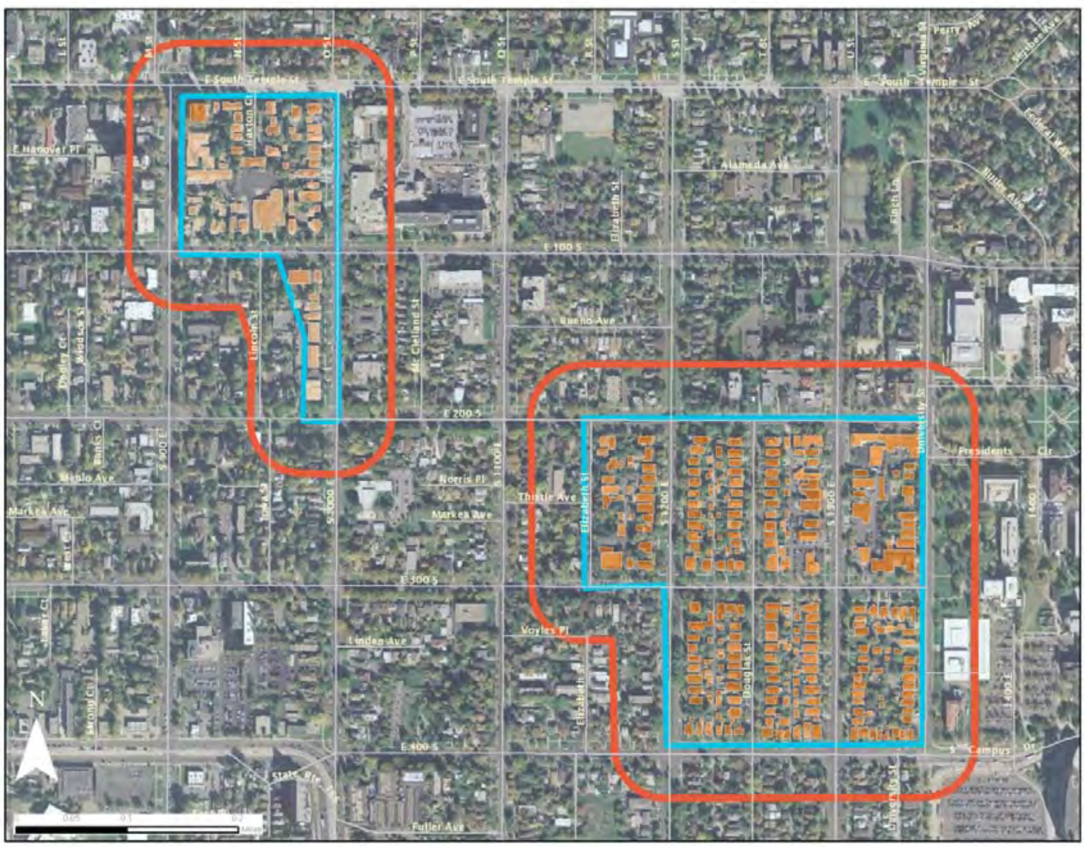

Figure 2: Pilot Study Area

Up-to-date parcel data was obtained from the Salt Lake County Assessor's Office in December 2010. Relevant data obtained for this study from the parcel dataset included site addresses, owners contact information, and parcel land use. The land use configuration for the study area is shown in Table 1.

Land Use	# of Buildings
10-19 Unit Apartment	5
3-4 Unit Apartment	6
5-9 Unit Apartment	3
Apartment 20-49 Units	2
Apartment Conversion	5
Bank	2
Church	3
Church Or Public	2
Condominium Timeshare Common Area	2
Condominium Unit	2
Convenience Store	1
Duplex	12
Fast Food Restaurant	1
Fraternity/Sorority	1
Medical Office	2
Mixed Retail	4
Multiple Residential	15
Nursing Hospital	2
Office	2
Office Conversion	2
Other Exempt	2
Residence Imps On Comm Land	1
Restaurant	4
Retail Store	3
Single Family Residential	151
Unknown	9

Table 1: Number of buildings per land-use type

Methods

ESRI's Area Solar Insolation tools were used to build the Cloud-Based-Model that calculates estimated insolation for the study area for an entire year. Inputs to the model included the corrected LiDAR derived digital elevation model, temporal parameters, and atmospheric modification factors based on local climate.

The model's output is a raster grid that retains the 0.61 square meter resolution of the input elevation model, in which each pixel represents the monthly estimated insolation for that location. These values were used to generate an average daily insolation value based on one square meter.

After extensive sensitivity testing, it was determined that the best temporal configuration was to calculate monthly insolation totals based on 24 hour sun position changes over 14-day time steps with half-hour intervals. A total of 32 directions, zenith divisions, and azimuth divisions were used to track the position of the sun in the sky, and to calculate the variance of diffuse radiation. Because computing time was not an issue, a standard-overcast-sky diffuse model was chosen over a uniform sky model. This allowed the model to calculate diffuse radiation variability based on zenith angles. Climate considerations were incorporated using the cloud-based insolation modeling approach described in the next section.

Roof polygons were derived from LiDAR data and used to estimate the amount of area available to accommodate typical 1.42 meter by 0.66 meter (56" by 26") photovoltaic solar panels, given their shape, aspect, shading characteristics, and rooftop objects such as chimneys.

The final analysis combined all of the model's outputs and building data to assess the estimated amount of insolation per rooftop and per PV panel for different time periods.

Cloud-Based Insolation Model

Diffusion refers the percentage of insolation that is received indirectly after passing through the atmosphere. Transmissivity refers to the percentage of insolation that directly reaches a flat surface after passing through the atmosphere.

ESRI's Area Solar Insolation toolset single diffusion and transmissivity values were entered for the time period being evaluated. According to ESRI's documentation a transmissivity value of 0.6 to 0.7 should be used for very clear sky conditions, and 0.5 is optimal for generally clear sky conditions. Diffusion values are inversely proportional to transmissivity and for very clear sky conditions it is recommended to use a diffusion value of 0.2.

Diffusion and transmissivity factors are directly dependent on atmospheric conditions. In the study area cloud cover varies from month to month. It was important to include these atmospheric variations in the model. Three models were run in parallel for each month in order to model these variations.

The first model calculated potential daily average solar power under clear sky conditions for any given month. The second model calculated the potential daily average solar power under partly cloudy skies. The third model performed the same calculation for cloudy days.

Each monthly total insolation then became a function of the ratio of clear, partly cloudy, and cloudy days within that month. For example, December has 31 days. If, on average, six days are clear, 18 days are partly cloudy, and 7 days are cloudy, the total monthly insolation for December would be:

6x + 18y + 7z = Total Monthly Insolation

Where:
x = December average clear sky insolation
y = December average partly cloudy sky insolation
z = December average cloudy sky insolation

This process was repeated within the model for each of the 12 months.

The number of average cloudy and clear sky days per month was obtained from the Western Regional Climatic Center (WRCC). According to the WRCC a clear day is defined as having zero to three tenths average cloud cover. A partly cloudy day is defined as having four tenths to seven tenths average cloud cover. A cloudy day is defined as having eight tenths to ten tenths average cloud cover. Table 2 below indicates the total number of days, by month, with clear skies, partly cloudy skies, and cloudy skies for Salt Lake City as defined by the WRCC.

Sky Condition	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Clear	6	5	7	7	9	14	17	16	16	14	8	6	125
Cloudy	19	16	16	14	12	6	4	4	5	9	15	18	138
Partly Cloudy	6	7	8	9	10	10	10	11	9	8	7	7	102
% Sunshine	45	54	64	69	72	80	83	82	82	72	53	42	66

Table 2: Total number of clear sky, partly cloudy, and cloudy days for Salt Lake City

Model Calibration

The model was calibrated using atmospheric transmissivity indexes obtained from NASA. The Atmospheric Science Data Center and NASA have calculated 22 year clear sky index averages from 1983 to 2005 utilizing data collected from hundreds of weather stations through the continental United States including Weather-Bureau-Army-Navy (WBAN) station number 24127 (WBAN24127) located at Salt Lake City International Airport.

The study area's proximity to WBAN24127 station (within 25 kilometers) allows us to accurately use data from the station for calibration purposes. Data from this station has been used by NASA, WRCC, and NREL to calculate different coefficients including expected solar insolation in a flat surface. The expected insolation values in a flat surface calculated for this station were used to calibrate our model. Refer to Appendix E for the corresponding NASA Surface Meteorology and Solar Energy report for Salt Lake City.

For the clear sky model the NASA monthly average clear sky insolation normalized clearness indexes were used for the transmissivity factor. Diffusion indexes were calculated based on a one hundred percent clearness index and adjusted to monthly average clear sky insolation normalized clearness indexes as indicated below.

$$CSD = (1 - AI) - \left[(1 - AI)\left[\frac{AI - NI}{AI}\right]\right]$$

$Where:$
$CSD\ is\ Clear\ Sky\ Diffusion$
$AI\ is\ Monthly\ Averaged\ Clear\ Sky\ Insolation\ Clearness\ Index$
$NI\ is\ Monthly\ Averaged\ Clear\ Sky\ Insolation\ Normalized\ Clearness\ Index$

The partly cloudy day model used the monthly averaged insolation clearness index as the transmissivity factor. Diffusion indexes were calculated as the difference between partly cloudy day transmissivity and the sum of clear day transmissivity and diffusion. In other words, the total insolation for clear sky days and partly cloudy days is the same but for partly cloudy days more insolation is received at ground level as diffuse insolation. Table 3 shows the transmissivity and diffusion factors that were used for clear sky, partly cloudy, and cloudy models.

$$PCD = (CST + CSD) - PCT$$

$Where:$
$PCD\ is\ Partly\ Cloudy\ Diffusion$
$CST\ is\ Clear\ Sky\ Transmitivity$
$CSD\ is\ Clear\ Sky\ Diffusion$
$PCT\ is\ Partly\ Cloudy\ Transmitivity$

Transmissivity and diffusion for the cloudy day model were calculated as follows:

$$CDT = PCT - (CST - PCT)$$
$$CDD = (CST + CSD) - CDT$$

$Where:$
$CDT\ is\ Cloudy\ Day\ Transmitivity$
$PCT\ is\ Partly\ Cloudy\ Transmitivity$
$CST\ is\ Clear\ Sky\ Transmitivity$
$PCT\ is\ Partly\ Cloudy\ Transmitivity$
$CDD\ is\ Cloudy\ Day\ Diffusion$
$CSD\ is\ Clear\ Sky\ Diffusion$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Clear Sky Indexes												
Transmissivity Index	0.690	0.710	0.730	0.730	0.720	0.700	0.680	0.640	0.680	0.690	0.690	0.680
Diffusion	0.230	0.212	0.183	0.183	0.191	0.221	0.239	0.261	0.239	0.230	0.230	0.239
Total	0.920	0.922	0.913	0.913	0.911	0.921	0.919	0.901	0.919	0.920	0.920	0.919
Partly Cloudy Indexes												
Transmissivity Index	0.585	0.585	0.580	0.550	0.500	0.500	0.500	0.600	0.620	0.600	0.585	0.585
Diffusion	0.335	0.337	0.333	0.363	0.411	0.421	0.419	0.301	0.299	0.320	0.335	0.334
Total	0.920	0.922	0.913	0.913	0.911	0.921	0.919	0.901	0.919	0.920	0.920	0.919
Cloudy Indexes												
Transmissivity	0.480	0.460	0.430	0.370	0.280	0.300	0.320	0.560	0.560	0.510	0.480	0.490
Diffusion	0.440	0.462	0.483	0.543	0.631	0.621	0.599	0.341	0.359	0.410	0.440	0.429
Total	0.920	0.922	0.913	0.913	0.911	0.921	0.919	0.901	0.919	0.920	0.920	0.919

Table 3: Transmissivity and diffusion indexes used for the Cloud-Based Solar Insolation model

During the calibration of the model, calculated insolation results were compared to the values obtained from the WBAN24127 station and the NASA Surface Meteorology and Solar Energy Report for Salt Lake City to ensure that the transmissivity and diffusion indexes derived for the model led to the expected values.

Three flat surfaces were chosen to measure the results of the models and were compared to the expected insolation values for flat surfaces. Adjustments to transmissivity factors for winter months were made to partly cloudy indexes as part of the calibration process. The new indexes were applied to the formulas that calculate partly cloudy transmissivity and diffusion, and cloudy transmissivity and diffusion. The new indexes never exceeded the annual averaged insolation clearness index, and the total percentage of received insolation (transmissivity plus diffusion) remained unchanged.

During calibration the yearly average clearness index was used for the summer peak months of May and June. Partly cloudy and cloudy transmissivity indexes were calibrated and a difference between 0.9% and 4.32% was achieved when compared to expected results from WBAN24127 station.

Figure 3 shows the expected maximum, minimum and average expected insolation values from the WBAN24127 station, the expected values from the NASA Surface Meteorology and Solar Energy Report and the modeled insolation values. In all models, the sum of transmissivity and diffusion indexes for each month is between 90% and 92.2% of the total insolation value at the top of the atmosphere.

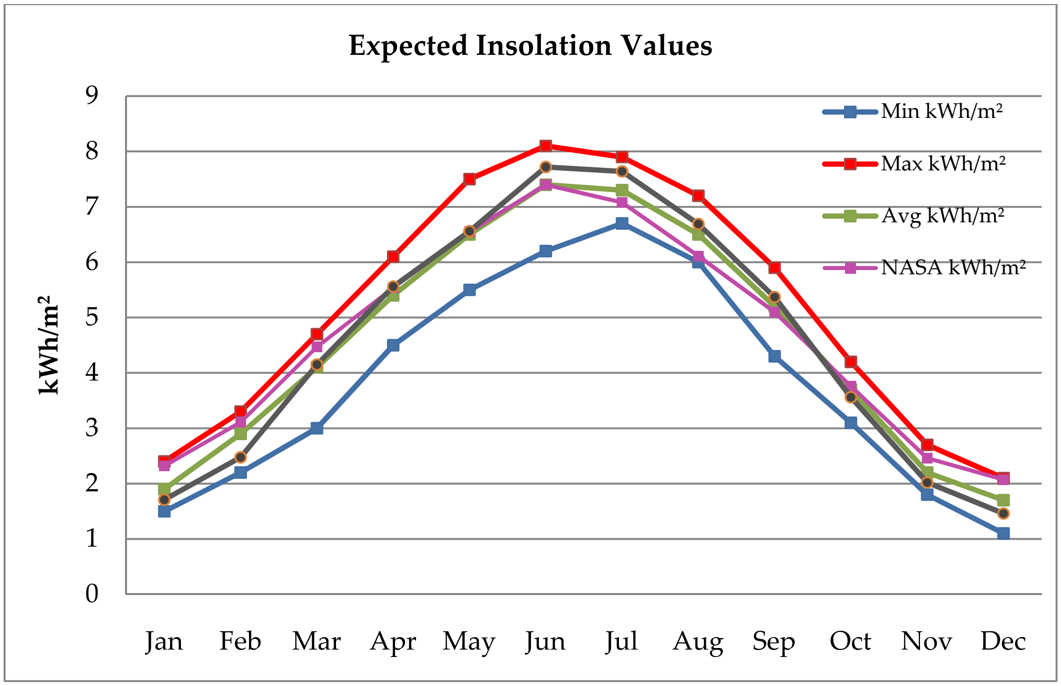

Figure 3: Modeled insolation values in relation to NASA Surface Meteorology and the WBAN24127 station

Identification of Roof Aspects and Objects

LiDAR data was obtained for the study area. For more details on the LiDAR data collection, processing or cleanup please see Appendix A. Rooftops were identified in the classified LiDAR data and used to develop a vector model of the roof outlines. The roof vectors were used to calculate total roof area.

Rooftop insolation models can be setup incorrectly by assuming that roof slope is continuous, roofs are flat, or that they have a continuous area that can be filled with solar panels. Architecture design varies from one building to the next. Finding those differences is important to assess the potential number of solar panels that can be installed on each roof. Roofs may have chimneys, air conditioning units and ducts, aspect changes, and dormers. These objects decrease the number of panels that can be installed on a roof. Calculating the total area of each rooftop is not enough to evaluate the number of panels that could be installed. Objects and other obstacles need to be identified.

Three different processes were tested to calculate roof aspect and object detection.

The first approach involved calculating a focal standard deviation to detect elevation change. Computations are performed in a three by three cell neighborhood which represents 3.34 square meters. The downside to this method is that the results become generalized. The analysis window of 3.34 square meters is too large when working with smaller surface areas like rooftops.

The second method created a raster dataset representing roof aspect, or roof direction. This indicated what parts of the roof were south, north, east, and west facing. This approach worked for certain roof angles but produced inconsistent data for flat roofs. Figure 4 shows calculated aspect for the rooftops in the sample area. Each color in the image represents a part of the roof that faces a specific direction.

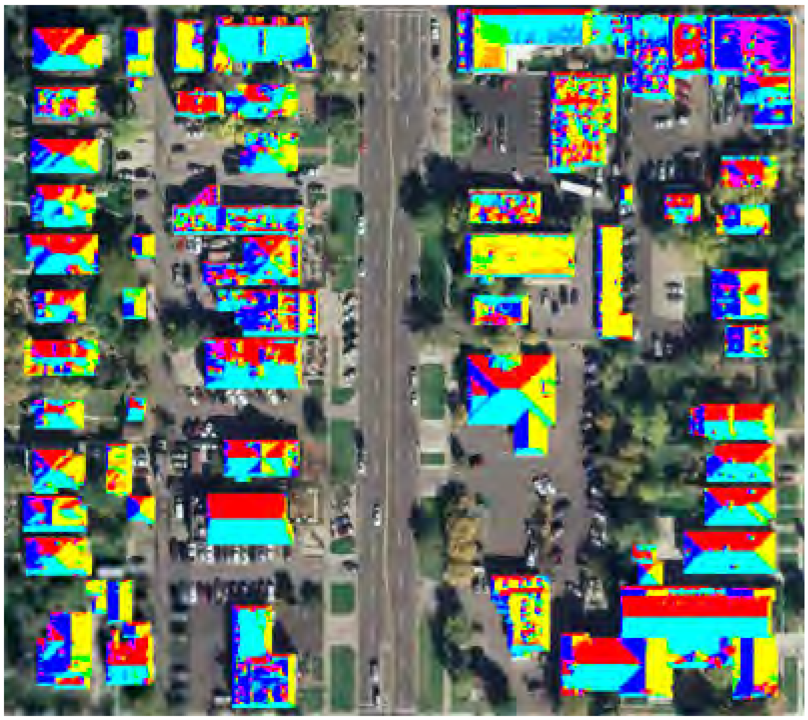

Figure 4: Aspects calculated for each rooftop in the study area

The last method used a hydrological approach of calculating focal flow of fluids on each rooftop. This method allowed us to simulate water flow on rooftops thus finding different aspect, changes in elevation, and objects. Objects on rooftops were well detected with this method, including flat rooftops. The downside to this method was that it produced some errors in roofs with lower pitch angles.

Based on the evaluation of these methods the flow of fluids method was used in this study to detect different regions and objects on flat rooftops. The aspect method was used to detect different regions and objects on pitched rooftops. Figure 5 shows the regions calculated with the flow of fluids model for the sample area.

The models resulted in raster grids which included cohesive regions of similar slope and aspect for each roof. These regions were converted to polygons for use in the next step.

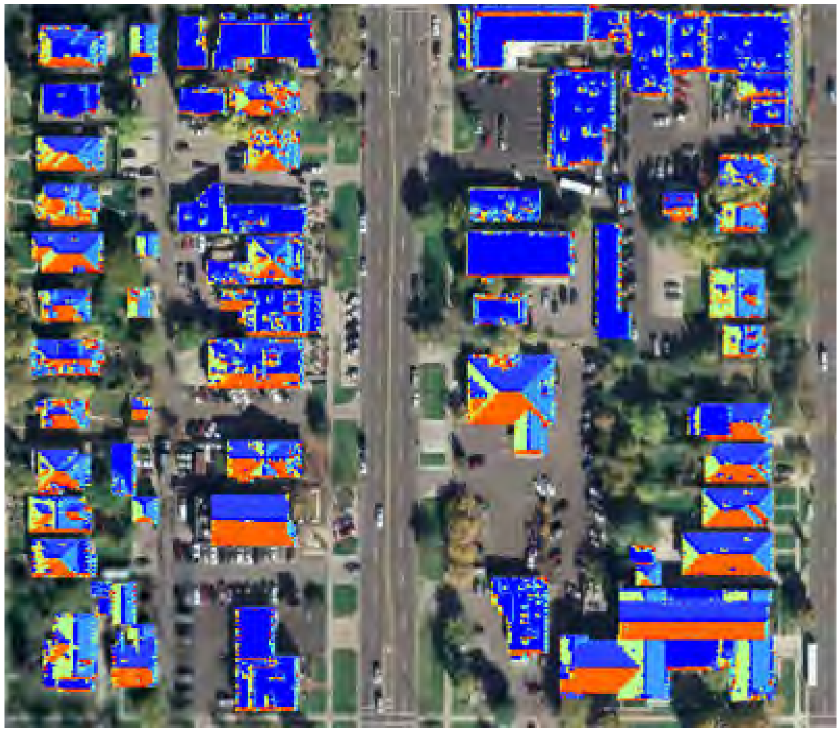

Figure 5: Output of flow of fluids model

Estimating number of panels per rooftop

The number of panels that could fit on a rooftop was estimated in this study in order to calculate solar energy generation potential with greater accuracy. The methodology for this calculation is explained below.

The following variables were assumed: 130 watt PV panels would be used and each panel would measure 1.42 meters by 0.66 meters. In order to simulate the installation of the panels a 1.42 meter by 1.42 meter grid dataset was created on top of each roof. Each of the resulting grid cells would fit two 130 watt PV panels. The goal was to determine the maximum number of panels that would fit each rooftop.

The resulting grid dataset was intersected with the cohesive slope/aspect region polygons created in the previous step. Model logic required that a cell that fit two panels must be contained completely by a region polygon. The cell should not intersect a region polygon since that would indicate that a change in the rooftop elevation, aspect, or an object would not allow the installation of two panels.

If the area of the resulting intersection was greater than fifty percent of the cell's area, and if it had a somewhat rectangular or squared shape it was assumed that at least one panel would fit in that part of the roof.

A script was built to eliminate cells with an area less than 65% of the original cell size, and with an irregular shape. A bounding box for each cell with an area of less than 65% of the original cell was created. If the cell's area is ninety percent similar to the bounding box's area that meant the cell had a somewhat regular shape, otherwise it has an irregular shape. An additional filter was built to detect cells with ten or more vertices or corners. Those cells identified for this filter had a high irregular shape and were eliminated because they would not fit a PV panel.

All other cell intersections resulting in an area of less than fifty percent of the cell's area was assumed to be unfit to accommodate a single panel. Figure 6 shows estimated number of PV panels that could fit on a rooftop after evaluating different regions on each rooftop for the sample area. Orange cells could fit two panels; yellow cells could fit one panel.

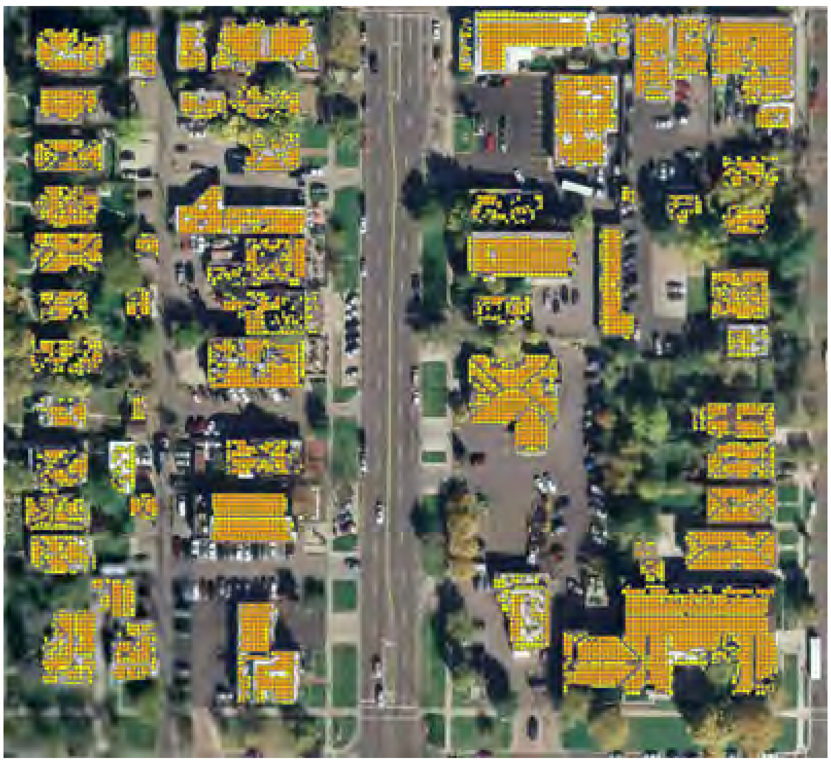

Figure 6: Estimated number of PV panels per rooftop

A more accurate prediction of the number of PV panels that could be installed on each rooftop was estimated by taking into account roof aspect, changes in shape, and other objects that may interfere with installation. This process also facilitated the estimation of solar insolation per panel thus providing a better assessment of solar energy generation potential per rooftop.

Solar Insolation and Energy Calculations

Rooftops with an area of less than 100 square meters were not considered for PV panel installation in order to keep the study focused on main buildings within each parcel. All other rooftop polygons derived from LiDAR data were used to extract the estimated solar radiation per rooftop per month. Zonal statistics were computed in ArcGIS to extract the solar insolation values for each of the rooftops in the study area.

The same procedure was performed on the PV panel dataset. Annual daily average solar insolation and daily average solar insolation for the summer were extracted per solar panel from the model's outputs. Figure 7 shows the annual daily average solar insolation values per panel for the sample area. Yellow panels are estimated to receive a daily average between 4kWh/m² and 5kWh/m² and red panels are estimated to receive between 5.0 kWh/m² and 5.25 kWh/m².

Figure 7: Annual daily average solar insolation values per panel

The annual daily average solar insolation and summer daily average solar insolation values per panel were used to calculate the estimated solar energy output per panel as follows:

$$Energy = SI * PVa * PVratio * Cl$$

$Where: SI \text{ is Average Daily Solar Insolation}$

$PVa \text{ is PV panel area in meters}^2$

$PVratio \text{ is PV panel efficiency ratio per } 1000 \text{ watts of solar insolation}$

$Cl \text{ is convertion rate}$

The conversion rate from DC to AC was set to ninety percent; the PV panel area was set to 0.939 square meters; PV panel efficiency ratio per 1000 watts of solar insolation was set to 0.13839.

The estimated energy calculations performed during this study were based on current roofs tilt. It must be noted that actual energy output varies depending on the tilt of the PV panel with respect to the roof. The effect of the PV panel tilt varies with time of the year. According to the NASA Meteorology and Solar Energy report for the study area PV panels installed with a tilt of zero to three degrees with respect to a flat roof would produce the most energy during June, but it would produce less energy in the following months. Refer to Appendix E for optimum angle per month for installation of tilted PV panels.

Solar Insolation and Distribution System Peaks

After reviewing the outputs from the monthly models it is easy to determine that the solar insolation peak occurs on June 21. As expected, this aligns with the summer solstice, when the Sun's apparent position in the sky reaches its northernmost extreme, resulting in the longest day of the year.

However, distribution system peaks do not occur on the same day as solar insolation peaks. Figure 8 shows a load profile for Northeast Circuit 16. The distribution load peaks occurs on or about August 2, 2010. The distribution system peak usually occurs within two weeks of this date each year, but has never occurred in June.

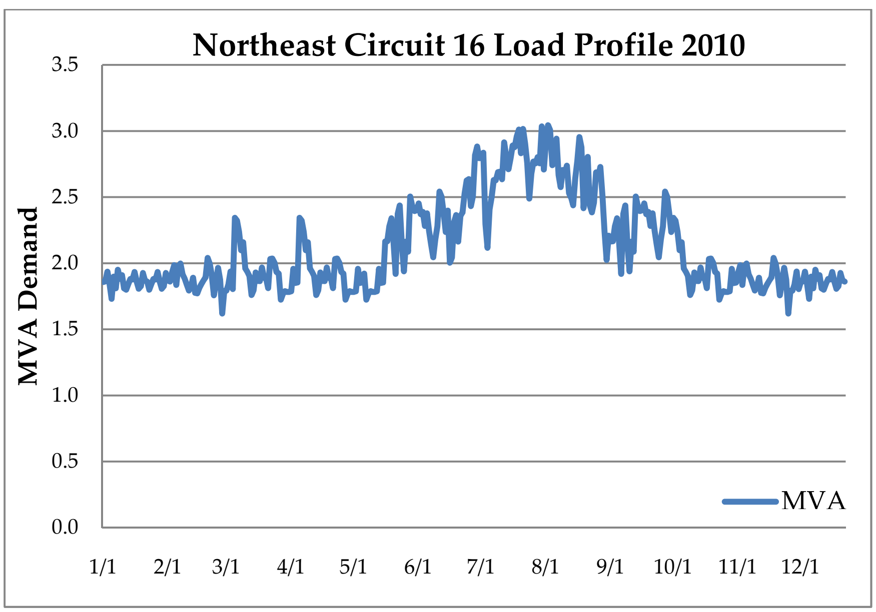

Figure 8: Load profile for Northeast Circuit 16

Individual models were setup to calculate hourly solar insolation to display the differences of available solar insolation between solar peak days and distribution system load peak days. Figure 9 shows the hourly solar insolation distribution for the peak insolation day – June 21.

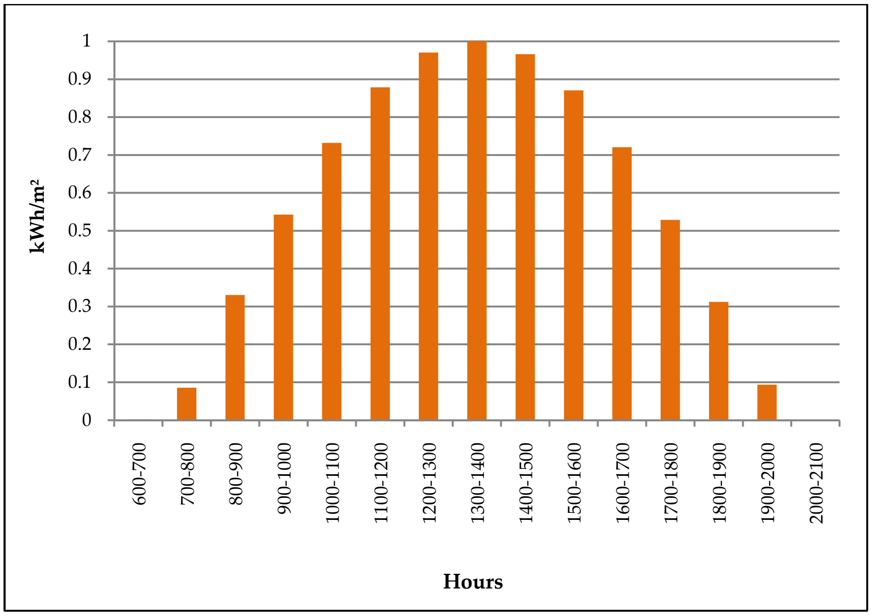

Figure 9: Peak solar insolation

Figure 10 below shows the hourly solar insolation distribution for the distribution system's summer peak load day.

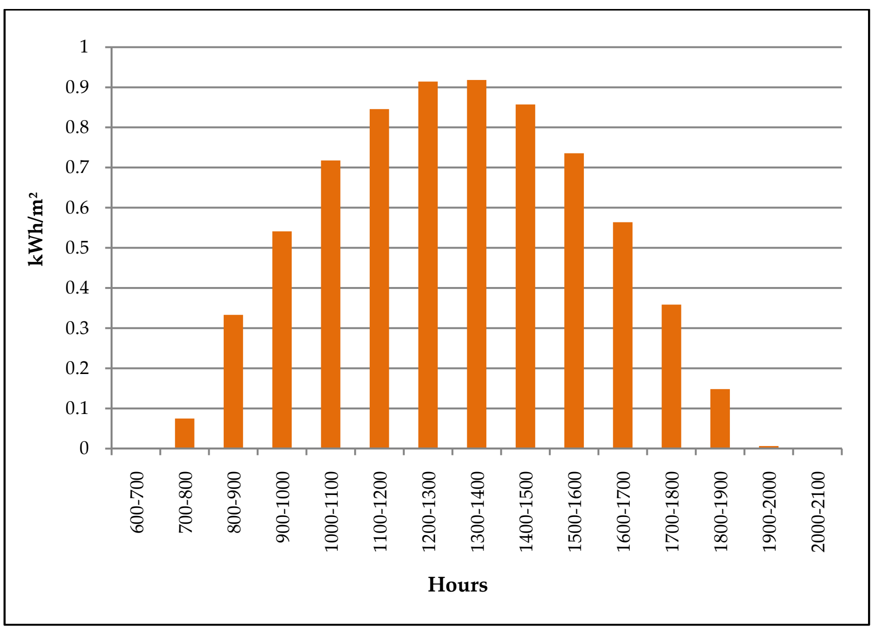

Figure 10: Solar insolation for distribution peak day

Two separate scenarios are analyzed to assess how much load can be offset from the system during peaks by incorporating distributable generation. Scenario one analyzes solar energy generation based on summer-only modeled solar insolation values. Scenario two analyzes solar energy generation based on year round modeled solar insolation values.

Results

The model's results and WBAN24127 data indicate that the peak average daily solar insolation for flat surfaces occurs in June. As tilt degree increases, the insolation peak shifts towards July.

Most of the rooftops in the study area reach their solar insolation peak between June and July. This aligns with the summer solstice that occurs on June 21 resulting in the most sunlight per meter squared reaching a surface.

Two different scenarios were modeled for this study. Scenario one was setup for summer months only, from May to September. These months are consistent with Rocky Mountain Power's Electric Service Schedule No. 1 that defines summer months for residential electric service. Scenario two was setup for an entire year.

Assessment data obtained from Salt Lake County was used to categorize buildings according to their land use. The following categories were created to summarize results for Scenario One and Scenario Two:

- Residential: this category includes all single family residential buildings.
- Multi-residential: includes duplexes, condominiums, apartments, multiple residential, time shares, and fraternity/sorority houses.
- Commercial: includes retail stores, convenience stores, and restaurants.
- Institution: includes banks, churches, hospitals, medical offices, and general offices.
- Unknown: includes all buildings for which land use data was not available.

Scenario One Results – Summer Solar Output

The purpose of scenario one is to analyze the potential solar energy generation during the months when the demand for electricity is higher.

Roof areas that receive the greatest amount of solar insolation are those facing south, southeast, or southwest. During the summer months the average daily insolation received by south facing roofs in the study area is 5.695 kWh/m^2. Solar panels that received at least 5.695 kWh/m^2 of solar insolation per day during the summer were considered as the most cost effective and viable for installation.

According to assessment data from Salt Lake County the study area includes 154 residential buildings with a median rooftop area of 171 square meters. During the summer the median number of PV panels per residential building is 25, at least four buildings are not suitable for installation of a single PV panel, and the maximum number of panels on a single building is 119; this building is located at 275 S. Douglas St., and has a roof area of 328 square meters. The median percentage of usable roof area for residential buildings is 13.81 percent.

A total of 54 multi-residential buildings are found within the study area. The median estimated number of PV panels per multi-residential building during the summer is 32, and the median percentage of usable roof area per building is 19.88 percent. At least three buildings are not suitable for installation of PV panels, and the maximum number of PV panels on a single building is 397.

Nine commercial buildings are found within the study area. The median roof footprint for these buildings is 348 square meters and the median number of PV panels per building is 136. The median percentage usable roof area per building is about 31.31 percent. The building that fits the least number of PV panels is a restaurant located at 224 South 1300 East; it can fit only six PV panels. The building that fits the most PV panels under this category is a retail store located at 206 S University St. This retail store has a flat roof with an area of 650 square meters that could fit 340 PV panels, or 49 percent of the roof area can accommodate PV panels.

In the institution category offices have the least roof footprint and hospitals and churches have the greatest. The median roof footprint is 430 square meters and the median number of PV panels for the summer is 160. The median percentage usable roof area per building is 32.74 percent.

A church located at 951 East 100 South could fit the most PV panels; the total PV panel count for this building is 917. Another church located at 274 S. University St. can fit 722 panels and has the second greatest roof footprint in the study area.

Other buildings with comparable roof footprint as churches are hospitals, but they can only fit a maximum of 371 PV panels. The difference between these types of buildings is that churches have fewer obstructions in their rooftops; hospitals on the other hand have numerous AC units and other equipment occupying a great portion of their roofs.

Parcels with unknown land use comprise the last category of buildings within the study area. The median roof area is 195 square meters and the median number of PV panels per building is 27. The median percentage usable roof area per building is 14.57 percent.

A summary of results per building category for scenario one is provided as Table 4 below. For individual building results please consult tables in Appendix C.

Category	Type of Buildings	Median Roof Footprint	Median # of PV Panels	Minimum # of PV Panels	Maximum # of PV Panels	Average % Usable Roof Area
Residential	Single Family Residential	171 m²	25	0	119	13.81%
Multi-Residential	Apartments, Condos, Fraternity/Sorority, Duplex	173 m²	32	0	397	19.88%
Commercial	Restaurant, Commercial Retail,	349 m²	136	6	340	31.31%
Institution	Churches, Banks, Hospitals, Offices	430 m²	160	16	917	32.74%
Unknown	Unknown Land Use	196 m²	26	2	262	14.57%

Table 4: Building summary results for Scenario One

Scenario Two Results – Yearly Solar Output

The purpose of scenario two is to look at the potential solar energy generation through the entire year.

The average daily insolation received by south facing roofs per year in the study area was estimated to be 4.08 kWh/m². Under this scenario PV panels that received at least this much solar insolation per day during an entire year were considered as the most cost effective and viable for installation.

Under scenario two, the median number of PV panels that could be installed per single family residential building is 21. Eleven buildings are not suitable for installation of a single PV panel, and the maximum number of PV panels on a single building is 90. Just like in scenario one the building that fits the most PV panels is located at 275 S. Douglas St. The median percentage usable roof area for single family residential buildings is 10.6 percent.

Multi-residential buildings within the study area total 54. The median estimated number of PV panels per multi-residential unit is 27, and the median percentage usable roof area per building is 14.78 percent. Six of these buildings are not suitable for installation of PV panels, and the maximum number of panels that can be installed on a single building is 368. This building is a condominium complex located at 960 E. 100 S. and it has a roof area of 547 square meters.

There are nine commercial buildings within the study area. The median roof footprint for these buildings is 348 square meters and the median number of PV panels per building under scenario two is 125. The median percentage of usable roof area per building is about 28.77 percent. As in scenario one, the building that fits the least number of PV panels is a restaurant located at 224 South 1300 East; under scenario two this building can fit nine PV panels.

The commercial building that fits the most PV panels is a retail store located at 206 S University St. The flat rooftop on this store has an area of 650 square meters and it can fit 331 PV panels accounting for 47.8 percent of the roof's total area.

In the institution category offices have the least roof footprint and hospitals and churches have the greatest. The median roof footprint is 430 square meters and the median number of PV panels under scenario two is 143. The median percentage usable roof area per building is 27.88 percent.

The least number of PV panels that can be installed under this category is one; this is a building located at 227 S. 1300 E. The institution building that fits the most panels is a church located at 951 E. 100 S. The total roof area for this church is 1986 square meters and under scenario two it can fit an estimated 877 PV panels accounting for 41.47 percent of the church's roof. Another church located at 274 S. University St. can fit 420 panels.

The institution building with the greatest percentage of usable roof is an office building located at 170 South 1000 East. Approximately 66.57 percent of its roof area can be fitted with PV panels.

The last category is that of buildings with unknown uses. Under scenario two the median number of PV panels per building is 23, the maximum is 246, and there is a building that's not viable for PV installation and another that has potential for a single PV panel. The median percentage usable roof area per building under this category is 13.15 percent.

A summary of results per building category for scenario two is provided in Table 5 below. For individual building results please consult the tables in Appendix C.

Category	Type of Buildings	Median Roof Footprint	Median # of PV Panels	Minimum # of PV Panels	Maximum # of PV Panels	Average % Usable Roof Area
Residential	Single Family Residential	171 m^2	21	0	90	10.60%
Multi-Residential	Apartments, Condos, Fraternity/Sorority, Duplex	173 m^2	27	0	368	14.78%
Commercial	Restaurant, Commercial Retail,	349 m^2	125	9	331	28.77%
Institution	Churches, Banks, Hospitals, Offices	430 m^2	143	1	877	27.88%
Unknown	Unknown Land Use	196 m^2	23	0	246	13.15%

Table 5: Building summary results for Scenario Two

Conclusions

Results provided for this study are based on two different scenarios. Scenario one was setup for summer months only, from May to September. These months are consistent with Rocky Mountain Power's Electric Service Schedule No. 1 that defines summer months for residential electric service. Scenario two was setup for an entire year.

The first scenario considers PV panels that receive a minimum daily average solar insolation of 5.695 kWh/m^2 during the summer. The second scenario considers PV panels that receive a minimum annual daily average solar insolation of 4.08 kWh/m^2.

Under scenario one, a total of 237 buildings within the study area have the potential for the installation of at least one PV panel. The estimated maximum number of PV panels for the study area under this scenario is 13,304. Under scenario two, a total of 227 buildings within the study area have the potential for the installation of at least one PV panel. The estimated maximum number of PV panels under scenario two is 11,193.

Under both scenarios, institution buildings are estimated to have the greatest potential for the installation of PV panels. Commercial buildings have the second greatest potential, and multi-residential buildings' potential is rated third. Unknown land use buildings come second to last under both scenarios and single family residential have the least potential when compared to other types of buildings. The median number of panels per single family residential building is 25 for scenario one, and 21 for scenario two.

It should be noted that there is a variation in the efficiency rate of solar panels due to temperature which was not considered in this study. For information, the listed power of a solar cell is the power measured under ideal laboratory conditions, which prescribe a temperature of 25 °C (77 °F). However, on a typical hot summer day, it is not uncommon for a solar cell to reach a temperature of 70 °C (158 °F). A general rule of thumb is that the efficiency of a solar cell decreases with 0.5% for every 1 °C (1.8 °F) above 25 °C (77 °F). This means that on a hot summer day, the efficiency of a solar cell could drop as much as 25%.

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APPENDIX A

LiDAR Data Collection, Processing and Clean Up

LiDAR Data Collection

The LiDAR data for this study was collected by TOWILL Inc., in October 2010 with an Optech Orion laser system at an altitude of 2,600 feet above ground level, a scan rate of 51Hz, scan angle of +/- 18 degrees, overlap of 55%, pulse rate of 100 kHz, 52-meter and 0.53-meter spacing across track and along track, respectively. The data was referenced horizontally to the North American Datum of 1983 (NAD83) and projected to the Utah State Plane System of 1994, Central Zone, with International Feet as ground units. Vertically the data was referenced to the North American Vertical Datum of 1988 (NAVD88), with International Feet as ground units. Datum origin coordinates are defined by the National Geodetic Survey control point "Temple 13" (PID L0694), a first order horizontal point and second order, class 0, vertical point mounted by a brass cap set approximately 5 cm (2") below the surface of the street in an 20.3 cm (8") diameter monument located at the intersection of South Temple Street and Thirteenth Street East, Salt Lake City, Utah.

Estimated vertical error of the collected LiDAR data is about 9 cm based on field survey positions tested against the LiDAR-derived points. Horizontal error is generally less than vertical error, so it is safe to assume horizontal error to be less than 9 cm.

LiDAR data was collected with a density of at least six points per square meter. First return points were used to generate a 0.61 meter by 0.61 meter (2' x 2') digital elevation model raster which was used as input to the Cloud-Based Area Solar Insolation Model.

LiDAR Data Processing

To illustrate the steps required to quantify the data obtained from the LiDAR survey, a sample area from the pilot area will be used. This sample area is the block bounded by 200 South to 300 South and from Douglas Street to University Street.

Figure 11 below shows a digital elevation model derived from first return LiDAR points showing buildings, vegetation and ground level based on differential elevation for the sample area.

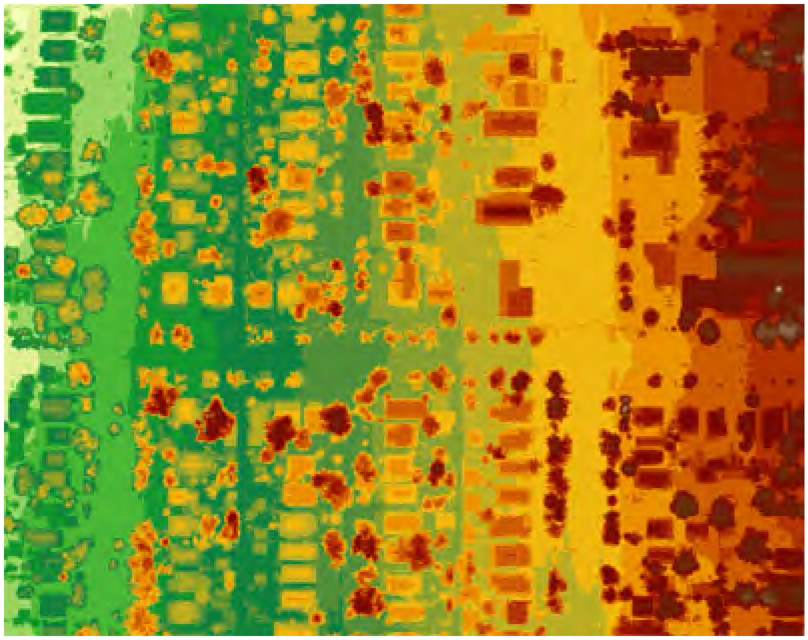

Figure 11: Digital Elevation Model

A digital elevation model containing pixels corresponding to roof outlines in the study areas was developed from LiDAR data by TOWILL by means of data classification. The digital elevation model was used to develop polygon outlines of each rooftop in the study area. The pixel regions were converted to rough polygons using a raster-to-feature function. The resulting polygons contained errors and irregular shapes, so the polygons were refined using a function to simplify the outlines. The shapes were analyzed and corrected against National Agricultural Information Program (NAIP) high-resolution orthorectified aerial imagery.

To the extent possible, roof edges obscured by LiDAR data from tree surfaces were restored to their original shapes. Misclassified pixels found around the edges of many roofs, which were actually upper wall edges, patios, awnings, etc., were removed from the roof surfaces. Secondary roof surfaces were identified to acknowledge the presence of split-level roofs, sheds, garages and other surfaces that may be stable, relatively flat surfaces that could potentially accommodate photovoltaic panels but which were not part of the main structure's primary roof. Roofs were then given unique identifiers based their tax lot identification number.

LiDAR Data Clean Up

LiDAR data are collected with sensitive equipment that is prone to capturing objects that should not be in the data. According to TOWILL, flocks of birds may be represented in the first return data as high altitude points. Obstructions generally show up in imagery as very small areas (i.e., one pixel representing 1 meter square), but given their altitude they cast a shadow which appears in the results as a long line of outlying values. Leaving these objects in the data could potentially impact results; therefore, they were identified and removed using mathematical focal functions which isolate outlying values. New elevation values for those points were calculated using nearest neighbor interpolation methods.

Missing data is another issue when working with LiDAR. This can create concern when consecutive points have missing data, or when points were not captured for large features on the ground. The LiDAR data collected for the study area had some missing data areas; fortunately there were no large hot spots of missing data which would have been difficult to interpolate accurately. Missing data was calculated by interpolating the values of immediate neighboring points. "No data" areas remained in a few spots where there was a lack of points to perform an interpolation of values; however those areas of missing data were generally at ground-level and their effect in the results was insignificant.

APPENDIX B

Minimum & Maximum Estimated Solar Insolation per Rooftop

Table 1 shows the estimated monthly and annual average solar insolation per rooftop. Values are shown as kilowatt hours per meter square. Roof IDs are equal to county parcel IDs. Multiple roofs within a single parcel are identified with an "_a" at the end of the roof ID.

Roof ID	Address	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
		meters²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²
1604151001	1318 E 200 S	143.68	22.82	31.61	50.87	62.75	76.33	82.34	84.72	77.35	63.11	45.54	25.91	19.63	642.98
1604151004	206 S UNIVERSITY ST	650.50	25.73	37.38	62.20	79.40	98.88	107.62	110.24	98.72	78.08	54.12	29.49	21.70	803.55
1604151005	220 S UNIVERSITY ST	147.11	8.23	12.97	25.44	40.29	57.50	65.36	65.24	52.02	33.16	18.22	9.28	6.95	394.65
1604151006	222 S UNIVERSITY ST	128.65	13.41	18.60	31.88	45.29	60.47	67.50	68.65	58.32	40.78	26.17	15.01	11.61	457.69
1604151007	232 S UNIVERSITY ST	243.67	19.51	28.02	46.72	60.87	76.62	83.68	85.64	76.22	59.09	40.30	22.29	16.51	615.45
1604151008	240 S UNIVERSITY ST	110.81	22.47	31.44	51.05	63.41	77.16	82.79	85.30	78.25	63.65	45.40	25.55	19.36	645.82
1604151011	252 S UNIVERSITY ST	209.30	22.68	31.98	53.46	68.45	85.19	92.45	94.77	84.96	67.00	46.14	25.71	19.53	692.33
1604151014	264 S UNIVERSITY ST	336.20	21.34	31.97	54.51	68.93	85.20	92.61	94.86	85.27	68.36	46.67	24.71	17.75	692.20
1604151015	274 S UNIVERSITY ST	1414.89	20.63	30.38	52.36	68.20	85.66	93.49	95.62	85.04	66.16	44.17	23.65	17.42	682.77
1604151016	248 S UNIVERSITY ST	224.64	21.23	30.88	52.83	67.97	85.02	92.60	94.69	84.28	66.23	44.86	24.18	18.18	682.94
1604151017	258 S UNIVERSITY ST	225.19	23.33	33.36	55.77	70.66	87.68	95.31	97.65	87.56	69.78	48.17	26.63	19.85	715.73
1604151018	1320 E 200 S # C	473.30	25.82	36.73	60.45	76.51	94.40	102.33	105.13	94.98	75.73	53.04	29.45	22.01	776.57
1604152001	1318 E 300 S	154.89	22.89	31.78	51.95	65.42	81.07	88.05	90.20	80.98	64.77	45.64	25.94	19.72	668.40
1604152002	1330 E 300 S	157.33	17.21	25.18	43.10	56.52	72.54	79.87	81.36	70.84	54.27	36.43	19.67	14.56	571.53
1604152003	1336-1338 E 300 S	191.71	20.02	29.72	51.70	68.11	86.22	94.56	96.51	85.05	65.22	43.19	22.90	16.95	680.14
1604152004	1342 E 300 S	169.11	17.05	25.12	43.15	56.85	72.29	78.99	80.67	70.99	54.44	36.36	19.52	14.46	569.89
1604152005	316 S UNIVERSITY ST	115.59	22.01	31.66	53.89	68.00	82.72	89.43	92.17	84.36	68.19	46.14	25.21	18.57	682.35
1604152006	316 S UNIVERSITY ST	152.38	19.79	29.32	50.03	62.44	74.79	80.10	83.04	77.53	63.47	43.50	22.88	16.70	623.59
1604301007	322 S UNIVERSITY ST	147.25	24.80	34.74	56.24	70.71	87.72	95.33	97.59	87.36	69.82	49.70	28.19	21.31	723.50
1604301008	328 S UNIVERSITY ST	88.20	7.97	11.72	20.82	31.41	45.94	52.92	52.14	39.72	25.80	15.91	8.87	6.79	320.02
1604301009	332 S UNIVERSITY ST	167.63	14.36	25.21	47.06	61.67	77.35	84.55	86.41	76.84	59.61	38.09	17.20	11.35	599.71
1604301010	340 S UNIVERSITY ST	116.45	8.80	12.29	22.08	39.61	61.46	71.46	70.35	51.97	28.12	15.44	9.50	7.68	398.76
1604301011	346 S UNIVERSITY ST	196.91	25.39	35.17	55.33	64.02	73.46	77.01	80.45	77.89	68.48	51.41	29.06	21.94	659.62
1604301013	356 S UNIVERSITY ST	182.46	20.24	28.40	46.94	59.53	73.48	79.30	81.38	73.41	58.62	40.79	23.00	17.39	602.47
1604301014	362 S UNIVERSITY ST	134.50	18.74	25.97	42.97	54.24	67.33	72.94	74.70	66.88	53.52	37.35	21.17	16.25	552.05

Roof ID	Address	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
		meters²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²
1604301015	368 S UNIVERSITY ST	118.70	20.22	31.77	57.41	76.40	95.91	104.79	107.31	95.59	73.32	46.87	23.53	16.59	749.72
1604301016	1319 E 400 S	95.56	11.72	19.14	36.88	52.48	68.95	76.62	77.92	66.86	47.95	28.29	13.54	9.70	510.04
1604301017	1321 E 400 S	72.24	9.44	16.27	33.79	50.54	68.71	77.35	78.16	64.80	44.03	24.34	10.99	7.71	486.13
1604301018	1327 E 400 S	117.65	13.73	21.40	39.55	53.84	68.50	75.31	77.08	68.08	51.12	31.77	15.91	11.45	527.74
1604301019	1333 E 400 S	108.71	19.53	28.80	50.12	66.97	85.80	94.09	95.93	83.89	63.40	41.55	22.30	16.49	668.88
1604301020	1337 E 400 S	113.07	17.89	24.84	41.77	55.26	70.17	76.98	78.47	68.87	52.31	35.40	20.08	15.58	557.62
1604301026	348 S UNIVERSITY ST	171.64	20.91	29.91	50.63	64.18	79.35	86.19	88.36	79.56	63.70	43.71	23.77	17.99	648.26
1604301027	352 S UNIVERSITY ST	171.23	18.94	26.48	44.81	59.02	75.14	82.51	84.03	73.56	56.28	37.85	21.36	16.35	596.34
1605127005	35 S 900 E	1386.33	16.88	25.39	45.27	61.32	78.69	86.81	88.60	77.42	57.68	37.00	19.35	14.21	608.62
1605127007	41 S 900 E	834.27	20.03	29.76	51.25	67.03	83.86	91.67	93.99	84.12	65.12	43.46	23.10	16.77	670.16
1605127009	59 S 900 E	146.47	14.23	24.01	44.96	60.52	76.85	85.05	86.94	76.76	58.13	36.30	16.82	11.56	592.13
1605127010	63 S 900 E	126.36	11.82	19.05	36.24	50.47	65.05	71.88	73.37	64.01	47.27	28.26	13.79	9.61	490.81
1605127017	12 S HAXTON PL	142.49	13.74	19.02	32.63	45.34	59.24	65.73	66.89	57.43	41.54	26.74	15.38	11.90	455.58
1605127018	16 S HAXTON PL	142.83	19.87	29.13	48.21	60.49	74.04	79.62	82.15	74.97	60.03	42.35	22.84	16.88	610.58
1605127019	22 S HAXTON PL	118.49	18.51	26.06	46.18	63.78	80.14	87.08	89.68	80.65	59.84	37.66	20.81	15.97	626.36
1605127020	32 S HAXTON PL	134.79	14.61	22.67	43.00	60.27	76.78	83.84	86.05	76.38	56.28	33.70	16.82	12.29	582.69
1605127021	35 S HAXTON PL	194.09	20.54	27.86	44.61	56.51	69.86	75.51	77.42	69.70	55.37	39.63	23.13	17.89	578.03
1605127027	927 E 100 S	181.32	9.41	14.55	27.27	39.72	53.70	60.29	60.90	50.76	35.13	20.98	10.70	7.93	391.34
1605127027_a	945 E 100 S	98.42	16.82	26.28	47.46	63.57	80.60	88.74	90.86	80.43	61.08	38.94	19.57	13.80	628.16
1605127028	945 E 100 S	211.17	15.70	22.99	40.65	55.05	71.36	78.85	80.06	69.04	51.58	33.23	17.78	13.49	549.78
1605127028_a	945 E 100 S	104.66	18.53	28.08	48.25	62.64	78.59	85.80	88.10	78.74	61.21	41.10	21.51	15.33	627.87
1605127029	919 E 100 S	147.49	18.01	24.75	39.98	49.63	60.14	64.65	66.61	61.12	49.70	35.57	20.39	15.58	506.14
1605127030	921 E 100 S	115.08	13.96	20.95	35.09	43.94	53.79	58.33	60.04	54.52	44.03	30.73	16.23	11.61	443.22
1605127033	75 S 900 E	197.28	21.72	30.34	48.34	58.19	69.48	74.60	77.23	71.96	60.27	44.19	24.85	18.64	599.81
1605128001	3-5 S HAXTON PL	194.93	17.98	26.02	44.59	58.96	75.57	83.52	84.96	73.81	56.05	37.42	20.40	15.39	594.68
1605128002	19 S HAXTON PL	234.08	9.64	14.33	26.73	43.01	61.50	69.99	70.08	55.79	35.03	19.95	10.75	8.24	425.06
1605128002_a	19 S HAXTON PL	102.30	9.50	17.67	39.15	55.32	70.66	77.66	79.75	70.67	52.07	28.13	11.32	7.66	519.55
1605128003	31 S HAXTON PL	171.40	19.55	26.92	44.06	57.55	73.62	81.81	83.10	72.14	55.10	38.19	22.07	16.90	591.02

Roof ID	Address	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
		meters²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²
1605128004	35 S HAXTON PL	196.82	18.83	25.43	40.68	52.04	65.37	71.22	72.81	64.67	50.52	36.02	21.18	16.44	535.21
1605128006	951 E 100 S	1986.43	23.52	34.04	58.07	75.80	95.62	104.66	106.97	94.59	73.15	49.29	26.79	20.04	762.54
1605128007	966 E SOUTHTEMPLE ST	230.46	19.29	26.92	44.09	56.58	71.37	78.06	79.56	70.16	54.75	38.39	21.81	16.66	577.65
1605128008	974 E SOUTHTEMPLE ST	219.37	20.47	27.95	46.37	60.27	75.85	82.83	84.55	74.82	58.03	39.78	22.93	17.92	611.76
1605128008_a	974 E SOUTHTEMPLE ST	212.93	21.26	32.39	55.33	71.45	89.28	97.59	99.92	89.16	69.65	47.35	24.67	17.64	715.69
1605128009	24-26 S 1000 E	193.27	19.58	27.12	47.17	63.06	79.42	86.54	88.67	78.88	60.31	38.92	21.95	17.06	628.68
1605128009_a	24-26 S 1000 E	129.94	10.60	17.17	35.40	53.35	70.90	79.48	80.65	68.42	47.41	25.54	12.21	8.79	509.93
1605128010	30 S 1000 E	159.05	18.29	25.74	42.98	54.48	67.92	74.38	75.65	66.84	53.36	37.01	20.65	15.84	553.15
1605128011	34 S 1000 E	216.12	17.20	26.52	47.33	62.25	78.59	86.46	88.57	78.26	60.24	39.09	19.99	14.20	618.67
1605128012	38 S 1000 E	133.16	21.10	29.51	48.13	60.58	73.94	79.64	81.86	74.70	60.09	42.51	24.05	18.09	614.19
1605128014	50-52 S 1000 E	99.028	11.21	16.06	26.91	41.25	59.83	68.82	68.29	53.17	33.1	21.5	12.6	9.365	422.14
1605128015	58 S 1000 E	368.55	16.26	25.07	45.36	62.26	80.91	89.53	91.05	78.70	58.01	36.72	18.68	13.70	616.26
1605128015_a	58 S 1000 E	124.28	10.67	16.71	32.32	47.00	61.82	68.89	70.11	60.20	42.42	24.67	12.21	8.93	455.96
1605128016	64 S 1000 E	129.53	21.55	29.43	48.06	59.09	70.98	76.42	78.92	73.09	60.31	42.78	24.43	18.78	603.82
1605128017	955 E 100 S	171.44	18.32	26.41	45.26	60.08	76.57	84.00	85.54	74.97	57.48	38.06	20.82	15.60	603.10
1605128019	975 E 100 S	213.93	21.06	29.81	49.34	63.29	78.98	85.82	87.85	78.57	61.89	42.90	23.95	18.00	641.45
1605134001	960 E 100 S # COM	547.00	25.19	36.86	62.53	81.42	102.55	111.95	114.29	101.66	79.01	53.28	28.81	21.42	818.96
1605135015	970 E 100 S	133.44	21.47	32.28	55.66	70.97	87.82	95.59	98.12	88.38	70.12	47.50	24.80	17.95	710.69
1605135016	120 S 1000 E	110.82	15.30	20.43	33.38	43.89	56.67	62.98	64.01	55.12	41.53	28.86	17.08	13.42	452.67
1605135017	128 S 1000 E	174.53	20.34	27.99	45.81	57.59	69.52	74.58	77.07	71.28	57.89	40.37	23.08	17.56	583.08
1605135018	130 S 1000 E	202.50	19.13	26.42	43.68	56.02	70.10	76.29	77.88	69.27	54.63	37.81	21.55	16.61	569.38
1605135019	150 S 1000 E	407.75	22.94	33.50	57.11	73.95	92.38	100.70	103.25	92.42	72.13	48.81	26.32	19.36	742.87
1605135027	160 S 1000 E	430.35	23.71	34.12	57.82	74.81	93.64	102.10	104.48	93.15	72.74	49.41	27.03	20.22	753.24
1605135028	170 S 1000 E	505.19	23.14	34.51	59.30	77.15	97.12	106.44	108.84	96.39	74.56	50.15	26.64	19.33	773.57
1605138001	908 E SOUTHTEMPLE ST	560.62	22.09	32.17	54.42	71.05	89.79	98.23	100.23	88.58	68.50	46.45	25.22	18.81	715.54
1605141001	926 E SOUTHTEMPLE ST	265.16	16.63	26.54	45.50	58.69	74.12	81.09	82.97	73.24	56.75	38.94	19.60	13.54	587.61
1605142001	42 S 1000 E	310.12	22.36	30.31	46.95	57.92	71.08	76.72	78.72	71.22	57.96	42.95	25.33	19.37	600.89
1605276001	205 S ELIZABETH ST	158.05	19.10	27.38	46.43	59.48	74.13	80.75	82.65	73.71	58.13	39.64	21.72	16.33	599.43

Roof ID	Address	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
		meters²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²
1605276002	209 S ELIZABETH ST	136.96	14.78	24.52	44.19	57.62	73.43	80.96	82.63	72.23	55.64	36.35	17.49	12.00	571.84
1605276003	219 S ELIZABETH ST	242.72	15.92	24.80	44.74	61.60	79.54	87.50	89.12	77.66	57.41	36.13	18.38	13.24	606.06
1605276004	235 S ELIZABETH ST	167.94	14.74	23.75	43.86	60.76	79.46	88.16	89.44	76.68	56.09	34.73	17.14	12.09	596.89
1605276005	239 S ELIZABETH ST	244.53	20.89	30.69	52.43	68.67	86.90	95.23	97.35	85.90	66.18	44.38	23.96	17.62	690.19
1605276006	243 S ELIZABETH ST	227.44	14.58	24.31	46.35	63.23	80.92	89.21	91.14	79.97	59.85	36.63	17.10	11.93	615.23
1605276007	263 S ELIZABETH ST	138.12	19.72	27.31	45.14	58.48	74.10	80.99	82.79	72.95	56.26	38.87	22.28	16.97	595.84
1605276009	1152 E 200 S	172.46	17.49	25.92	45.12	59.89	76.08	83.35	85.12	74.88	57.20	37.49	20.06	14.66	597.27
1605276011	206 S 1200 E	222.70	16.79	30.14	57.07	74.29	92.08	100.31	102.83	92.61	72.76	46.02	20.35	13.10	718.35
1605276012	214 S 1200 E	196.25	18.21	25.64	42.30	53.90	67.41	73.22	74.90	66.68	52.62	36.79	20.63	15.65	547.96
1605276013	222 S 1200 E	186.08	21.57	30.00	48.93	62.44	77.60	83.92	86.05	77.45	61.15	42.90	24.43	18.64	635.09
1605276014	226 S 1200 E	221.64	19.94	28.61	47.58	60.69	76.07	82.32	84.48	75.59	59.44	41.41	22.74	17.01	615.89
1605276015	228-230 S 1200 E	199.98	20.29	29.06	48.26	61.57	76.82	83.61	85.28	76.09	60.33	41.85	23.14	17.36	623.68
1605276016	238 S 1200 E	283.72	22.79	33.20	55.77	70.62	87.52	94.93	97.42	87.85	69.99	48.46	26.11	19.38	714.03
1605276017	242 S 1200 E	290.18	16.75	27.01	49.07	66.74	84.98	93.07	95.17	84.26	62.84	39.70	19.69	13.46	652.76
1605276018	250 S 1200 E	158.44	12.26	20.01	37.97	53.49	70.30	77.88	78.92	67.36	48.57	29.34	14.19	10.11	520.40
1605276019	256 S 1200 E	118.35	13.21	21.86	41.47	55.02	67.67	73.63	75.95	69.33	54.13	33.24	15.61	10.80	531.92
1605276020	270 S 1200 E	235.53	10.59	15.90	29.97	44.41	60.01	67.68	68.40	57.18	39.30	22.99	11.96	9.02	437.41
1605276021	274 S 1200 E	396.94	17.94	26.27	44.93	58.46	73.45	80.20	82.24	73.31	56.90	38.33	20.58	15.19	587.81
1605276024	1155 E 300 S	717.18	20.03	29.63	51.70	68.59	87.00	95.42	97.34	85.65	65.38	42.94	22.90	16.91	683.49
1605276024_a	1155 E 300 S	141.62	7.74	11.46	30.02	55.64	78.96	88.99	90.29	74.75	42.87	16.75	8.30	6.79	512.58
1605277001	1212 E 200 S	230.59	15.40	23.57	44.14	62.10	80.98	89.26	91.07	78.83	57.07	34.50	17.52	13.12	607.57
1605277002	217 S 1200 E	238.39	17.33	25.95	44.81	58.86	74.10	80.76	82.55	73.23	56.26	37.64	19.92	14.62	586.03
1605277003	221 S 1200 E	145.19	19.33	27.07	44.48	55.40	67.31	72.64	74.57	68.11	55.73	39.21	22.05	16.52	562.43
1605277004	225 S 1200 E	163.54	18.14	25.71	44.31	58.82	73.42	79.56	81.53	72.94	56.25	36.98	20.46	15.68	583.81
1605277005	229 S 1200 E	180.92	16.03	21.96	35.54	46.17	58.74	64.19	65.17	56.76	43.87	30.84	18.00	13.93	471.19
1605277006	235 S 1200 E	149.12	14.05	22.52	42.13	58.30	75.33	83.24	84.88	73.94	54.48	33.36	16.33	11.57	570.14
1605277007	241 S 1200 E	161.80	23.05	31.21	50.00	62.39	77.01	83.09	85.17	76.83	62.05	44.54	25.99	20.01	641.34
1605277008	245 S 1200 E	212.83	14.05	21.33	39.66	56.62	74.57	82.89	84.15	72.13	51.45	30.92	15.94	11.98	555.66

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		meters²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²
1605277009	253 S 1200 E	251.89	18.58	27.01	46.76	60.27	74.20	80.65	82.94	75.08	59.42	39.55	21.24	15.80	601.50
1605277010	259 S 1200 E	196.26	21.10	30.60	51.60	66.32	82.47	89.60	91.90	82.48	64.80	44.24	24.14	17.88	667.13
1605277011	263 S 1200 E	145.12	14.99	20.81	35.04	47.41	61.55	68.29	69.29	59.60	44.04	29.39	16.82	12.99	480.23
1605277012	206 S DOUGLAS ST	158.61	21.37	31.10	51.89	64.58	78.79	84.80	87.29	79.87	65.00	45.36	24.52	18.15	652.72
1605277013	208 S DOUGLAS ST	214.62	18.87	25.77	41.17	52.64	67.99	75.10	76.18	65.44	50.41	36.32	21.22	16.41	547.53
1605277013_a	208 S DOUGLAS ST	103.67	10.73	15.82	27.67	39.47	52.72	58.92	59.49	50.03	35.54	22.48	12.23	9.10	394.20
1605277014	216 S DOUGLAS ST	179.28	20.08	28.94	48.65	62.09	76.81	82.96	85.23	76.87	61.03	42.03	22.92	17.15	624.75
1605277015	220 S DOUGLAS ST	192.36	21.50	31.48	54.49	70.99	88.07	95.79	98.37	88.67	69.26	45.86	24.62	18.11	707.21
1605277016	228 S DOUGLAS ST	243.40	18.56	27.25	47.25	62.06	78.41	85.82	87.54	77.12	59.53	39.45	21.14	15.81	619.94
1605277017	234 S DOUGLAS ST	135.13	22.49	31.76	51.55	62.38	74.60	79.96	82.52	76.43	63.87	45.99	25.77	19.18	636.50
1605277018	238 S DOUGLAS ST	224.67	20.66	29.67	48.78	61.38	76.00	82.54	84.45	75.72	60.74	42.93	23.60	17.65	624.12
1605277019	244 S DOUGLAS ST	210.56	16.73	25.51	47.02	64.71	81.55	89.01	91.23	81.44	60.99	37.36	19.17	14.10	628.82
1605277020	252 S DOUGLAS ST	145.80	24.98	35.43	56.77	69.04	83.85	90.44	92.87	84.49	69.93	50.95	28.62	21.38	708.74
1605277021	258 S DOUGLAS ST	159.39	15.03	20.90	34.66	48.43	64.29	71.68	72.36	60.90	43.51	29.11	16.89	12.90	490.64
1605277022	266 S DOUGLAS ST	140.64	19.92	28.59	48.16	59.45	71.07	75.94	78.56	73.11	60.60	41.94	22.80	17.08	597.22
1605277023	1205 E 300 S	241.42	19.96	28.60	47.38	61.25	77.43	84.44	86.21	76.39	59.38	41.11	22.80	16.90	621.84
1605277024	1215 E 300 S	202.49	20.07	28.91	47.93	61.84	78.07	85.26	86.90	76.65	59.83	41.34	22.87	17.24	626.91
1605277025	1223 E 300 S	140.23	21.66	29.59	48.94	63.18	79.55	86.75	88.40	78.11	61.07	42.26	24.29	18.90	642.70
1605277026	1227 E 300 S	147.10	17.89	24.95	42.74	57.92	75.15	82.99	84.39	72.79	53.79	35.57	20.06	15.55	583.80
1605277027	1231 E 300 S	145.35	17.69	25.37	44.03	59.68	77.20	85.07	86.47	74.91	55.79	36.28	20.00	15.23	597.73
1605278001	1246 E 200 S	199.26	19.40	27.44	45.56	58.00	73.61	80.57	81.90	71.47	56.41	39.35	21.93	16.71	592.36
1605278001_a	1246 E 200 S	113.51	20.79	30.45	50.83	65.50	82.11	89.45	91.65	81.81	63.66	43.94	23.88	17.54	661.61
1605278002	209 S DOUGLAS ST	154.51	25.22	35.27	57.74	74.62	93.85	102.32	104.69	92.89	72.18	50.19	28.59	21.56	759.13
1605278003	215 S DOUGLAS ST	185.68	23.65	33.47	54.77	68.05	83.68	90.29	92.63	83.81	68.10	48.33	26.91	20.37	694.07
1605278004	219 S DOUGLAS ST	204.66	21.28	30.56	51.15	65.05	79.21	85.37	87.92	80.55	64.56	44.55	24.33	18.11	652.64
1605278005	227 S DOUGLAS ST	232.91	17.66	26.98	46.38	61.82	79.97	88.47	89.86	77.44	58.01	38.74	20.39	14.70	620.41
1605278006	233 S DOUGLAS ST	132.12	12.61	19.42	37.31	55.48	72.59	80.12	81.81	70.96	49.28	28.06	14.32	10.64	532.61
1605278007	239 S DOUGLAS ST	221.50	10.47	16.20	30.54	43.60	57.20	63.21	64.26	55.09	39.46	23.62	11.98	8.81	424.43

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1605278008	241 S DOUGLAS ST	124.76	20.41	30.56	52.25	63.15	74.71	79.87	83.00	78.27	65.99	45.76	23.86	16.89	634.69
1605278009	249 S DOUGLAS ST	181.31	19.47	27.42	46.24	60.13	75.68	82.39	84.16	74.80	57.94	39.42	21.99	16.82	606.44
1605278009_a	249 S DOUGLAS ST	111.38	16.38	24.91	44.76	61.98	80.84	89.40	90.91	78.22	57.08	35.98	18.76	13.77	612.98
1605278010	255 S DOUGLAS ST	173.31	20.64	30.00	50.70	64.60	80.39	87.47	89.80	80.48	64.03	43.59	23.71	17.45	652.86
1605278011	259 S DOUGLAS ST	190.88	20.07	29.74	49.65	63.84	79.74	86.66	88.64	79.24	62.32	43.01	23.11	17.08	643.10
1605278012	275 S DOUGLAS ST	327.75	23.57	33.14	54.81	69.69	86.35	93.71	96.14	86.55	68.71	47.87	26.75	20.28	707.58
1605278013	1259 E 300 S # NFF1	82.20	22.69	32.88	56.10	72.51	90.82	99.05	101.44	90.27	70.66	47.70	25.90	19.26	729.28
1605278014	1264 E 200 S	129.67	19.03	29.54	51.23	67.11	84.41	92.09	94.13	83.79	64.77	43.07	22.17	15.67	667.01
1605278015	1268 E 200 S	390.54	23.35	33.89	56.82	73.08	91.50	99.56	101.82	90.87	71.30	48.99	26.69	19.78	737.64
1605278016	208-212 S 1300 E	183.07	16.81	25.50	45.12	58.48	71.53	77.18	79.69	73.11	57.72	37.92	19.47	14.08	576.61
1605278016_a	208-212 S 1300 E	104.09	24.13	33.86	55.31	69.17	84.95	91.65	94.03	85.22	68.95	48.81	27.42	20.75	704.26
1605278017	216 S 1300 E	183.44	25.49	34.48	53.34	62.51	73.28	77.55	80.54	76.37	65.91	49.72	29.00	22.13	650.31
1605278018	222 S 1300 E	348.83	21.51	32.04	56.71	75.37	95.08	103.82	106.16	94.31	72.23	46.85	24.60	18.18	746.87
1605278019	224 S 1300 E	326.65	19.03	27.68	47.41	61.37	77.09	84.04	85.87	76.29	59.55	40.28	21.70	16.24	616.56
1605278020	226 S 1300 E	283.16	20.77	31.45	55.25	72.23	90.12	98.69	100.96	90.18	70.22	46.12	23.97	17.37	717.34
1605278021	238 S 1300 E	408.08	24.65	34.63	56.69	71.40	88.25	95.58	97.96	88.09	70.57	49.78	28.00	21.15	726.74
1605278023	252 S 1300 E	210.48	21.06	31.15	52.17	66.58	82.46	89.41	91.58	82.33	65.36	45.07	24.32	17.56	669.05
1605278024	258 S 1300 E	358.21	25.73	33.15	49.84	63.46	79.22	85.41	87.23	77.87	61.19	45.87	28.66	22.77	660.40
1605278027	1259 E 300 S	210.35	18.45	27.64	48.72	65.42	83.51	91.63	93.43	81.82	61.84	40.13	21.12	15.57	649.27
1605278029	280 S 1300 E	455.06	21.59	31.83	54.01	70.14	88.12	96.06	98.18	87.39	68.08	46.13	24.79	18.26	704.59
1605279001	1310 E 200 S	419.66	26.66	37.26	60.48	75.86	93.77	101.45	103.88	93.40	75.09	53.58	30.19	22.96	774.60
1605279002	215 S 1300 E	507.73	22.73	33.23	56.63	73.34	91.99	100.54	102.88	91.46	71.41	48.26	25.98	19.28	737.74
1605279003	221 S 1300 E	193.90	8.58	12.73	27.64	46.45	67.06	76.58	76.57	60.57	36.77	17.83	9.33	7.45	447.54
1605279005	235-255 S 1300 E	594.86	24.37	34.39	56.54	71.06	87.42	94.61	97.20	88.12	70.87	49.75	27.76	20.83	722.92
1605279006	273 S 1300 E	323.62	20.56	30.34	52.47	68.70	86.54	94.62	96.80	85.90	66.07	44.15	23.53	17.33	687.02
1605279008	227 S 1300 E # 1	414.24	26.14	36.95	60.35	76.22	94.65	102.70	105.09	94.28	75.29	53.05	29.72	22.34	776.77
1605279008_a	227 S 1300 E # 1	263.22	21.08	31.46	55.15	72.62	91.03	99.20	101.62	90.56	69.89	45.88	24.22	17.71	720.43
1605279009	227-231 S 1300 E	151.37	10.27	16.54	33.74	51.83	71.25	80.61	81.59	67.63	44.88	24.40	11.75	8.59	503.08

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1605280001	305 S 1200 E	185.54	15.25	21.24	34.50	44.24	56.22	61.75	62.57	54.22	42.32	29.96	17.20	13.19	452.65
1605280001_a	305 S 1200 E	114.73	19.68	27.96	45.85	55.57	65.50	70.00	72.47	68.22	57.43	40.97	22.65	16.72	563.03
1605280002	1224 E 300 S	248.14	13.87	20.28	34.21	46.35	61.74	69.04	69.52	58.03	42.27	28.65	15.78	11.72	471.46
1605280003	1228 E 300 S	158.89	8.82	13.05	23.47	37.14	58.09	67.95	66.78	48.24	28.76	17.24	9.71	7.57	386.82
1605280004	306 S DOUGLAS ST	145.17	17.14	24.85	40.80	52.39	66.72	73.31	74.19	64.45	49.87	35.21	19.56	14.51	532.98
1605280005	315 S 1200 E	347.28	14.51	21.40	37.80	52.36	68.64	76.38	77.65	66.68	48.25	30.92	16.55	12.28	523.42
1605280008	316 S DOUGLAS ST	133.64	17.19	25.02	43.79	60.81	79.60	88.49	90.08	77.34	56.19	35.77	19.54	14.63	608.45
1605281001	1250-1252 E 300 S	229.53	20.90	29.97	50.17	64.65	80.82	87.65	89.83	80.23	62.72	43.07	23.79	17.98	651.78
1605281002	305 S DOUGLAS ST	217.70	19.48	28.22	47.54	60.51	74.58	80.81	82.85	74.74	59.73	40.93	22.21	16.72	608.32
1605281003	315 S DOUGLAS ST	238.97	19.26	27.45	45.85	59.89	77.07	85.29	86.56	74.51	56.93	39.14	21.83	16.51	610.29
1605281004	304 S 1300 E	251.66	22.41	32.45	54.03	66.46	79.38	85.04	87.74	81.52	67.62	47.44	25.71	19.07	668.86
1605281005	310 S 1300 E	215.98	16.84	24.71	44.14	59.58	77.94	86.58	87.82	74.95	55.55	35.77	19.05	14.37	597.29
1605281006	316 S 1300 E	206.88	22.71	32.24	53.60	66.19	80.28	86.33	89.01	81.70	66.82	47.08	25.87	19.48	671.32
1605282002	1314 E 300 S	151.17	23.64	32.53	52.98	66.96	83.04	90.29	92.37	82.77	66.05	46.58	26.69	20.52	684.43
1605282003	309-311 S 1300 E	139.28	16.78	23.72	38.98	51.18	64.71	70.61	71.95	63.38	48.61	33.68	18.99	14.38	516.96
1605282003_a	309-311 S 1300 E	88.25	12.22	20.68	38.41	51.06	65.55	72.43	73.89	64.32	48.63	31.05	14.45	9.97	502.65
1605282004	315-319 S 1300 E	205.01	19.04	25.43	42.90	57.16	71.95	78.24	80.19	71.34	54.44	36.07	21.18	16.73	574.65
1605282004_a	315-319 S 1300 E	114.70	18.30	28.56	50.83	64.94	78.27	84.06	86.99	80.67	65.13	42.68	21.34	15.23	637.00
1605282005	303-305 S 1300 E	157.32	19.65	26.91	43.70	55.02	67.84	73.15	75.01	67.56	54.06	38.34	22.18	17.00	560.42
1605427001	321 S 1200 E	157.19	17.60	25.44	43.07	56.54	70.77	77.09	79.01	70.59	54.73	36.74	20.08	15.03	566.69
1605427002	327 S 1200 E	145.37	17.41	24.09	40.91	54.92	71.19	78.70	80.00	68.91	51.35	34.19	19.51	15.15	556.33
1605427003	333 S 1200 E	151.68	19.37	26.77	43.84	57.16	71.60	78.02	80.00	71.44	55.10	38.30	21.89	16.84	580.34
1605427004	337 S 1200 E	168.40	19.60	28.38	48.40	63.49	80.40	88.19	90.11	79.36	60.88	40.99	22.32	16.71	638.84
1605427005	343 S 1200 E	258.51	19.86	29.03	49.17	63.14	78.87	85.89	88.01	78.57	61.57	42.16	22.73	16.85	635.85
1605427006	351 S 1200 E	193.22	15.97	23.72	42.02	56.84	73.14	80.73	82.07	71.31	53.27	34.42	18.23	13.45	565.17
1605427007	357 S 1200 E	175.00	9.60	16.25	34.44	51.85	69.70	77.99	79.06	66.61	45.68	24.44	10.95	8.06	494.63
1605427009	322 S DOUGLAS ST	184.05	24.45	34.35	57.69	72.59	89.33	96.60	99.27	89.89	72.35	50.02	27.71	21.08	735.34
1605427010	330 S DOUGLAS ST	249.21	21.44	29.91	48.97	63.73	81.31	89.43	91.29	79.86	61.14	42.52	24.28	18.46	652.32

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1605427011	334 S DOUGLAS ST	198.11	21.35	29.60	49.23	61.62	75.32	81.30	83.33	75.57	61.25	42.74	24.11	18.45	623.87
1605427012	336 S DOUGLAS ST	186.12	22.17	30.81	49.68	63.33	78.31	84.64	87.01	78.63	62.19	43.95	25.28	18.84	644.84
1605427013	342 S DOUGLAS ST	185.22	20.38	28.13	46.71	60.51	76.38	83.59	85.28	75.18	58.50	40.17	22.93	17.77	615.53
1605427014	348 S DOUGLAS ST	265.35	20.84	29.41	49.42	64.26	81.15	88.44	90.44	79.99	61.85	42.37	23.53	18.07	649.78
1605427015	358 S DOUGLAS ST	199.28	24.14	34.48	57.55	72.33	88.23	94.95	97.84	89.50	72.31	50.07	27.59	20.51	729.49
1605427015_a	358 S DOUGLAS ST	105.73	18.55	27.84	50.09	67.53	85.02	92.98	95.39	85.14	64.36	40.86	21.18	15.73	664.67
1605427016	364 S DOUGLAS ST	218.76	19.90	29.26	49.70	64.71	82.08	90.12	91.93	80.72	62.37	42.22	22.85	16.74	652.60
1605427017	1203 E 400 S	167.59	18.87	26.33	42.45	52.98	64.82	70.10	71.90	65.24	52.98	37.83	21.46	16.27	541.23
1605427018	1209 E 400 S	162.26	21.43	28.87	44.94	53.91	64.27	68.65	70.99	66.28	55.75	41.53	24.27	18.70	559.57
1605427019	1215 E 400 S	153.51	19.76	29.12	50.20	65.63	82.83	90.92	92.91	81.99	63.47	42.28	22.63	16.76	658.51
1605427020	1219 E 400 S	111.51	16.56	25.32	44.69	60.13	76.73	84.63	86.18	75.37	57.08	36.84	19.18	13.68	596.40
1605427021	1225 E 400 S	122.95	16.43	24.07	42.64	57.63	73.73	81.13	82.56	71.97	54.15	34.79	18.68	13.91	571.68
1605427022	1231 E 400 S	110.20	16.01	22.84	38.91	52.32	66.70	73.30	75.02	66.13	49.70	32.88	18.21	13.71	525.72
1605428001	319 S DOUGLAS ST	186.93	19.41	30.26	51.20	64.85	80.01	86.72	89.19	80.76	64.25	44.35	22.72	16.16	649.89
1605428002	327 S DOUGLAS ST	228.20	13.01	19.49	36.49	53.45	70.92	78.76	80.13	68.29	47.41	28.02	14.64	11.15	521.75
1605428003	333 S DOUGLAS ST	157.03	17.72	25.73	42.02	52.53	64.83	70.27	71.81	64.30	51.81	36.92	20.35	15.01	533.30
1605428004	339 S DOUGLAS ST	191.50	19.61	27.34	45.27	59.13	74.58	81.88	83.65	74.01	56.93	39.09	22.21	16.83	600.54
1605428005	345 S DOUGLAS ST	193.03	19.39	26.92	45.54	58.99	73.97	80.62	82.24	72.78	57.01	38.66	21.79	16.85	594.76
1605428006	351 S DOUGLAS ST	203.53	16.18	23.18	39.12	52.71	67.97	74.84	76.05	65.81	49.30	32.86	18.40	13.77	530.18
1605428007	355 S DOUGLAS ST	220.88	16.90	24.26	41.83	55.53	71.01	78.08	79.73	69.80	53.10	35.09	19.17	14.50	558.99
1605428007_a	355 S DOUGLAS ST	111.24	13.35	20.65	38.44	54.73	72.07	80.22	81.20	69.16	49.55	30.03	15.28	11.23	535.90
1605428008	363 S DOUGLAS ST	117.65	22.77	31.34	51.43	63.61	76.74	82.26	84.93	78.46	64.42	45.51	25.75	19.78	646.99
1605428009	371 S DOUGLAS ST	137.14	16.13	25.37	46.35	63.03	80.94	89.48	91.20	79.56	59.19	37.19	18.70	13.27	620.40
1605428010	1253 E 400 S	197.39	23.60	32.76	53.31	66.70	81.53	87.87	90.37	82.33	66.52	47.08	26.77	20.34	679.18
1605428011	322 S 1300 E	193.13	22.85	31.91	52.70	67.30	84.75	92.60	94.59	83.50	65.47	45.78	25.83	19.73	686.99
1605428012	330 S 1300 E	253.63	22.67	32.38	54.14	69.71	87.40	95.19	97.34	86.53	67.73	46.61	25.79	19.39	704.88
1605428013	334 S 1300 E	283.91	21.77	30.80	52.14	67.34	84.14	91.64	93.71	83.53	65.56	44.34	24.62	18.82	678.40
1605428014	340 S 1300 E	229.82	22.25	33.05	56.35	71.88	89.17	97.09	99.41	89.01	70.70	48.16	25.63	18.67	721.38

Roof ID	Address	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
		meters²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²
1605428015	344 S 1300 E	139.62	23.52	33.45	55.00	69.46	85.69	92.73	95.09	85.87	68.95	48.26	26.83	20.06	704.90
1605428016	354 S 1300 E	245.25	15.31	24.59	46.28	63.97	82.37	90.83	92.42	80.38	59.52	36.26	17.69	12.72	622.34
1605428017	360 S 1300 E	175.70	23.42	32.68	52.27	64.11	77.16	82.77	85.55	79.19	65.12	47.17	26.78	20.05	656.27
1605428018	364 S 1300 E	225.05	22.27	32.21	53.80	67.91	84.02	91.32	93.67	84.23	67.39	46.83	25.46	18.99	688.08
1605428020	1259 E 400 S	106.37	20.99	30.14	50.87	65.67	81.39	88.41	90.66	81.54	64.23	43.53	23.86	18.04	659.33
1605428021	1263-1265 S 400 E	204.35	16.82	25.52	45.39	61.61	79.35	87.38	88.96	77.43	57.85	37.10	19.35	14.07	610.84
1605428022	1271 E 400 S	186.40	18.89	26.83	46.45	61.61	78.47	86.24	87.84	76.80	58.65	38.52	21.28	16.30	617.88
1605428023	378 S 1300 E	267.55	15.39	24.17	43.61	58.39	74.22	81.29	83.04	73.13	55.42	35.60	17.84	12.78	574.89
1605428024	1255-1261 E 400 S	138.54	24.09	33.97	57.29	73.21	90.47	98.14	100.81	91.00	72.16	49.28	27.27	20.77	738.47
1605428025	1255-1261 E 400 S	133.88	15.96	25.24	46.04	62.82	80.13	87.92	89.94	79.27	59.29	37.35	18.60	13.27	615.82
1605429001	327 S 1300 E	146.18	18.13	26.82	46.49	59.66	74.26	80.77	82.71	74.03	58.42	39.33	20.73	15.53	596.89
1605429001_a	327 S 1300 E	125.90	17.12	26.27	45.66	57.71	69.58	74.65	77.34	72.02	58.17	39.23	20.00	14.25	571.99
1605429002	333 S 1300 E	121.42	10.66	15.41	27.44	40.46	57.76	66.53	66.26	51.70	34.55	21.18	11.97	9.00	412.94
1605429003	339 S 1300 E	132.61	10.69	16.24	29.95	44.70	60.11	67.22	68.12	57.52	39.31	23.30	12.19	9.00	438.35
1605429004	343 S 1300 E	104.49	23.71	30.88	48.68	61.87	76.73	82.95	84.75	75.81	60.38	43.25	26.43	20.87	636.31
1605429006	355 S 1300 E	167.52	22.88	32.06	52.62	65.73	80.34	86.82	89.13	80.90	65.48	46.10	25.96	19.65	667.65
1605429007	357 S 1300 E	116.32	19.79	27.23	44.06	56.45	70.79	77.24	78.82	69.64	54.70	38.64	22.33	17.19	576.87
1605429008	361 S 1300 E	235.94	21.13	30.42	51.10	64.51	79.59	86.24	88.64	80.20	64.11	44.40	24.16	18.00	652.52
1605429009	367-369 S 1300 E	147.06	21.95	29.91	48.15	60.79	75.36	81.60	83.43	74.77	59.81	42.42	24.73	19.08	622.01
1605429011	1303 E 400 S	190.04	20.28	29.68	50.46	64.81	80.30	87.15	89.47	80.61	63.79	43.15	23.30	17.09	650.10
1605429012	1309 E 400 S	179.59	18.95	28.40	48.89	64.35	81.62	89.32	91.29	80.48	61.49	41.08	21.84	15.91	643.61
1605429013	1311 E 400 S	132.92	17.04	25.50	44.34	59.29	76.40	84.16	85.62	74.33	56.17	36.74	19.56	14.36	593.52
1605429014	351 S 1300 E	150.10	19.59	27.80	48.04	63.46	79.45	86.69	88.80	79.24	61.21	40.23	22.21	16.85	633.57

Table 2 shows estimated daily average solar insolation per month, minimum and maximum solar insolation per month, and it indicates the month when the minimum and maximum daily average occurs. Values are shown as kilowatt hours per meter square. Roof IDs are equal to county parcel IDs. Multiple roofs within a single parcel are identified with an "_a" at the end of the roof ID.

Roof ID	Location	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max	Max	Min	Min
		meter²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	Month	Month
1604151001	1318 E 200 S	143.68	1.51	2.31	3.36	4.28	5.04	5.61	5.59	5.10	4.30	3.01	1.77	1.30	5.61	Jun	1.30	Dec
1604151004	206 S UNIVERSITY ST	650.50	1.65	2.66	4.00	5.27	6.35	7.14	7.08	6.34	5.18	3.48	1.96	1.39	7.14	Jun	1.39	Dec
1604151005	220 S UNIVERSITY ST	147.11	0.54	0.94	1.67	2.73	3.77	4.42	4.27	3.41	2.24	1.19	0.63	0.46	4.42	Jun	0.46	Dec
1604151006	222 S UNIVERSITY ST	128.65	0.88	1.35	2.09	3.07	3.97	4.58	4.51	3.83	2.77	1.72	1.02	0.76	4.58	Jun	0.76	Dec
1604151007	232 S UNIVERSITY ST	243.67	1.23	1.95	2.94	3.96	4.82	5.44	5.39	4.80	3.84	2.54	1.45	1.04	5.44	Jun	1.04	Dec
1604151008	240 S UNIVERSITY ST	110.81	1.44	2.23	3.27	4.20	4.95	5.49	5.47	5.02	4.22	2.91	1.69	1.24	5.49	Jun	1.24	Dec
1604151011	252 S UNIVERSITY ST	209.30	1.45	2.26	3.41	4.51	5.43	6.09	6.04	5.42	4.41	2.94	1.69	1.24	6.09	Jun	1.24	Dec
1604151014	264 S UNIVERSITY ST	336.20	1.39	2.30	3.54	4.63	5.54	6.22	6.17	5.54	4.59	3.03	1.66	1.15	6.22	Jun	1.15	Dec
1604151015	274 S UNIVERSITY ST	1414.89	1.33	2.17	3.37	4.54	5.51	6.22	6.16	5.47	4.40	2.84	1.57	1.12	6.22	Jun	1.12	Dec
1604151016	248 S UNIVERSITY ST	224.64	1.36	2.19	3.38	4.50	5.44	6.13	6.06	5.40	4.38	2.87	1.60	1.16	6.13	Jun	1.16	Dec
1604151017	258 S UNIVERSITY ST	225.19	1.48	2.35	3.55	4.64	5.57	6.26	6.21	5.57	4.58	3.06	1.75	1.26	6.26	Jun	1.26	Dec
1604151018	1320 E 200 S # C	473.30	1.68	2.64	3.93	5.14	6.13	6.87	6.83	6.17	5.08	3.45	1.98	1.43	6.87	Jun	1.43	Dec
1604152001	1318 E 300 S	154.89	1.49	2.29	3.37	4.39	5.27	5.91	5.86	5.26	4.35	2.96	1.74	1.28	5.91	Jun	1.28	Dec
1604152002	1330 E 300 S	157.33	1.13	1.83	2.84	3.84	4.77	5.43	5.35	4.66	3.69	2.40	1.34	0.96	5.43	Jun	0.96	Dec
1604152003	1336-1338 E 300 S	191.71	1.28	2.11	3.31	4.50	5.52	6.25	6.18	5.44	4.31	2.76	1.51	1.08	6.25	Jun	1.08	Dec
1604152004	1342 E 300 S	169.11	1.10	1.80	2.79	3.80	4.67	5.28	5.22	4.59	3.64	2.35	1.30	0.94	5.28	Jun	0.94	Dec
1604152005	316 S UNIVERSITY ST	115.59	1.50	2.38	3.67	4.78	5.63	6.29	6.27	5.74	4.79	3.14	1.77	1.26	6.29	Jun	1.26	Dec
1604152006	316 S UNIVERSITY ST	152.38	1.23	2.02	3.11	4.01	4.64	5.14	5.16	4.81	4.07	2.70	1.47	1.04	5.16	Jul	1.04	Dec
1604301007	322 S UNIVERSITY ST	147.25	1.65	2.55	3.73	4.85	5.82	6.54	6.48	5.80	4.79	3.30	1.93	1.42	6.54	Jun	1.42	Dec
1604301008	328 S UNIVERSITY ST	88.20	0.53	0.86	1.37	2.14	3.03	3.61	3.44	2.62	1.76	1.05	0.60	0.45	3.61	Jun	0.45	Dec
1604301009	332 S UNIVERSITY ST	167.63	0.92	1.80	3.03	4.10	4.98	5.63	5.56	4.95	3.97	2.45	1.14	0.73	5.63	Jun	0.73	Dec
1604301010	340 S UNIVERSITY ST	116.45	0.55	0.85	1.37	2.55	3.82	4.59	4.38	3.23	1.81	0.96	0.61	0.48	4.59	Jun	0.48	Dec
1604301011	346 S UNIVERSITY ST	196.91	1.61	2.47	3.52	4.20	4.67	5.06	5.11	4.95	4.50	3.27	1.91	1.39	5.11	Jul	1.39	Dec
1604301013	356 S UNIVERSITY ST	182.46	1.31	2.03	3.03	3.97	4.74	5.29	5.25	4.74	3.91	2.63	1.53	1.12	5.29	Jun	1.12	Dec

Roof ID	Location	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max	Max	Min	Min
		meter²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	Month	Month
1604301014	362 S UNIVERSITY ST	134.50	1.22	1.88	2.80	3.66	4.39	4.92	4.87	4.36	3.61	2.44	1.43	1.06	4.92	Jun	1.06	Dec
1604301015	368 S UNIVERSITY ST	118.70	1.27	2.20	3.60	4.95	6.01	6.78	6.72	5.99	4.75	2.94	1.52	1.04	6.78	Jun	1.04	Dec
1604301016	1319 E 400 S	95.56	0.78	1.41	2.45	3.60	4.58	5.25	5.17	4.44	3.29	1.88	0.93	0.64	5.25	Jun	0.64	Dec
1604301017	1321 E 400 S	72.24	0.61	1.17	2.20	3.39	4.46	5.19	5.08	4.21	2.96	1.58	0.74	0.50	5.19	Jun	0.50	Dec
1604301018	1327 E 400 S	117.65	0.87	1.50	2.50	3.52	4.33	4.92	4.87	4.31	3.34	2.01	1.04	0.72	4.92	Jun	0.72	Dec
1604301019	1333 E 400 S	108.71	1.31	2.13	3.35	4.63	5.74	6.51	6.42	5.61	4.38	2.78	1.54	1.10	6.51	Jun	1.10	Dec
1604301020	1337 E 400 S	113.07	1.14	1.75	2.65	3.63	4.46	5.05	4.98	4.37	3.43	2.25	1.32	0.99	5.05	Jun	0.99	Dec
1604301026	348 S UNIVERSITY ST	171.64	1.34	2.12	3.24	4.25	5.08	5.71	5.66	5.10	4.22	2.80	1.57	1.15	5.71	Jun	1.15	Dec
1604301027	352 S UNIVERSITY ST	171.23	1.26	1.95	2.97	4.05	4.99	5.66	5.58	4.88	3.86	2.51	1.46	1.08	5.66	Jun	1.08	Dec
1605127005	35 S 900 E	1386.33	1.09	1.81	2.92	4.08	5.07	5.78	5.71	4.99	3.84	2.38	1.29	0.92	5.78	Jun	0.92	Dec
1605127007	41 S 900 E	834.27	1.29	2.12	3.30	4.46	5.40	6.10	6.05	5.42	4.33	2.80	1.54	1.08	6.10	Jun	1.08	Dec
1605127009	59 S 900 E	146.47	0.89	1.66	2.80	3.90	4.79	5.48	5.42	4.78	3.74	2.26	1.08	0.72	5.48	Jun	0.72	Dec
1605127010	63 S 900 E	126.36	0.76	1.37	2.34	3.37	4.21	4.81	4.75	4.14	3.16	1.83	0.92	0.62	4.81	Jun	0.62	Dec
1605127017	12 S HAXTON PL	142.49	0.90	1.38	2.14	3.07	3.89	4.46	4.39	3.77	2.82	1.75	1.04	0.78	4.46	Jun	0.78	Dec
1605127018	16 S HAXTON PL	142.83	1.27	2.07	3.09	4.00	4.74	5.27	5.26	4.80	3.97	2.71	1.51	1.08	5.27	Jun	1.08	Dec
1605127019	22 S HAXTON PL	118.49	1.16	1.80	2.89	4.12	5.01	5.63	5.61	5.04	3.87	2.35	1.34	1.00	5.63	Jun	1.00	Dec
1605127020	32 S HAXTON PL	134.79	0.99	1.69	2.90	4.20	5.18	5.84	5.80	5.15	3.92	2.27	1.17	0.83	5.84	Jun	0.83	Dec
1605127021	35 S HAXTON PL	194.09	1.29	1.94	2.80	3.66	4.38	4.90	4.86	4.37	3.59	2.49	1.50	1.12	4.90	Jun	1.12	Dec
1605127027	927 E 100 S	181.32	0.60	1.03	1.74	2.63	3.44	3.99	3.90	3.25	2.32	1.34	0.71	0.51	3.99	Jun	0.51	Dec
1605127027_a	945 E 100 S	98.42	1.01	1.74	2.85	3.94	4.83	5.50	5.45	4.82	3.78	2.33	1.21	0.83	5.50	Jun	0.83	Dec
1605127028_a	945 E 100 S	104.66	1.21	2.02	3.14	4.22	5.12	5.77	5.74	5.13	4.12	2.68	1.45	1.00	5.77	Jun	1.00	Dec
1605127028	945 E 100 S	211.17	1.04	1.68	2.69	3.76	4.72	5.39	5.30	4.57	3.53	2.20	1.22	0.89	5.39	Jun	0.89	Dec
1605127029	919 E 100 S	147.49	1.18	1.79	2.61	3.35	3.93	4.36	4.35	3.99	3.35	2.32	1.38	1.02	4.36	Jun	1.02	Dec
1605127030	921 E 100 S	115.08	0.90	1.49	2.26	2.93	3.47	3.88	3.87	3.51	2.93	1.98	1.08	0.75	3.88	Jun	0.75	Dec
1605127033	75 S 900 E	197.28	1.41	2.18	3.14	3.90	4.51	5.00	5.01	4.67	4.04	2.87	1.67	1.21	5.01	Jul	1.21	Dec
1605128001	3-5 S HAXTON PL	194.93	1.19	1.91	2.96	4.04	5.01	5.73	5.64	4.90	3.84	2.48	1.40	1.02	5.73	Jun	1.02	Dec
1605128002	19 S HAXTON PL	234.08	0.63	1.03	1.74	2.89	4.00	4.70	4.56	3.63	2.35	1.30	0.72	0.54	4.70	Jun	0.54	Dec
1605128002_a	19 S HAXTON PL	102.30	0.61	1.25	2.50	3.65	4.51	5.13	5.10	4.51	3.44	1.80	0.75	0.49	5.13	Jun	0.49	Dec

Roof ID	Location	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max	Max	Min	Min
		meter²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	Month	Month
1605128003	31 S HAXTON PL	171.40	1.28	1.95	2.88	3.89	4.81	5.53	5.43	4.72	3.72	2.50	1.49	1.11	5.53	Jun	1.11	Dec
1605128004	35 S HAXTON PL	196.82	1.21	1.81	2.62	3.46	4.21	4.74	4.69	4.16	3.36	2.32	1.41	1.06	4.74	Jun	1.06	Dec
1605128006	951 E 100 S	1986.43	1.52	2.43	3.75	5.05	6.17	6.98	6.90	6.10	4.88	3.18	1.79	1.29	6.98	Jun	1.29	Dec
1605128007	966 E SOUTHTEMPLE ST	230.46	1.23	1.89	2.80	3.71	4.53	5.12	5.05	4.46	3.59	2.44	1.43	1.06	5.12	Jun	1.06	Dec
1605128008	974 E SOUTHTEMPLE ST	219.37	1.28	1.94	2.90	3.90	4.75	5.36	5.30	4.69	3.76	2.49	1.48	1.12	5.36	Jun	1.12	Dec
1605128008_a	974 E SOUTHTEMPLE ST	212.93	1.32	2.23	3.44	4.60	5.56	6.28	6.22	5.55	4.48	2.95	1.59	1.10	6.28	Jun	1.10	Dec
1605128009_a	24-26 S 1000 E	129.94	0.68	1.21	2.26	3.52	4.53	5.25	5.15	4.37	3.13	1.63	0.81	0.56	5.25	Jun	0.56	Dec
1605128009	24-26 S 1000 E	193.27	1.27	1.94	3.06	4.22	5.14	5.79	5.74	5.11	4.04	2.52	1.47	1.11	5.79	Jun	1.11	Dec
1605128010	30 S 1000 E	159.05	1.14	1.78	2.68	3.52	4.24	4.80	4.73	4.18	3.44	2.31	1.33	0.99	4.80	Jun	0.99	Dec
1605128011	34 S 1000 E	216.12	1.11	1.90	3.06	4.16	5.08	5.78	5.73	5.06	4.03	2.53	1.34	0.92	5.78	Jun	0.92	Dec
1605128012	38 S 1000 E	133.16	1.34	2.08	3.07	3.99	4.71	5.24	5.21	4.76	3.95	2.71	1.58	1.15	5.24	Jun	1.15	Dec
1605128014	50-52 S 1000 E	99.03	0.74	1.18	1.78	2.82	3.96	4.70	4.52	3.52	2.26	1.42	0.86	0.62	4.70	Jun	0.62	Dec
1605128015	58 S 1000 E	368.55	1.03	1.76	2.87	4.07	5.12	5.85	5.76	4.98	3.79	2.32	1.22	0.87	5.85	Jun	0.87	Dec
1605128015_a	58 S 1000 E	124.28	0.70	1.21	2.11	3.18	4.04	4.65	4.58	3.94	2.87	1.61	0.83	0.58	4.65	Jun	0.58	Dec
1605128016	64 S 1000 E	129.53	1.39	2.11	3.11	3.95	4.59	5.10	5.10	4.72	4.03	2.76	1.63	1.21	5.10	Jun	1.21	Dec
1605128017	955 E 100 S	171.44	1.18	1.88	2.92	4.00	4.93	5.59	5.51	4.83	3.83	2.45	1.39	1.01	5.59	Jun	1.01	Dec
1605128019	975 E 100 S	213.93	1.39	2.18	3.25	4.31	5.21	5.85	5.80	5.18	4.22	2.83	1.63	1.19	5.85	Jun	1.19	Dec
1605134001	960 E 100 S # COM	547.00	1.62	2.62	4.02	5.41	6.59	7.43	7.34	6.53	5.25	3.42	1.91	1.38	7.43	Jun	1.38	Dec
1605135015	970 E 100 S	133.44	1.36	2.26	3.51	4.63	5.54	6.24	6.19	5.58	4.57	3.00	1.62	1.13	6.24	Jun	1.13	Dec
1605135016	120 S 1000 E	110.82	0.99	1.46	2.15	2.93	3.66	4.20	4.13	3.56	2.77	1.86	1.14	0.87	4.20	Jun	0.87	Dec
1605135017	128 S 1000 E	174.53	1.31	2.00	2.95	3.84	4.48	4.97	4.97	4.60	3.86	2.60	1.54	1.13	4.97	Jun	1.13	Dec
1605135018	130 S 1000 E	202.50	1.21	1.85	2.77	3.67	4.44	4.99	4.93	4.39	3.58	2.40	1.41	1.05	4.99	Jun	1.05	Dec
1605135019	150 S 1000 E	407.75	1.45	2.34	3.61	4.83	5.84	6.58	6.53	5.84	4.71	3.08	1.72	1.22	6.58	Jun	1.22	Dec
1605135027	160 S 1000 E	430.35	1.55	2.46	3.77	5.04	6.10	6.88	6.81	6.07	4.90	3.22	1.82	1.32	6.88	Jun	1.32	Dec
1605135028	170 S 1000 E	505.19	1.50	2.48	3.85	5.18	6.31	7.14	7.07	6.26	5.00	3.26	1.79	1.25	7.14	Jun	1.25	Dec
1605138001	908 E SOUTHTEMPLE ST	560.62	1.42	2.28	3.49	4.70	5.75	6.50	6.42	5.68	4.54	2.98	1.67	1.21	6.50	Jun	1.21	Dec
1605141001	926 E SOUTHTEMPLE ST	265.16	1.05	1.85	2.87	3.82	4.67	5.28	5.23	4.62	3.70	2.46	1.28	0.85	5.28	Jun	0.85	Dec
1605142001	42 S 1000 E	310.12	1.43	2.15	3.01	3.84	4.56	5.09	5.05	4.57	3.84	2.76	1.68	1.24	5.09	Jun	1.24	Dec

Roof ID	Location	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max	Max	Min	Min
		meter²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	Month	Month
1605276001	205 S ELIZABETH ST	158.05	1.28	2.03	3.11	4.12	4.97	5.60	5.54	4.94	4.03	2.66	1.51	1.10	5.60	Jun	1.10	Dec
1605276002	209 S ELIZABETH ST	136.96	0.95	1.74	2.83	3.82	4.71	5.36	5.30	4.63	3.68	2.33	1.16	0.77	5.36	Jun	0.77	Dec
1605276003	219 S ELIZABETH ST	242.72	1.03	1.78	2.90	4.13	5.16	5.87	5.79	5.04	3.85	2.35	1.23	0.86	5.87	Jun	0.86	Dec
1605276004	235 S ELIZABETH ST	167.94	0.94	1.67	2.79	4.00	5.06	5.80	5.69	4.88	3.69	2.21	1.13	0.77	5.80	Jun	0.77	Dec
1605276005	239 S ELIZABETH ST	244.53	1.37	2.23	3.45	4.66	5.71	6.47	6.40	5.65	4.49	2.92	1.63	1.16	6.47	Jun	1.16	Dec
1605276006	243 S ELIZABETH ST	227.44	0.93	1.71	2.95	4.16	5.15	5.87	5.80	5.09	3.94	2.33	1.13	0.76	5.87	Jun	0.76	Dec
1605276007	263 S ELIZABETH ST	138.12	1.24	1.91	2.85	3.81	4.68	5.28	5.22	4.60	3.67	2.45	1.45	1.07	5.28	Jun	1.07	Dec
1605276009	1152 E 200 S	172.46	1.15	1.89	2.97	4.07	5.01	5.67	5.60	4.93	3.89	2.47	1.36	0.96	5.67	Jun	0.96	Dec
1605276011	206 S 1200 E	222.70	1.07	2.13	3.64	4.89	5.87	6.60	6.55	5.90	4.79	2.93	1.34	0.83	6.60	Jun	0.83	Dec
1605276012	214 S 1200 E	196.25	1.17	1.83	2.72	3.59	4.34	4.87	4.82	4.29	3.50	2.37	1.37	1.01	4.87	Jun	1.01	Dec
1605276013	222 S 1200 E	186.08	1.42	2.18	3.21	4.24	5.10	5.69	5.65	5.09	4.15	2.82	1.66	1.22	5.69	Jun	1.22	Dec
1605276014	226 S 1200 E	221.64	1.29	2.05	3.07	4.05	4.91	5.49	5.45	4.88	3.97	2.67	1.52	1.10	5.49	Jun	1.10	Dec
1605276015	228-230 S 1200 E	199.98	1.34	2.12	3.18	4.19	5.06	5.69	5.62	5.01	4.11	2.76	1.58	1.14	5.69	Jun	1.14	Dec
1605276016	238 S 1200 E	283.72	1.53	2.46	3.73	4.88	5.86	6.56	6.52	5.88	4.84	3.24	1.81	1.30	6.56	Jun	1.30	Dec
1605276017	242 S 1200 E	290.18	1.08	1.93	3.17	4.46	5.50	6.22	6.15	5.45	4.20	2.57	1.32	0.87	6.22	Jun	0.87	Dec
1605276018	250 S 1200 E	158.44	0.82	1.48	2.54	3.69	4.69	5.37	5.27	4.50	3.35	1.96	0.98	0.67	5.37	Jun	0.67	Dec
1605276019	256 S 1200 E	118.35	0.88	1.61	2.76	3.78	4.50	5.06	5.05	4.61	3.72	2.21	1.07	0.72	5.06	Jun	0.72	Dec
1605276020	270 S 1200 E	235.53	0.69	1.15	1.96	3.01	3.93	4.58	4.48	3.75	2.66	1.51	0.81	0.59	4.58	Jun	0.59	Dec
1605276021	274 S 1200 E	396.94	1.16	1.89	2.92	3.92	4.77	5.38	5.34	4.76	3.82	2.49	1.38	0.99	5.38	Jun	0.99	Dec
1605276024_a	1155 E 300 S	141.62	0.48	0.79	1.86	3.57	4.90	5.71	5.61	4.64	2.75	1.04	0.53	0.42	5.71	Jun	0.42	Dec
1605276024	1155 E 300 S	717.18	1.29	2.12	3.34	4.58	5.62	6.37	6.29	5.53	4.36	2.77	1.53	1.09	6.37	Jun	1.09	Dec
1605277001	1212 E 200 S	230.59	0.98	1.66	2.81	4.08	5.15	5.87	5.80	5.02	3.75	2.20	1.15	0.84	5.87	Jun	0.84	Dec
1605277002	217 S 1200 E	238.39	1.15	1.90	2.96	4.02	4.90	5.52	5.46	4.84	3.84	2.49	1.36	0.97	5.52	Jun	0.97	Dec
1605277003	221 S 1200 E	145.19	1.23	1.91	2.84	3.65	4.30	4.79	4.76	4.35	3.67	2.50	1.45	1.05	4.79	Jun	1.05	Dec
1605277004	225 S 1200 E	163.54	1.14	1.78	2.78	3.81	4.60	5.15	5.11	4.57	3.64	2.32	1.33	0.98	5.15	Jun	0.98	Dec
1605277005	229 S 1200 E	180.92	1.04	1.58	2.32	3.11	3.83	4.32	4.25	3.70	2.95	2.01	1.21	0.91	4.32	Jun	0.91	Dec
1605277006	235 S 1200 E	149.12	0.92	1.64	2.77	3.96	4.95	5.65	5.58	4.86	3.70	2.19	1.11	0.76	5.65	Jun	0.76	Dec
1605277007	241 S 1200 E	161.80	1.48	2.22	3.21	4.14	4.95	5.52	5.47	4.94	4.12	2.86	1.73	1.29	5.52	Jun	1.29	Dec

Roof ID	Location	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max	Max	Min	Min
		meter²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	Month	Month
1605277008	245 S 1200 E	212.83	0.90	1.51	2.54	3.75	4.78	5.49	5.40	4.63	3.41	1.98	1.06	0.77	5.49	Jun	0.77	Dec
1605277009	253 S 1200 E	251.89	1.19	1.92	3.00	3.99	4.76	5.34	5.32	4.81	3.94	2.54	1.41	1.01	5.34	Jun	1.01	Dec
1605277010	259 S 1200 E	196.26	1.34	2.15	3.28	4.36	5.24	5.89	5.84	5.24	4.26	2.81	1.59	1.14	5.89	Jun	1.14	Dec
1605277011	263 S 1200 E	145.12	0.98	1.50	2.29	3.20	4.02	4.61	4.52	3.89	2.97	1.92	1.13	0.85	4.61	Jun	0.85	Dec
1605277012	206 S DOUGLAS ST	158.61	1.44	2.31	3.48	4.48	5.29	5.89	5.86	5.36	4.51	3.05	1.70	1.22	5.89	Jun	1.22	Dec
1605277013_a	208 S DOUGLAS ST	103.67	0.73	1.19	1.89	2.78	3.59	4.15	4.06	3.41	2.50	1.53	0.86	0.62	4.15	Jun	0.62	Dec
1605277013	208 S DOUGLAS ST	214.62	1.26	1.90	2.74	3.62	4.52	5.16	5.07	4.35	3.47	2.42	1.46	1.09	5.16	Jun	1.09	Dec
1605277014	216 S DOUGLAS ST	179.28	1.28	2.04	3.10	4.09	4.90	5.47	5.44	4.90	4.02	2.68	1.51	1.09	5.47	Jun	1.09	Dec
1605277015	220 S DOUGLAS ST	192.36	1.34	2.18	3.41	4.59	5.51	6.19	6.15	5.55	4.48	2.87	1.59	1.13	6.19	Jun	1.13	Dec
1605277016	228 S DOUGLAS ST	243.40	1.19	1.93	3.02	4.10	5.01	5.67	5.60	4.93	3.93	2.52	1.40	1.01	5.67	Jun	1.01	Dec
1605277017	234 S DOUGLAS ST	135.13	1.40	2.18	3.20	4.00	4.63	5.13	5.12	4.74	4.10	2.85	1.65	1.19	5.13	Jun	1.19	Dec
1605277018	238 S DOUGLAS ST	224.67	1.34	2.13	3.17	4.12	4.93	5.54	5.48	4.91	4.07	2.79	1.58	1.15	5.54	Jun	1.15	Dec
1605277019	244 S DOUGLAS ST	210.56	1.06	1.79	2.98	4.24	5.18	5.84	5.79	5.17	4.00	2.37	1.26	0.89	5.84	Jun	0.89	Dec
1605277020	252 S DOUGLAS ST	145.80	1.58	2.49	3.60	4.53	5.32	5.93	5.89	5.36	4.58	3.23	1.88	1.36	5.93	Jun	1.36	Dec
1605277021	258 S DOUGLAS ST	159.39	0.96	1.48	2.21	3.19	4.10	4.72	4.61	3.88	2.87	1.86	1.11	0.82	4.72	Jun	0.82	Dec
1605277022	266 S DOUGLAS ST	140.64	1.29	2.05	3.12	3.98	4.60	5.08	5.09	4.74	4.06	2.72	1.53	1.11	5.09	Jul	1.11	Dec
1605277023	1205 E 300 S	241.42	1.30	2.06	3.08	4.11	5.03	5.67	5.60	4.96	3.99	2.67	1.53	1.10	5.67	Jun	1.10	Dec
1605277024	1215 E 300 S	202.49	1.31	2.09	3.13	4.18	5.10	5.76	5.68	5.01	4.04	2.70	1.54	1.13	5.76	Jun	1.13	Dec
1605277025	1223 E 300 S	140.23	1.37	2.08	3.10	4.14	5.04	5.68	5.60	4.95	4.00	2.68	1.59	1.20	5.68	Jun	1.20	Dec
1605277026	1227 E 300 S	147.10	1.14	1.76	2.73	3.82	4.80	5.48	5.39	4.65	3.55	2.27	1.32	0.99	5.48	Jun	0.99	Dec
1605277027	1231 E 300 S	145.35	1.13	1.79	2.81	3.94	4.93	5.62	5.52	4.79	3.68	2.32	1.32	0.97	5.62	Jun	0.97	Dec
1605278001	1246 E 200 S	199.26	1.24	1.94	2.91	3.83	4.70	5.31	5.23	4.56	3.72	2.51	1.45	1.07	5.31	Jun	1.07	Dec
1605278001_a	1246 E 200 S	113.51	1.37	2.22	3.35	4.46	5.41	6.09	6.04	5.39	4.34	2.90	1.63	1.16	6.09	Jun	1.16	Dec
1605278002	209 S DOUGLAS ST	154.51	1.63	2.53	3.74	5.00	6.08	6.85	6.78	6.02	4.83	3.25	1.91	1.40	6.85	Jun	1.40	Dec
1605278003	215 S DOUGLAS ST	185.68	1.54	2.41	3.56	4.57	5.44	6.06	6.02	5.45	4.57	3.14	1.81	1.32	6.06	Jun	1.32	Dec
1605278004	219 S DOUGLAS ST	204.66	1.38	2.19	3.31	4.35	5.13	5.71	5.69	5.21	4.32	2.88	1.63	1.17	5.71	Jun	1.17	Dec
1605278005	227 S DOUGLAS ST	232.91	1.11	1.88	2.93	4.03	5.04	5.77	5.67	4.89	3.78	2.44	1.33	0.93	5.77	Jun	0.93	Dec
1605278006	233 S DOUGLAS ST	132.12	0.82	1.40	2.42	3.73	4.72	5.38	5.32	4.61	3.31	1.82	0.96	0.69	5.38	Jun	0.69	Dec

Roof ID	Location	Area meter²	Jan kWh/m²	Feb kWh/m²	Mar kWh/m²	Apr kWh/m²	May kWh/m²	Jun kWh/m²	Jul kWh/m²	Aug kWh/m²	Sep kWh/m²	Oct kWh/m²	Nov kWh/m²	Dec kWh/m²	Max kWh/m²	Max kWh/m²	Min Month	Min Month
1605278007	239 S DOUGLAS ST	221.50	0.69	1.18	2.01	2.96	3.76	4.29	4.22	3.62	2.68	1.55	0.81	0.58	4.29	Jun	0.58	Dec
1605278008	241 S DOUGLAS ST	124.76	1.36	2.25	3.48	4.35	4.98	5.50	5.53	5.22	4.54	3.05	1.64	1.13	5.53	Jul	1.13	Dec
1605278009	249 S DOUGLAS ST	181.31	1.29	2.02	3.07	4.13	5.03	5.65	5.59	4.97	3.98	2.62	1.51	1.12	5.65	Jun	1.12	Dec
1605278009_a	249 S DOUGLAS ST	111.38	1.07	1.80	2.92	4.18	5.28	6.03	5.94	5.11	3.85	2.35	1.27	0.90	6.03	Jun	0.90	Dec
1605278010	255 S DOUGLAS ST	173.31	1.26	2.03	3.09	4.07	4.91	5.52	5.48	4.91	4.04	2.66	1.50	1.07	5.52	Jun	1.07	Dec
1605278011	259 S DOUGLAS ST	190.88	1.27	2.09	3.15	4.19	5.06	5.69	5.63	5.03	4.09	2.73	1.52	1.08	5.69	Jun	1.08	Dec
1605278012	275 S DOUGLAS ST	327.75	1.52	2.36	3.53	4.64	5.56	6.23	6.19	5.57	4.57	3.08	1.78	1.31	6.23	Jun	1.31	Dec
1605278013	1259 E 300 S # NFF1	82.20	1.41	2.27	3.50	4.67	5.66	6.38	6.32	5.63	4.55	2.97	1.67	1.20	6.38	Jun	1.20	Dec
1605278014	1264 E 200 S	129.67	1.19	2.04	3.19	4.32	5.26	5.93	5.87	5.22	4.17	2.69	1.43	0.98	5.93	Jun	0.98	Dec
1605278015	1268 E 200 S	390.54	1.49	2.40	3.63	4.83	5.85	6.58	6.51	5.81	4.71	3.13	1.76	1.26	6.58	Jun	1.26	Dec
1605278016_a	208-212 S 1300 E	104.09	1.60	2.48	3.66	4.73	5.62	6.27	6.22	5.64	4.72	3.23	1.88	1.37	6.27	Jun	1.37	Dec
1605278016	208-212 S 1300 E	183.07	1.06	1.78	2.85	3.81	4.51	5.03	5.03	4.61	3.76	2.39	1.27	0.89	5.03	Jun	0.89	Dec
1605278017	216 S 1300 E	183.44	1.73	2.59	3.61	4.38	4.97	5.43	5.46	5.18	4.61	3.37	2.03	1.50	5.46	Jul	1.50	Dec
1605278018	222 S 1300 E	348.83	1.41	2.32	3.71	5.10	6.23	7.02	6.95	6.17	4.89	3.07	1.66	1.19	7.02	Jun	1.19	Dec
1605278019	224 S 1300 E	326.65	1.23	1.99	3.07	4.11	5.00	5.63	5.57	4.94	3.99	2.61	1.45	1.05	5.63	Jun	1.05	Dec
1605278020	226 S 1300 E	283.16	1.31	2.20	3.50	4.72	5.70	6.45	6.39	5.71	4.59	2.92	1.57	1.10	6.45	Jun	1.10	Dec
1605278021	238 S 1300 E	408.08	1.58	2.46	3.64	4.73	5.66	6.34	6.29	5.65	4.68	3.19	1.86	1.36	6.34	Jun	1.36	Dec
1605278023	252 S 1300 E	210.48	1.34	2.19	3.31	4.36	5.23	5.86	5.81	5.22	4.28	2.86	1.59	1.11	5.86	Jun	1.11	Dec
1605278024	258 S 1300 E	358.21	1.65	2.36	3.20	4.21	5.09	5.67	5.60	5.00	4.06	2.95	1.90	1.46	5.67	Jun	1.46	Dec
1605278027	1259 E 300 S	210.35	1.18	1.96	3.12	4.32	5.34	6.06	5.98	5.23	4.09	2.57	1.40	1.00	6.06	Jun	1.00	Dec
1605278029	280 S 1300 E	455.06	1.39	2.28	3.49	4.68	5.69	6.41	6.34	5.65	4.54	2.98	1.65	1.18	6.41	Jun	1.18	Dec
1605279001	1310 E 200 S	419.66	1.75	2.70	3.96	5.13	6.14	6.86	6.80	6.11	5.08	3.51	2.04	1.50	6.86	Jun	1.50	Dec
1605279002	215 S 1300 E	507.73	1.45	2.35	3.62	4.84	5.88	6.64	6.57	5.84	4.71	3.08	1.71	1.23	6.64	Jun	1.23	Dec
1605279003	221 S 1300 E	193.90	0.57	0.93	1.82	3.17	4.43	5.22	5.05	4.00	2.51	1.18	0.64	0.49	5.22	Jun	0.49	Dec
1605279005	235-255 S 1300 E	594.86	1.56	2.44	3.63	4.71	5.61	6.27	6.23	5.65	4.70	3.19	1.84	1.34	6.27	Jun	1.34	Dec
1605279006	273 S 1300 E	323.62	1.35	2.21	3.46	4.68	5.70	6.44	6.38	5.66	4.50	2.91	1.60	1.14	6.44	Jun	1.14	Dec
1605279008_a	227 S 1300 E # 1	263.22	1.35	2.23	3.53	4.81	5.83	6.57	6.51	5.80	4.63	2.94	1.60	1.14	6.57	Jun	1.14	Dec
1605279008	227 S 1300 E # 1	414.24	1.73	2.71	4.00	5.22	6.27	7.03	6.96	6.24	5.15	3.51	2.03	1.48	7.03	Jun	1.48	Dec

Roof ID	Location	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max	Max	Min	Min
		meter²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	Month	Month
1605279009	227-231 S 1300 E	151.37	0.67	1.19	2.19	3.48	4.62	5.40	5.29	4.39	3.01	1.58	0.79	0.56	5.40	Jun	0.56	Dec
1605280001	305 S 1200 E	185.54	0.96	1.47	2.16	2.86	3.52	4.00	3.92	3.40	2.74	1.88	1.11	0.83	4.00	Jun	0.83	Dec
1605280001_a	305 S 1200 E	114.73	1.24	1.95	2.88	3.61	4.12	4.55	4.55	4.29	3.73	2.57	1.47	1.05	4.55	Jul	1.05	Dec
1605280002	1224 E 300 S	248.14	0.89	1.45	2.20	3.08	3.98	4.59	4.48	3.74	2.81	1.84	1.05	0.75	4.59	Jun	0.75	Dec
1605280003	1228 E 300 S	158.89	0.58	0.95	1.54	2.52	3.82	4.61	4.39	3.17	1.95	1.13	0.66	0.50	4.61	Jun	0.50	Dec
1605280004	306 S DOUGLAS ST	145.17	1.06	1.70	2.51	3.34	4.11	4.67	4.57	3.97	3.18	2.17	1.25	0.89	4.67	Jun	0.89	Dec
1605280005	315 S 1200 E	347.28	0.92	1.50	2.40	3.43	4.35	5.00	4.92	4.23	3.16	1.96	1.08	0.78	5.00	Jun	0.78	Dec
1605280008	316 S DOUGLAS ST	133.64	1.08	1.75	2.76	3.96	5.02	5.77	5.68	4.88	3.66	2.25	1.27	0.92	5.77	Jun	0.92	Dec
1605281001	1250-1252 E 300 S	229.53	1.34	2.13	3.22	4.29	5.19	5.82	5.77	5.16	4.17	2.77	1.58	1.16	5.82	Jun	1.16	Dec
1605281002	305 S DOUGLAS ST	217.70	1.28	2.06	3.13	4.12	4.91	5.50	5.46	4.92	4.06	2.70	1.51	1.10	5.50	Jun	1.10	Dec
1605281003	315 S DOUGLAS ST	238.97	1.25	1.97	2.98	4.02	5.00	5.72	5.62	4.84	3.82	2.54	1.46	1.07	5.72	Jun	1.07	Dec
1605281004	304 S 1300 E	251.66	1.42	2.28	3.43	4.35	5.03	5.57	5.56	5.17	4.43	3.01	1.68	1.21	5.57	Jun	1.21	Dec
1605281005	310 S 1300 E	215.98	1.08	1.75	2.82	3.94	4.99	5.72	5.62	4.80	3.67	2.29	1.26	0.92	5.72	Jun	0.92	Dec
1605281006	316 S 1300 E	206.88	1.48	2.33	3.49	4.46	5.23	5.82	5.80	5.33	4.50	3.07	1.74	1.27	5.82	Jun	1.27	Dec
1605282002	1314 E 300 S	151.17	1.48	2.25	3.31	4.32	5.19	5.83	5.77	5.17	4.26	2.91	1.72	1.28	5.83	Jun	1.28	Dec
1605282003	309-311 S 1300 E	139.28	1.07	1.68	2.49	3.38	4.14	4.67	4.60	4.05	3.21	2.15	1.26	0.92	4.67	Jun	0.92	Dec
1605282003_a	309-311 S 1300 E	88.25	0.77	1.44	2.42	3.33	4.13	4.72	4.66	4.06	3.17	1.96	0.94	0.63	4.72	Jun	0.63	Dec
1605282004	315-319 S 1300 E	205.01	1.26	1.86	2.84	3.91	4.76	5.35	5.30	4.72	3.72	2.39	1.45	1.11	5.35	Jun	1.11	Dec
1605282004_a	315-319 S 1300 E	114.70	1.16	2.00	3.21	4.24	4.95	5.49	5.50	5.10	4.25	2.70	1.39	0.96	5.50	Jul	0.96	Dec
1605282005	303-305 S 1300 E	157.32	1.30	1.97	2.88	3.75	4.48	4.99	4.95	4.46	3.69	2.53	1.51	1.12	4.99	Jun	1.12	Dec
1605427001	321 S 1200 E	157.19	1.10	1.77	2.70	3.66	4.44	5.00	4.96	4.43	3.55	2.30	1.30	0.94	5.00	Jun	0.94	Dec
1605427002	327 S 1200 E	145.37	1.14	1.74	2.67	3.71	4.65	5.32	5.23	4.51	3.47	2.24	1.32	0.99	5.32	Jun	0.99	Dec
1605427003	333 S 1200 E	151.68	1.21	1.85	2.73	3.68	4.46	5.02	4.98	4.45	3.54	2.38	1.41	1.05	5.02	Jun	1.05	Dec
1605427004	337 S 1200 E	168.40	1.29	2.07	3.19	4.32	5.29	6.00	5.93	5.23	4.14	2.70	1.52	1.10	6.00	Jun	1.10	Dec
1605427005	343 S 1200 E	258.51	1.25	2.02	3.09	4.10	4.96	5.58	5.53	4.94	4.00	2.65	1.48	1.06	5.58	Jun	1.06	Dec
1605427006	351 S 1200 E	193.22	1.02	1.68	2.69	3.76	4.68	5.34	5.25	4.57	3.52	2.20	1.21	0.86	5.34	Jun	0.86	Dec
1605427007	357 S 1200 E	175.00	0.62	1.17	2.24	3.49	4.53	5.24	5.14	4.33	3.07	1.59	0.74	0.52	5.24	Jun	0.52	Dec
1605427009	322 S DOUGLAS ST	184.05	1.51	2.35	3.57	4.64	5.52	6.17	6.14	5.56	4.62	3.09	1.77	1.30	6.17	Jun	1.30	Dec

Roof ID	Location	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max	Max	Min	Min
		meter²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	Month	Month
1605427010	330 S DOUGLAS ST	249.21	1.38	2.13	3.16	4.25	5.24	5.96	5.89	5.15	4.07	2.74	1.62	1.19	5.96	Jun	1.19	Dec
1605427011	334 S DOUGLAS ST	198.11	1.37	2.09	3.15	4.07	4.81	5.37	5.33	4.83	4.05	2.73	1.59	1.18	5.37	Jun	1.18	Dec
1605427012	336 S DOUGLAS ST	186.12	1.47	2.25	3.28	4.32	5.17	5.78	5.75	5.20	4.25	2.90	1.73	1.24	5.78	Jun	1.24	Dec
1605427013	342 S DOUGLAS ST	185.22	1.31	2.00	3.00	4.02	4.91	5.56	5.48	4.84	3.89	2.58	1.52	1.14	5.56	Jun	1.14	Dec
1605427014	348 S DOUGLAS ST	265.35	1.32	2.07	3.14	4.22	5.16	5.81	5.75	5.08	4.06	2.69	1.55	1.15	5.81	Jun	1.15	Dec
1605427015	358 S DOUGLAS ST	199.28	1.51	2.38	3.59	4.67	5.51	6.13	6.11	5.59	4.67	3.13	1.78	1.28	6.13	Jun	1.28	Dec
1605427015_a	358 S DOUGLAS ST	105.73	1.17	1.94	3.15	4.39	5.34	6.04	6.00	5.35	4.18	2.57	1.38	0.99	6.04	Jun	0.99	Dec
1605427016	364 S DOUGLAS ST	218.76	1.30	2.12	3.25	4.38	5.37	6.10	6.02	5.29	4.22	2.76	1.55	1.10	6.10	Jun	1.10	Dec
1605427017	1203 E 400 S	167.59	1.22	1.89	2.75	3.55	4.20	4.69	4.66	4.23	3.55	2.45	1.44	1.05	4.69	Jun	1.05	Dec
1605427018	1209 E 400 S	162.26	1.49	2.23	3.13	3.88	4.48	4.95	4.95	4.62	4.02	2.90	1.75	1.30	4.95	Jul	1.30	Dec
1605427019	1215 E 400 S	153.51	1.30	2.13	3.31	4.47	5.46	6.20	6.13	5.41	4.33	2.79	1.54	1.11	6.20	Jun	1.11	Dec
1605427020	1219 E 400 S	111.51	1.05	1.78	2.84	3.94	4.87	5.55	5.47	4.78	3.74	2.34	1.26	0.87	5.55	Jun	0.87	Dec
1605427021	1225 E 400 S	122.95	1.02	1.65	2.64	3.68	4.56	5.19	5.11	4.45	3.46	2.15	1.19	0.86	5.19	Jun	0.86	Dec
1605427022	1231 E 400 S	110.20	1.07	1.69	2.60	3.62	4.46	5.07	5.02	4.42	3.44	2.20	1.26	0.92	5.07	Jun	0.92	Dec
1605428001	319 S DOUGLAS ST	186.93	1.25	2.15	3.28	4.30	5.13	5.75	5.72	5.18	4.26	2.84	1.51	1.04	5.75	Jun	1.04	Dec
1605428002	327 S DOUGLAS ST	228.20	0.87	1.45	2.45	3.70	4.75	5.46	5.37	4.58	3.28	1.88	1.01	0.75	5.46	Jun	0.75	Dec
1605428003	333 S DOUGLAS ST	157.03	1.17	1.88	2.77	3.57	4.27	4.78	4.73	4.23	3.53	2.43	1.38	0.99	4.78	Jun	0.99	Dec
1605428004	339 S DOUGLAS ST	191.50	1.27	1.96	2.93	3.95	4.82	5.47	5.41	4.79	3.81	2.53	1.48	1.09	5.47	Jun	1.09	Dec
1605428005	345 S DOUGLAS ST	193.03	1.20	1.84	2.82	3.77	4.57	5.15	5.08	4.50	3.64	2.39	1.39	1.04	5.15	Jun	1.04	Dec
1605428006	351 S DOUGLAS ST	203.53	1.05	1.67	2.55	3.55	4.43	5.04	4.96	4.29	3.32	2.14	1.24	0.90	5.04	Jun	0.90	Dec
1605428007_a	355 S DOUGLAS ST	111.24	0.86	1.48	2.48	3.65	4.65	5.35	5.24	4.47	3.31	1.94	1.02	0.72	5.35	Jun	0.72	Dec
1605428007	355 S DOUGLAS ST	220.88	1.07	1.69	2.64	3.62	4.48	5.09	5.03	4.40	3.46	2.21	1.25	0.91	5.09	Jun	0.91	Dec
1605428008	363 S DOUGLAS ST	117.65	1.46	2.23	3.30	4.22	4.93	5.46	5.46	5.04	4.28	2.92	1.71	1.27	5.46	Jun	1.27	Dec
1605428009	371 S DOUGLAS ST	137.14	1.04	1.81	2.99	4.20	5.22	5.97	5.88	5.13	3.95	2.40	1.25	0.86	5.97	Jun	0.86	Dec
1605428010	1253 E 400 S	197.39	1.56	2.40	3.52	4.55	5.38	6.00	5.97	5.44	4.54	3.11	1.83	1.34	6.00	Jun	1.34	Dec
1605428011	322 S 1300 E	193.13	1.51	2.33	3.48	4.59	5.59	6.32	6.24	5.51	4.47	3.02	1.76	1.30	6.32	Jun	1.30	Dec
1605428012	330 S 1300 E	253.63	1.44	2.27	3.43	4.57	5.55	6.24	6.18	5.49	4.44	2.96	1.69	1.23	6.24	Jun	1.23	Dec
1605428013	334 S 1300 E	283.91	1.40	2.20	3.36	4.49	5.43	6.11	6.05	5.39	4.37	2.86	1.64	1.21	6.11	Jun	1.21	Dec

Roof ID	Location	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max	Max	Min	Min
		meter²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²	Month	Month
1605428014	340 S 1300 E	229.82	1.39	2.29	3.52	4.65	5.58	6.27	6.22	5.57	4.57	3.01	1.66	1.17	6.27	Jun	1.17	Dec
1605428015	344 S 1300 E	139.62	1.47	2.31	3.44	4.48	5.35	5.99	5.94	5.36	4.45	3.01	1.73	1.25	5.99	Jun	1.25	Dec
1605428016	354 S 1300 E	245.25	0.94	1.67	2.84	4.06	5.05	5.76	5.67	4.93	3.77	2.22	1.12	0.78	5.76	Jun	0.78	Dec
1605428017	360 S 1300 E	175.70	1.49	2.30	3.33	4.22	4.91	5.45	5.45	5.04	4.29	3.00	1.76	1.28	5.45	Jul	1.28	Dec
1605428018	364 S 1300 E	225.05	1.47	2.36	3.56	4.64	5.55	6.24	6.19	5.57	4.60	3.10	1.74	1.26	6.24	Jun	1.26	Dec
1605428020	1259 E 400 S	106.37	1.36	2.16	3.30	4.40	5.27	5.92	5.87	5.28	4.30	2.82	1.60	1.17	5.92	Jun	1.17	Dec
1605428021	1263-1265 S 400 E	204.35	1.10	1.85	2.97	4.17	5.19	5.91	5.82	5.07	3.91	2.43	1.31	0.92	5.91	Jun	0.92	Dec
1605428022	1271 E 400 S	186.40	1.21	1.90	2.98	4.08	5.03	5.71	5.63	4.92	3.88	2.47	1.41	1.04	5.71	Jun	1.04	Dec
1605428023	378 S 1300 E	267.55	0.98	1.70	2.77	3.83	4.72	5.34	5.28	4.65	3.64	2.26	1.17	0.81	5.34	Jun	0.81	Dec
1605428024	1255-1261 E 400 S	138.54	1.55	2.42	3.68	4.87	5.82	6.52	6.48	5.85	4.80	3.17	1.81	1.34	6.52	Jun	1.34	Dec
1605428025	1255-1261 E 400 S	133.88	1.04	1.82	3.01	4.24	5.23	5.93	5.87	5.18	4.00	2.44	1.25	0.87	5.93	Jun	0.87	Dec
1605429001	327 S 1300 E	146.18	1.11	1.82	2.85	3.78	4.55	5.12	5.07	4.54	3.70	2.41	1.31	0.95	5.12	Jun	0.95	Dec
1605429001_a	327 S 1300 E	125.90	1.13	1.91	3.01	3.93	4.58	5.08	5.09	4.74	3.96	2.58	1.36	0.94	5.09	Jul	0.94	Dec
1605429002	333 S 1300 E	121.42	0.71	1.14	1.83	2.79	3.85	4.59	4.42	3.45	2.38	1.41	0.83	0.60	4.59	Jun	0.60	Dec
1605429003	339 S 1300 E	132.61	0.73	1.23	2.05	3.16	4.12	4.76	4.67	3.94	2.78	1.60	0.86	0.62	4.76	Jun	0.62	Dec
1605429004	343 S 1300 E	104.49	1.58	2.27	3.23	4.25	5.10	5.70	5.63	5.04	4.15	2.87	1.81	1.39	5.70	Jun	1.39	Dec
1605429006	355 S 1300 E	167.52	1.45	2.25	3.33	4.30	5.09	5.68	5.65	5.13	4.29	2.92	1.70	1.24	5.68	Jun	1.24	Dec
1605429007	357 S 1300 E	116.32	1.28	1.95	2.84	3.76	4.57	5.15	5.09	4.49	3.65	2.49	1.49	1.11	5.15	Jun	1.11	Dec
1605429008	361 S 1300 E	235.94	1.34	2.14	3.25	4.23	5.05	5.66	5.63	5.09	4.21	2.82	1.59	1.14	5.66	Jun	1.14	Dec
1605429009	367-369 S 1300 E	147.06	1.34	2.03	2.95	3.85	4.61	5.16	5.11	4.58	3.78	2.60	1.56	1.17	5.16	Jun	1.17	Dec
1605429011	1303 E 400 S	190.04	1.32	2.14	3.28	4.36	5.23	5.86	5.82	5.25	4.29	2.81	1.57	1.11	5.86	Jun	1.11	Dec
1605429012	1309 E 400 S	179.59	1.23	2.03	3.16	4.30	5.28	5.97	5.91	5.21	4.11	2.66	1.46	1.03	5.97	Jun	1.03	Dec
1605429013	1311 E 400 S	132.92	1.05	1.74	2.74	3.78	4.71	5.37	5.28	4.59	3.58	2.27	1.25	0.89	5.37	Jun	0.89	Dec
1605429014	351 S 1300 E	150.10	1.25	1.97	3.08	4.20	5.09	5.74	5.69	5.07	4.05	2.58	1.47	1.08	5.74	Jun	1.08	Dec

APPENDIX C

Estimated Total Number of Panels per Rooftop

and Estimated Energy per Rooftop

Table 1. Scenario 1 and 2 estimated maximum number of PV panels and kWh based on an average solar insolation input of 5.695 kWh/m² and 4.08 kWh/m² for scenario 1 and scenario 2 respectively. Roof IDs followed by "_a" identify a secondary building within a parcel. Scenario 1 results apply from May to September. Scenario 2 results includes all months.

Roof ID	Site Address	Parcel Land Use	Roof Area meters²	Scenario 1 # of panels	Scenario 1 kWh/Day	Scenario 1 kWh	Scenario 1 % usable roof	Scenario 2 # of panels	Scenario 2 kWh/Day	Scenario 2 kWh	Scenario 2 % usable roof
1604151001	1318 E 200 S	UNKNOWN	143.6835	24	17.19	2630.42	15.69	19	9.47	3456.55	12.42
1604151004	206 S UNIVERSITY ST	RETAIL STORE	650.5026	340	269.33	41207.96	49.10	331	177.61	64827.65	47.80
1604151005	220 S UNIVERSITY ST	DUPLEX	147.1055	0	0.00	0.00	0.00	0	0	0.00	0.00
1604151006	222 S UNIVERSITY ST	SINGLE FAMILY RESIDE	128.6451	14	9.96	1523.30	10.22	3	1.44	525.60	2.19
1604151007	232 S UNIVERSITY ST	CHURCH OR PUBLIC	243.6718	37	26.92	4118.64	14.26	26	13.34	4869.10	10.02
1604151008	240 S UNIVERSITY ST	SINGLE FAMILY RESIDE	110.8073	17	12.38	1894.14	14.41	15	7.55	2755.75	12.72
1604151011	252 S UNIVERSITY ST	SINGLE FAMILY RESIDE	209.2991	43	34.47	5274.64	19.30	42	24.43	8916.95	18.85
1604151014	264 S UNIVERSITY ST	SINGLE FAMILY RESIDE	336.1979	114	88.02	13467.26	31.85	85	49.04	17899.60	23.75
1604151015	274 S UNIVERSITY ST	CHURCH	1414.894	722	547.46	83761.46	47.93	420	233.6	85264.00	27.88
1604151016	248 S UNIVERSITY ST	SINGLE FAMILY RESIDE	224.6386	54	43.22	6612.80	22.58	54	30.22	11030.30	22.58
1604151017	258 S UNIVERSITY ST	SINGLE FAMILY RESIDE	225.1857	55	42.66	6527.04	22.94	50	28.79	10508.35	20.86
1604151018	1320 E 200 S # C	RETAIL STORE	473.3033	228	178.53	27314.60	45.25	216	115.23	42058.95	42.87
1604152001	1318 E 300 S	SINGLE FAMILY RESIDE	154.8868	22	16.78	2566.85	13.34	24	13.24	4832.60	14.56
1604152002	1330 E 300 S	SINGLE FAMILY RESIDE	157.3332	22	15.31	2342.30	13.14	7	3.45	1259.25	4.18
1604152003	1336-1338 E 300 S	DUPLEX	191.7078	60	46.03	7043.17	29.40	55	28.57	10428.05	26.95
1604152004	1342 E 300 S	SINGLE FAMILY RESIDE	169.1146	13	9.38	1434.66	7.22	5	2.61	952.65	2.78
1604152005	316 S UNIVERSITY ST	MULTIPLE RESIDENTIAL	115.5853	43	33.68	5153.48	34.95	42	22.58	8241.70	34.13
1604152006	316 S UNIVERSITY ST	SINGLE FAMILY RESIDE	152.3837	11	8.05	1231.68	6.78	8	4.2	1533.00	4.93
1604301007	322 S UNIVERSITY ST	FRATERNITY/SORORITY	147.2541	81	62.19	9515.54	51.67	77	40.49	14778.85	49.12
1604301008	328 S UNIVERSITY ST	SINGLE FAMILY RESIDE	88.20264	0	0.00	0.00	0.00	0	0	0.00	0.00
1604301009	332 S UNIVERSITY ST	SINGLE FAMILY RESIDE	167.6276	17	12.42	1900.69	9.53	8	4.34	1584.10	4.48
1604301010	340 S UNIVERSITY ST	DUPLEX	116.4484	0	0.00	0.00	0.00	0	0	0.00	0.00
1604301011	346 S UNIVERSITY ST	SINGLE FAMILY RESIDE	196.9054	34	26.01	3979.50	16.22	33	18.58	6781.70	15.74

Roof ID	Site Address	Parcel Land Use	Roof Area meters²	Scenario 1 # of panels	Scenario 1 kWh/Day	Scenario 1 kWh	Scenario 1 % usable roof	Scenario 2 # of panels	Scenario 2 kWh/Day	Scenario 2 kWh	Scenario 2 % usable roof
1604301013	356 S UNIVERSITY ST	3-4 UNIT APARTMENT	182.4639	27	21.50	3288.79	13.90	30	17.43	6361.95	15.44
1604301014	362 S UNIVERSITY ST	SINGLE FAMILY RESIDE	134.4994	18	13.71	2098.12	12.57	14	8.15	2974.75	9.78
1604301015	368 S UNIVERSITY ST	SINGLE FAMILY RESIDE	118.7013	52	39.93	6109.53	41.15	47	24.19	8829.35	37.19
1604301016	1319 E 400 S	SINGLE FAMILY RESIDE	95.55621	4	2.92	447.40	3.93	2	1.08	394.20	1.97
1604301017	1321 E 400 S	SINGLE FAMILY RESIDE	72.23743	4	2.76	421.54	5.20	0	0	0.00	0.00
1604301018	1327 E 400 S	SINGLE FAMILY RESIDE	117.6507	8	5.71	873.87	6.39	3	1.5	547.50	2.40
1604301019	1333 E 400 S	SINGLE FAMILY RESIDE	108.7107	38	28.22	4317.84	32.84	34	17.08	6234.20	29.38
1604301020	1337 E 400 S	SINGLE FAMILY RESIDE	113.0673	4	2.79	426.81	3.32	3	1.59	580.35	2.49
1604301026	348 S UNIVERSITY ST	SINGLE FAMILY RESIDE	171.6395	30	23.56	3604.52	16.42	31	17.27	6303.55	16.97
1604301027	352 S UNIVERSITY ST	SINGLE FAMILY RESIDE	171.2277	21	15.50	2371.90	11.52	13	7.1	2591.50	7.13
1605127005	35 S 900 E	NURSING HOSPITAL	1386.328	371	274.07	41933.44	25.14	231	118.13	43117.45	15.65
1605127007	41 S 900 E	NURSING HOSPITAL	834.2706	204	159.36	24381.99	22.97	176	97.79	35693.35	19.82
1605127009	59 S 900 E	MULTIPLE RESIDENTIAL	146.4693	30	22.21	3398.79	19.24	20	10.4	3796.00	12.83
1605127010	63 S 900 E	RESIDENCE IMPS ON CO	126.3632	10	6.76	1034.99	7.43	0	0	0.00	0.00
1605127017	12 S HAXTON PL	SINGLE FAMILY RESIDE	142.4884	0	0.00	0.00	0.00	0	0	0.00	0.00
1605127018	16 S HAXTON PL	SINGLE FAMILY RESIDE	142.8303	32	22.67	3469.11	21.05	21	10.88	3971.20	13.81
1605127019	22 S HAXTON PL	SINGLE FAMILY RESIDE	118.4881	35	26.31	4025.84	27.75	29	16.17	5902.05	22.99
1605127020	32 S HAXTON PL	SINGLE FAMILY RESIDE	134.79	26	19.69	3012.08	18.12	24	12.9	4708.50	16.73
1605127021	35 S HAXTON PL	SINGLE FAMILY RESIDE	194.0873	18	13.29	2034.08	8.71	17	9.43	3441.95	8.23
1605127027	927 E 100 S	SINGLE FAMILY RESIDE	181.3241	10	6.91	1057.89	5.18	0	0	0.00	0.00
1605127027_a	945 E 100 S	SINGLE FAMILY RESIDE	98.42355	24	16.97	2597.06	22.91	6	2.98	1087.70	5.73
1605127028_a	945 E 100 S	SINGLE FAMILY RESIDE	104.6624	23	16.45	2516.38	20.64	12	5.97	2179.05	10.77
1605127028	945 E 100 S	SINGLE FAMILY RESIDE	211.1706	6	4.39	672.42	2.67	4	2.05	748.25	1.78
1605127029	919 E 100 S	UNKNOWN	147.494	2	1.43	218.40	1.27	1	0.5	182.50	0.64
1605127030	921 E 100 S	SINGLE FAMILY RESIDE	115.0753	0	0.00	0.00	0.00	0	0	0.00	0.00
1605127033	75 S 900 E	CONVENIENCE STORE	197.2808	31	22.62	3461.14	14.76	27	13.63	4974.95	12.86
1605128001	3-5 S HAXTON PL	DUPLEX	194.9314	61	42.81	6549.85	29.40	13	6.6	2409.00	6.26
1605128002	19 S HAXTON PL	SINGLE FAMILY RESIDE	234.0765	6	4.15	635.37	2.41	0	0	0.00	0.00

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1605128002_a	19 S HAXTON PL	SINGLE FAMILY RESIDE	102.298	11	7.81	1195.18	10.10	2	1.01	368.65	1.84
1605128003	31 S HAXTON PL	SINGLE FAMILY RESIDE	171.4013	41	30.01	4591.33	22.47	19	10.74	3920.10	10.41
1605128004	35 S HAXTON PL	SINGLE FAMILY RESIDE	196.8178	15	11.01	1685.23	7.16	15	8.32	3036.80	7.16
1605128006	951 E 100 S	CHURCH	1986.431	917	721.95	110458.63	43.36	877	469.05	171203.25	41.47
1605128007	966 E SOUTHTEMPLE ST	SINGLE FAMILY RESIDE	230.4637	14	9.95	1522.92	5.71	15	7.66	2795.90	6.11
1605128008	974 E SOUTHTEMPLE ST	OTHER EXEMPT	219.3675	45	34.25	5239.88	19.27	42	23.41	8544.65	17.98
1605128008_a	974 E SOUTHTEMPLE ST	OTHER EXEMPT	212.9275	47	36.86	5639.15	20.73	45	23.95	8741.75	19.85
1605128009_a	24-26 S 1000 E	MULTIPLE RESIDENTIAL	129.9428	8	5.80	887.42	5.78	2	0.97	354.05	1.45
1605128009	24-26 S 1000 E	MULTIPLE RESIDENTIAL	193.265	42	32.01	4896.85	20.41	33	18.52	6759.80	16.04
1605128010	30 S 1000 E	SINGLE FAMILY RESIDE	159.0512	13	9.23	1411.84	7.68	8	3.91	1427.15	4.72
1605128011	34 S 1000 E	SINGLE FAMILY RESIDE	216.1243	36	27.72	4241.24	15.65	30	16.15	5894.75	13.04
1605128012	38 S 1000 E	SINGLE FAMILY RESIDE	133.1614	23	17.77	2718.47	16.22	21	11.88	4336.20	14.81
1605128014	50-52 S 1000 E	SINGLE FAMILY RESIDE	99.02797	2	1.36	207.90	1.90	1	0.5	182.50	0.95
1605128015	58 S 1000 E	10-19 UNIT APARTMENT	368.5505	159	122.57	18753.20	40.53	131	67.21	24531.65	33.39
1605128015_a	58 S 1000 E	10-19 UNIT APARTMENT	124.2836	0	0.00	0.00	0.00	0	0	0.00	0.00
1605128016	64 S 1000 E	UNKNOWN	129.5328	18	13.48	2062.83	13.05	19	10.83	3952.95	13.78
1605128017	955 E 100 S	5-9 UNIT APARTMENT	171.4358	15	10.72	1640.91	8.22	4	2.11	770.15	2.19
1605128019	975 E 100 S	OFFICE CONVERSION	213.9287	36	27.35	4184.79	15.81	32	17.5	6387.50	14.05
1605134001	960 E 100 S # COM	CONDOMINIUM TIMESHAR	546.9962	397	320.83	49086.77	68.18	368	203	74095.00	63.20
1605135015	970 E 100 S	SINGLE FAMILY RESIDE	133.4405	32	22.89	3502.27	22.53	12	6.21	2266.65	8.45
1605135016	120 S 1000 E	SINGLE FAMILY RESIDE	110.8156	2	1.39	213.42	1.70	6	3.01	1098.65	5.09
1605135017	128 S 1000 E	APARTMENT CONVERSION	174.5269	14	10.39	1590.17	7.54	13	7.18	2620.70	7.00
1605135018	130 S 1000 E	UNKNOWN	202.4962	29	22.40	3427.82	13.45	27	15.57	5683.05	12.52
1605135019	150 S 1000 E	MEDICAL OFFICE	407.7488	160	125.93	19267.55	36.86	143	76.29	27845.85	32.94
1605135027	160 S 1000 E	MEDICAL OFFICE	430.3495	150	117.82	18026.57	32.74	139	73.95	26991.75	30.34
1605135028	170 S 1000 E	OFFICE	505.195	367	285.77	43722.68	68.24	358	187.19	68324.35	66.57
1605138001	908 E SOUTHTEMPLE ST	CONDOMINIUM TIMESHAR	560.6207	207	158.35	24228.11	34.68	176	91.68	33463.20	29.49

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1605141001	926 E SOUTHTEMPLE ST	CONDOMINIUM UNIT	265.1553	74	52.46	8025.87	26.22	73	38.07	13895.55	25.86
1605142001	42 S 1000 E	CONDOMINIUM UNIT	310.1218	30	21.62	3307.33	9.09	28	15.74	5745.10	8.48
1605276001	205 S ELIZABETH ST	DUPLEX	158.048	45	33.54	5131.60	26.75	38	19.62	7161.30	22.59
1605276002	209 S ELIZABETH ST	SINGLE FAMILY RESIDE	136.9621	30	22.73	3478.22	20.58	23	12.03	4390.95	15.77
1605276003	219 S ELIZABETH ST	SINGLE FAMILY RESIDE	242.7163	62	47.13	7211.13	24.00	43	22.59	8245.35	16.64
1605276004	235 S ELIZABETH ST	SINGLE FAMILY RESIDE	167.9423	47	35.90	5493.25	26.29	37	18.84	6876.60	20.70
1605276005	239 S ELIZABETH ST	3-4 UNIT APARTMENT	244.5272	86	66.82	10222.90	33.04	80	41.95	15311.75	30.73
1605276006	243 S ELIZABETH ST	SINGLE FAMILY RESIDE	227.4428	72	52.09	7969.70	29.74	37	18.7	6825.50	15.28
1605276007	263 S ELIZABETH ST	SINGLE FAMILY RESIDE	138.1248	14	10.04	1536.86	9.52	9	4.62	1686.30	6.12
1605276009	1152 E 200 S	SINGLE FAMILY RESIDE	172.4639	25	18.36	2809.21	13.62	18	9.09	3317.85	9.80
1605276011	206 S 1200 E	3-4 UNIT APARTMENT	222.6958	102	77.91	11920.62	43.02	75	40.21	14676.65	31.64
1605276012	214 S 1200 E	SINGLE FAMILY RESIDE	196.2476	7	5.02	767.89	3.35	5	2.58	941.70	2.39
1605276013	222 S 1200 E	SINGLE FAMILY RESIDE	186.0761	38	29.53	4517.97	19.18	46	25.93	9464.45	23.22
1605276014	226 S 1200 E	SINGLE FAMILY RESIDE	221.6389	19	14.92	2283.26	8.05	14	8.27	3018.55	5.93
1605276015	228-230 S 1200 E	SINGLE FAMILY RESIDE	199.9769	39	29.92	4577.64	18.32	36	19.47	7106.55	16.91
1605276016	238 S 1200 E	SINGLE FAMILY RESIDE	283.7177	112	86.89	13294.17	37.08	87	49.26	17979.90	28.80
1605276017	242 S 1200 E	SINGLE FAMILY RESIDE	290.1803	100	75.42	11539.38	32.37	60	33.19	12114.35	19.42
1605276018	250 S 1200 E	SINGLE FAMILY RESIDE	158.4388	37	26.49	4052.57	21.94	11	5.5	2007.50	6.52
1605276019	256 S 1200 E	SINGLE FAMILY RESIDE	118.3537	8	5.71	872.90	6.35	5	2.57	938.05	3.97
1605276020	270 S 1200 E	SINGLE FAMILY RESIDE	235.5349	10	7.60	1162.57	3.99	9	4.98	1817.70	3.59
1605276021	274 S 1200 E	SINGLE FAMILY RESIDE	396.9357	34	26.91	4116.50	8.05	34	19.75	7208.75	8.05
1605276024_a	1155 E 300 S	APARTMENT 20-49 UNIT	141.6225	64	46.55	7122.91	42.45	0	0	0.00	0.00
1605276024	1155 E 300 S	APARTMENT 20-49 UNIT	717.1847	365	284.07	43462.60	47.81	329	171.74	62685.10	43.09
1605277001	1212 E 200 S	SINGLE FAMILY RESIDE	230.5922	45	33.60	5141.16	18.33	29	15.59	5690.35	11.81
1605277002	217 S 1200 E	DUPLEX	238.3894	20	14.79	2263.48	7.88	9	5.13	1872.45	3.55
1605277003	221 S 1200 E	SINGLE FAMILY RESIDE	145.1868	20	15.02	2297.50	12.94	24	13.35	4872.75	15.53
1605277004	225 S 1200 E	SINGLE FAMILY RESIDE	163.5374	23	17.15	2624.15	13.21	23	12.33	4500.45	13.21
1605277005	229 S 1200 E	SINGLE FAMILY RESIDE	180.9163	15	11.04	1688.78	7.79	14	7.57	2763.05	7.27

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1605277006	235 S 1200 E	SINGLE FAMILY RESIDE	149.1182	18	13.45	2057.29	11.34	14	7.53	2748.45	8.82
1605277007	241 S 1200 E	5-9 UNIT APARTMENT	161.8021	19	14.36	2197.22	11.03	19	10.95	3996.75	11.03
1605277008	245 S 1200 E	SINGLE FAMILY RESIDE	212.8285	29	20.81	3184.08	12.80	8	4.06	1481.90	3.53
1605277009	253 S 1200 E	SINGLE FAMILY RESIDE	251.8917	41	30.98	4739.49	15.29	39	21.71	7924.15	14.54
1605277010	259 S 1200 E	SINGLE FAMILY RESIDE	196.2624	45	35.20	5384.91	21.54	42	22.94	8373.10	20.10
1605277011	263 S 1200 E	SINGLE FAMILY RESIDE	145.1248	18	13.40	2050.26	11.65	17	8.44	3080.60	11.00
1605277012	206 S DOUGLAS ST	SINGLE FAMILY RESIDE	158.6148	30	22.32	3414.47	17.77	28	14.4	5256.00	16.58
1605277013_a	208 S DOUGLAS ST	MULTIPLE RESIDENTIAL	103.6661	7	4.77	729.50	6.34	0	0	0.00	0.00
1605277013	208 S DOUGLAS ST	MULTIPLE RESIDENTIAL	214.6194	20	15.05	2302.32	8.75	21	11.84	4321.60	9.19
1605277014	216 S DOUGLAS ST	SINGLE FAMILY RESIDE	179.2765	34	26.19	4007.66	17.81	34	17.86	6518.90	17.81
1605277015	220 S DOUGLAS ST	SINGLE FAMILY RESIDE	192.3642	49	37.56	5746.00	23.93	42	23.16	8453.40	20.51
1605277016	228 S DOUGLAS ST	DUPLEX	243.4003	42	32.50	4972.74	16.21	36	19.27	7033.55	13.89
1605277017	234 S DOUGLAS ST	SINGLE FAMILY RESIDE	135.1336	11	8.42	1288.31	7.65	15	8.33	3040.45	10.43
1605277018	238 S DOUGLAS ST	SINGLE FAMILY RESIDE	224.6682	35	26.23	4013.40	14.63	32	17.6	6424.00	13.38
1605277019	244 S DOUGLAS ST	SINGLE FAMILY RESIDE	210.561	48	36.70	5614.94	21.41	36	19.89	7259.85	16.06
1605277020	252 S DOUGLAS ST	SINGLE FAMILY RESIDE	145.802	19	14.25	2179.54	12.24	18	10.11	3690.15	11.60
1605277021	258 S DOUGLAS ST	SINGLE FAMILY RESIDE	159.3901	10	7.23	1106.82	5.89	10	5.32	1941.80	5.89
1605277022	266 S DOUGLAS ST	SINGLE FAMILY RESIDE	140.6436	14	10.53	1611.21	9.35	14	7.73	2821.45	9.35
1605277023	1205 E 300 S	SINGLE FAMILY RESIDE	241.421	20	15.44	2363.02	7.78	21	11.32	4131.80	8.17
1605277024	1215 E 300 S	APARTMENT CONVERSION	202.4895	24	17.38	2659.44	11.13	17	8.69	3171.85	7.89
1605277025	1223 E 300 S	SINGLE FAMILY RESIDE	140.2267	17	12.65	1935.86	11.39	15	7.93	2894.45	10.05
1605277026	1227 E 300 S	SINGLE FAMILY RESIDE	147.1	10	7.65	1170.10	6.39	12	6.48	2365.20	7.66
1605277027	1231 E 300 S	3-4 UNIT APARTMENT	145.3516	11	7.88	1205.01	7.11	5	2.58	941.70	3.23
1605278001	1246 E 200 S	SINGLE FAMILY RESIDE	199.2629	25	20.01	3061.69	11.79	25	14.4	5256.00	11.79
1605278001_a	1246 E 200 S	SINGLE FAMILY RESIDE	113.5118	36	26.49	4053.06	29.79	34	16.91	6172.15	28.14
1605278002	209 S DOUGLAS ST	CHURCH OR PUBLIC	154.5081	101	79.97	12236.15	61.40	98	52.62	19206.30	59.58
1605278003	215 S DOUGLAS ST	SINGLE FAMILY RESIDE	185.6789	30	22.84	3494.04	15.18	31	16.88	6161.20	15.68
1605278004	219 S DOUGLAS ST	SINGLE FAMILY RESIDE	204.6562	41	30.82	4716.22	18.82	46	24.58	8971.70	21.11

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1605278005	227 S DOUGLAS ST	SINGLE FAMILY RESIDE	232.9136	46	35.18	5383.00	18.55	45	24.54	8957.10	18.15
1605278006	233 S DOUGLAS ST	SINGLE FAMILY RESIDE	132.1226	15	10.94	1673.16	10.66	8	4.11	1500.15	5.69
1605278007	239 S DOUGLAS ST	SINGLE FAMILY RESIDE	221.4976	11	7.64	1168.57	4.67	0	0	0.00	0.00
1605278008	241 S DOUGLAS ST	SINGLE FAMILY RESIDE	124.7618	20	14.97	2290.59	15.06	22	12.02	4387.30	16.56
1605278009	249 S DOUGLAS ST	SINGLE FAMILY RESIDE	181.306	29	21.80	3335.88	15.03	23	12.74	4650.10	11.92
1605278009_a	249 S DOUGLAS ST	SINGLE FAMILY RESIDE	111.3759	8	6.26	957.84	6.75	8	4.07	1485.55	6.75
1605278010	255 S DOUGLAS ST	SINGLE FAMILY RESIDE	173.3061	26	19.36	2962.55	14.09	23	12.08	4409.20	12.47
1605278011	259 S DOUGLAS ST	SINGLE FAMILY RESIDE	190.8798	35	26.77	4096.27	17.22	36	19.24	7022.60	17.72
1605278012	275 S DOUGLAS ST	SINGLE FAMILY RESIDE	327.7535	119	87.96	13457.33	34.11	90	47.01	17158.65	25.79
1605278013	1259 E 300 S # NFF1	VACANT RESIDENTIAL L	82.19913	34	25.58	3913.31	38.85	34	17.32	6321.80	38.85
1605278014	1264 E 200 S	3-4 UNIT APARTMENT	129.667	49	36.92	5648.74	35.50	41	20.88	7621.20	29.70
1605278015	1268 E 200 S	10-19 UNIT APARTMENT	390.5395	181	148.52	22723.71	43.54	183	102.62	37456.30	44.02
1605278016_a	208-212 S 1300 E	MIXED RETAIL	104.0892	28	22.60	3457.67	25.27	28	15.13	5522.45	25.27
1605278016	208-212 S 1300 E	MIXED RETAIL	183.0711	10	7.59	1161.35	5.13	10	5.21	1901.65	5.13
1605278017	216 S 1300 E	OFFICE CONVERSION	183.4444	16	12.76	1951.62	8.19	15	8.86	3233.90	7.68
1605278018	222 S 1300 E	FAST FOOD RESTAURANT	348.8272	181	142.02	21729.37	48.74	171	90.34	32974.10	46.05
1605278019	224 S 1300 E	RESTAURANT	326.6493	6	4.64	709.58	1.73	9	4.86	1773.90	2.59
1605278020	226 S 1300 E	RESTAURANT	283.1552	57	44.63	6829.14	18.91	53	28.45	10384.25	17.58
1605278021	238 S 1300 E	RESTAURANT	408.0846	136	106.91	16357.95	31.31	125	69.69	25436.85	28.77
1605278023	252 S 1300 E	MIXED RETAIL	210.4789	44	33.83	5175.70	19.64	44	24.16	8818.40	19.64
1605278024	258 S 1300 E	RESTAURANT	358.207	140	105.28	16107.34	36.71	140	82.24	30017.60	36.71
1605278027	1259 E 300 S	UNKNOWN	210.346	51	38.92	5954.25	22.78	41	22.02	8037.30	18.31
1605278029	280 S 1300 E	BANK	455.0582	185	148.73	22755.49	38.19	179	97.34	35529.10	36.95
1605279001	1310 E 200 S	MIXED RETAIL	419.662	242	197.15	30164.68	54.17	250	139.92	51070.80	55.96
1605279002	215 S 1300 E	UNKNOWN	507.7339	262	207.19	31699.80	48.47	246	131.41	47964.65	45.51
1605279003	221 S 1300 E	UNKNOWN	193.8981	9	6.45	986.76	4.36	0	0	0.00	0.00
1605279005	235-255 S 1300 E	BANK	594.8639	216	167.96	25698.21	34.11	203	112.66	41120.90	32.06

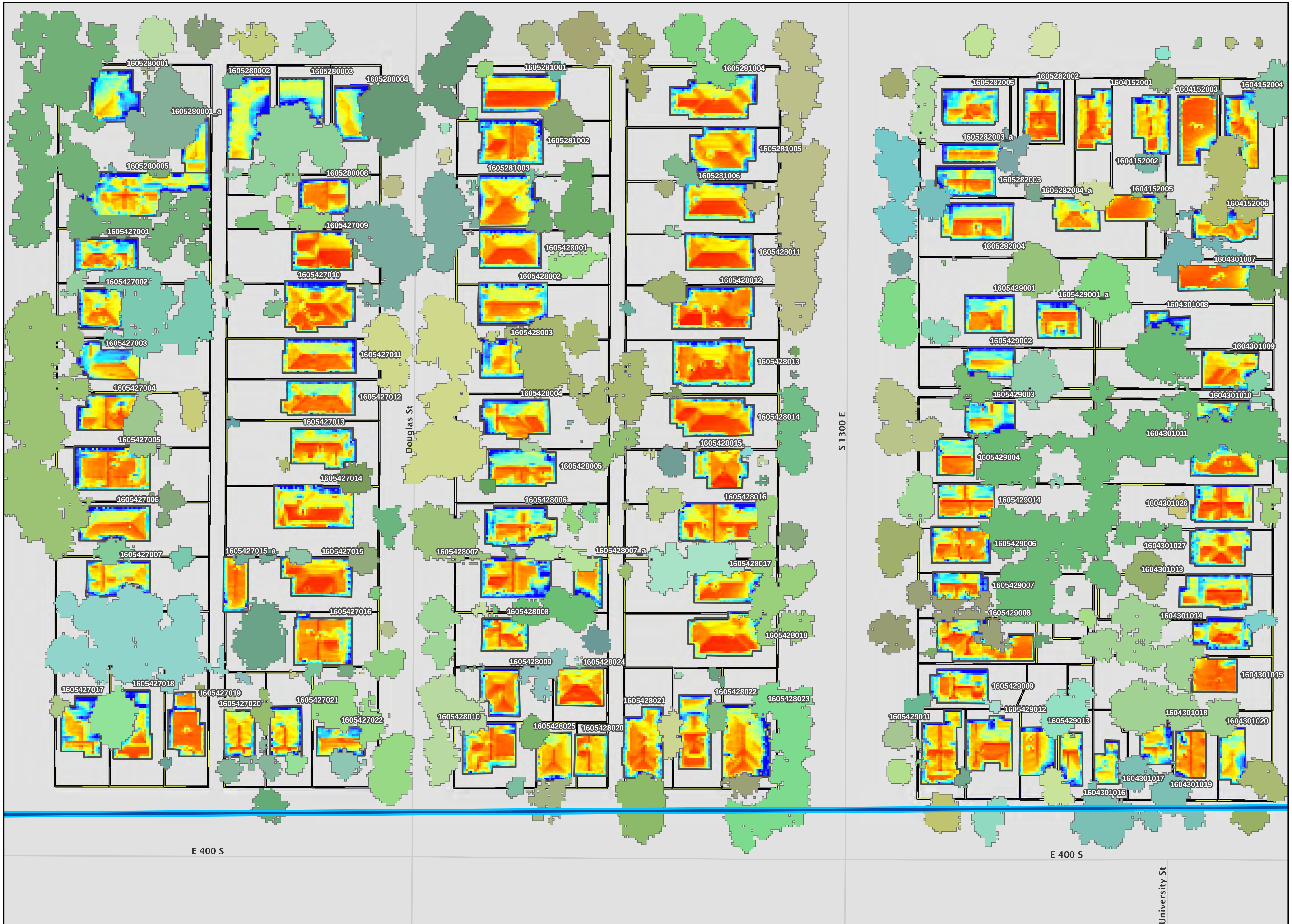
Roof ID	Site Address	Parcel Land Use	Roof Area meters²	Scenario 1 # of panels	Scenario 1 kWh/Day	Scenario 1 kWh	Scenario 1 % usable roof	Scenario 2 # of panels	Scenario 2 kWh/Day	Scenario 2 kWh	Scenario 2 % usable roof
1605279006	273 S 1300 E	RETAIL STORE	323.6171	43	33.35	5102.20	12.48	40	21.35	7792.75	11.61
1605279008_a	227 S 1300 E # 1	10-19 UNIT APARTMENT	263.2206	157	120.66	18460.48	56.03	153	78.96	28820.40	54.60
1605279008	227 S 1300 E # 1	10-19 UNIT APARTMENT	414.2418	258	211.32	32331.80	58.51	260	144.02	52567.30	58.96
1605279009	227-231 S 1300 E	OFFICE	151.3719	16	11.51	1760.70	9.93	1	0.49	178.85	0.62
1605280001	305 S 1200 E	SINGLE FAMILY RESIDE	185.5413	2	1.38	211.36	1.01	5	2.54	927.10	2.53
1605280001_a	305 S 1200 E	SINGLE FAMILY RESIDE	114.7252	4	2.77	424.36	3.28	1	0.48	175.20	0.82
1605280002	1224 E 300 S	SINGLE FAMILY RESIDE	248.1354	1	0.69	105.98	0.38	1	0.48	175.20	0.38
1605280003	1228 E 300 S	SINGLE FAMILY RESIDE	158.8861	0	0.00	0.00	0.00	0	0	0.00	0.00
1605280004	306 S DOUGLAS ST	SINGLE FAMILY RESIDE	145.1689	5	3.44	526.78	3.24	4	2.01	733.65	2.59
1605280005	315 S 1200 E	SINGLE FAMILY RESIDE	347.279	20	14.31	2189.67	5.41	12	6.32	2306.80	3.25
1605280008	316 S DOUGLAS ST	SINGLE FAMILY RESIDE	133.6405	28	21.12	3231.31	19.68	27	13.67	4989.55	18.98
1605281001	1250-1252 E 300 S	5-9 UNIT APARTMENT	229.5263	86	68.82	10529.81	35.20	76	44.97	16414.05	31.10
1605281002	305 S DOUGLAS ST	APARTMENT CONVERSION	217.7028	49	37.23	5696.13	21.14	45	23.56	8599.40	19.42
1605281003	315 S DOUGLAS ST	SINGLE FAMILY RESIDE	238.9656	38	28.99	4434.85	14.94	35	19.77	7216.05	13.76
1605281004	304 S 1300 E	SINGLE FAMILY RESIDE	251.6617	34	27.24	4167.94	12.69	35	20.15	7354.75	13.06
1605281005	310 S 1300 E	APARTMENT CONVERSION	215.9772	49	35.12	5373.94	21.31	20	10.91	3982.15	8.70
1605281006	316 S 1300 E	SINGLE FAMILY RESIDE	206.8791	39	31.83	4869.84	17.71	54	30.58	11161.70	24.52
1605282002	1314 E 300 S	APARTMENT CONVERSION	151.1685	32	25.05	3832.92	19.88	28	16.36	5971.40	17.40
1605282003	309-311 S 1300 E	MULTIPLE RESIDENTIAL	139.2845	17	12.52	1915.60	11.47	17	9.28	3387.20	11.47
1605282003_a	309-311 S 1300 E	MULTIPLE RESIDENTIAL	88.2549	16	11.83	1809.33	17.03	16	8.61	3142.65	17.03
1605282004	315-319 S 1300 E	MULTIPLE RESIDENTIAL	205.0054	29	22.01	3367.26	13.29	27	15.2	5548.00	12.37
1605282004_a	315-319 S 1300 E	MULTIPLE RESIDENTIAL	114.7038	11	8.06	1233.30	9.01	11	5.84	2131.60	9.01
1605282005	303-305 S 1300 E	DUPLEX	157.3159	13	9.58	1465.62	7.76	18	9.76	3562.40	10.75
1605427001	321 S 1200 E	SINGLE FAMILY RESIDE	157.1854	9	6.77	1036.07	5.38	7	4.02	1467.30	4.18
1605427002	327 S 1200 E	DUPLEX	145.3709	14	9.94	1520.38	9.05	8	4.25	1551.25	5.17
1605427003	333 S 1200 E	SINGLE FAMILY RESIDE	151.6766	25	17.73	2712.76	15.48	29	15.56	5679.40	17.96
1605427004	337 S 1200 E	SINGLE FAMILY RESIDE	168.3971	14	10.26	1570.10	7.81	9	4.83	1762.95	5.02
1605427005	343 S 1200 E	SINGLE FAMILY RESIDE	258.5053	57	42.81	6550.21	20.71	50	25.52	9314.80	18.17

Roof ID	Site Address	Parcel Land Use	Roof Area meters²	Scenario 1 # of panels	Scenario 1 kWh/Day	Scenario 1 kWh	Scenario 1 % usable roof	Scenario 2 # of panels	Scenario 2 kWh/Day	Scenario 2 kWh	Scenario 2 % usable roof
1605427006	351 S 1200 E	SINGLE FAMILY RESIDE	193.2244	25	18.65	2853.81	12.15	22	11.15	4069.75	10.70
1605427007	357 S 1200 E	SINGLE FAMILY RESIDE	174.9998	19	13.19	2018.57	10.20	2	0.98	357.70	1.07
1605427009	322 S DOUGLAS ST	SINGLE FAMILY RESIDE	184.0548	61	47.53	7272.21	31.13	43	25.28	9227.20	21.95
1605427010	330 S DOUGLAS ST	SINGLE FAMILY RESIDE	249.2073	36	26.68	4081.63	13.57	23	12.82	4679.30	8.67
1605427011	334 S DOUGLAS ST	SINGLE FAMILY RESIDE	198.1112	47	36.51	5586.56	22.29	43	25.07	9150.55	20.39
1605427012	336 S DOUGLAS ST	SINGLE FAMILY RESIDE	186.1189	34	26.04	3983.87	17.16	40	22.59	8245.35	20.19
1605427013	342 S DOUGLAS ST	SINGLE FAMILY RESIDE	185.223	21	16.39	2507.42	10.65	22	12.67	4624.55	11.16
1605427014	348 S DOUGLAS ST	SINGLE FAMILY RESIDE	265.3484	39	30.43	4656.26	13.81	42	23.26	8489.90	14.87
1605427015	358 S DOUGLAS ST	MULTIPLE RESIDENTIAL	199.2803	63	47.67	7293.31	29.70	43	23.7	8650.50	20.27
1605427015_a	358 S DOUGLAS ST	MULTIPLE RESIDENTIAL	105.7312	27	20.21	3092.47	23.99	22	10.94	3993.10	19.55
1605427016	364 S DOUGLAS ST	SINGLE FAMILY RESIDE	218.7586	67	49.89	7632.99	28.77	63	31.91	11647.15	27.05
1605427017	1203 E 400 S	SINGLE FAMILY RESIDE	167.5887	18	12.91	1975.61	10.09	13	6.9	2518.50	7.29
1605427018	1209 E 400 S	SINGLE FAMILY RESIDE	162.2611	21	15.87	2428.63	12.16	21	11.97	4369.05	12.16
1605427019	1215 E 400 S	SINGLE FAMILY RESIDE	153.5139	54	41.15	6295.51	33.04	40	21.03	7675.95	24.48
1605427020	1219 E 400 S	SINGLE FAMILY RESIDE	111.5094	22	15.39	2354.06	18.53	6	2.96	1080.40	5.05
1605427021	1225 E 400 S	SINGLE FAMILY RESIDE	122.9537	10	7.06	1080.00	7.64	5	2.63	959.95	3.82
1605427022	1231 E 400 S	SINGLE FAMILY RESIDE	110.1957	15	11.08	1695.11	12.79	15	8.25	3011.25	12.79
1605428001	319 S DOUGLAS ST	SINGLE FAMILY RESIDE	186.9304	48	36.59	5598.07	24.12	32	18.29	6675.85	16.08
1605428002	327 S DOUGLAS ST	SINGLE FAMILY RESIDE	228.2021	43	31.78	4863.03	17.70	25	13.51	4931.15	10.29
1605428003	333 S DOUGLAS ST	SINGLE FAMILY RESIDE	157.0265	7	4.78	731.93	4.19	2	1.01	368.65	1.20
1605428004	339 S DOUGLAS ST	SINGLE FAMILY RESIDE	191.4984	27	20.03	3064.62	13.24	20	11.22	4095.30	9.81
1605428005	345 S DOUGLAS ST	SINGLE FAMILY RESIDE	193.0332	23	16.85	2578.20	11.19	18	9.86	3598.90	8.76
1605428006	351 S DOUGLAS ST	SINGLE FAMILY RESIDE	203.5254	14	10.23	1565.12	6.46	11	6.23	2273.95	5.08
1605428007_a	355 S DOUGLAS ST	SINGLE FAMILY RESIDE	111.2357	1	0.72	109.45	0.84	0	0	0.00	0.00
1605428007	355 S DOUGLAS ST	SINGLE FAMILY RESIDE	220.8829	39	29.25	4474.97	16.59	30	15.61	5697.65	12.76
1605428008	363 S DOUGLAS ST	SINGLE FAMILY RESIDE	117.652	7	5.05	772.23	5.59	2	1.19	434.35	1.60
1605428009	371 S DOUGLAS ST	SINGLE FAMILY RESIDE	137.1409	33	23.90	3657.35	22.60	19	9.57	3493.05	13.01
1605428010	1253 E 400 S	UNKNOWN	197.3911	47	35.16	5379.54	22.37	39	20.14	7351.10	18.56

Roof ID	Site Address	Parcel Land Use	Roof Area meters²	Scenario 1 # of panels	Scenario 1 kWh/Day	Scenario 1 kWh	Scenario 1 % usable roof	Scenario 2 # of panels	Scenario 2 kWh/Day	Scenario 2 kWh	Scenario 2 % usable roof
1605428011	322 S 1300 E	SINGLE FAMILY RESIDE	193.1283	68	53.41	8171.69	33.07	52	30.61	11172.65	25.29
1605428012	330 S 1300 E	SINGLE FAMILY RESIDE	253.6293	73	55.08	8427.29	27.04	48	26.22	9570.30	17.78
1605428013	334 S 1300 E	CHURCH	283.9121	72	55.25	8453.25	23.82	78	40.86	14913.90	25.81
1605428014	340 S 1300 E	SINGLE FAMILY RESIDE	229.8225	72	54.57	8349.37	29.43	50	28.26	10314.90	20.44
1605428015	344 S 1300 E	SINGLE FAMILY RESIDE	139.6188	28	21.36	3268.77	18.84	28	14.8	5402.00	18.84
1605428016	354 S 1300 E	SINGLE FAMILY RESIDE	245.2524	56	40.75	6234.83	21.45	22	11.51	4201.15	8.43
1605428017	360 S 1300 E	SINGLE FAMILY RESIDE	175.696	44	33.06	5058.93	23.52	41	22.88	8351.20	21.92
1605428018	364 S 1300 E	SINGLE FAMILY RESIDE	225.0506	53	41.22	6305.93	22.12	51	28.43	10376.95	21.29
1605428020	1259 E 400 S	SINGLE FAMILY RESIDE	106.3676	32	22.45	3435.40	28.26	10	4.95	1806.75	8.83
1605428021	1263-1265 S 400 E	SINGLE FAMILY RESIDE	204.3457	29	21.52	3291.92	13.33	22	11.2	4088.00	10.11
1605428022	1271 E 400 S	SINGLE FAMILY RESIDE	186.4038	30	22.51	3443.50	15.12	23	12.54	4577.10	11.59
1605428023	378 S 1300 E	SINGLE FAMILY RESIDE	267.5466	40	28.89	4420.49	14.04	29	14.46	5277.90	10.18
1605428024	1255-1261 E 400 S	DUPLEX	138.5363	40	31.14	4764.26	27.12	37	20.74	7570.10	25.09
1605428025	1255-1261 E 400 S	SINGLE FAMILY RESIDE	133.8838	30	21.10	3228.44	21.05	4	1.98	722.70	2.81
1605429001	327 S 1300 E	MULTIPLE RESIDENTIAL	146.1817	24	17.91	2740.41	15.42	23	12.52	4569.80	14.78
1605429001_a	327 S 1300 E	MULTIPLE RESIDENTIAL	125.8954	20	15.16	2318.78	14.92	20	11.3	4124.50	14.92
1605429002	333 S 1300 E	SINGLE FAMILY RESIDE	121.4191	1	0.67	103.22	0.77	0	0	0.00	0.00
1605429003	339 S 1300 E	MULTIPLE RESIDENTIAL	132.6133	8	5.87	898.75	5.67	9	4.81	1755.65	6.38
1605429004	343 S 1300 E	3-4 UNIT APARTMENT	104.4885	33	25.46	3895.65	29.67	33	19.39	7077.35	29.67
1605429006	355 S 1300 E	SINGLE FAMILY RESIDE	167.523	41	30.68	4693.45	22.99	40	20.51	7486.15	22.43
1605429007	357 S 1300 E	SINGLE FAMILY RESIDE	116.3214	9	6.73	1030.01	7.27	7	4.01	1463.65	5.65
1605429008	361 S 1300 E	SINGLE FAMILY RESIDE	235.9425	52	38.60	5906.31	20.70	36	19.19	7004.35	14.33
1605429009	367-369 S 1300 E	DUPLEX	147.0554	27	19.98	3057.44	17.25	22	12.03	4390.95	14.05
1605429011	1303 E 400 S	SINGLE FAMILY RESIDE	190.0401	42	29.71	4545.23	20.76	18	9.07	3310.55	8.90
1605429012	1309 E 400 S	DUPLEX	179.5946	40	30.03	4594.01	20.92	28	15.77	5756.05	14.65
1605429013	1311 E 400 S	SINGLE FAMILY RESIDE	132.9194	30	21.46	3282.63	21.20	15	7.41	2704.65	10.60
1605429014	351 S 1300 E	SINGLE FAMILY RESIDE	150.1047	27	20.94	3203.61	16.90	27	15.5	5657.50	16.90

APPENDIX D

Average Daily Insolation and Estimated Panels per Rooftop Maps



Scenario 1
May-September Estimated Average Daily Insolation (kWh/m²)

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A1
B1
C3
C4
D4

Legend

Study Area

Average Daily Insolation/Summer

kWh/m²

High : 7.29

Low : 0.006

Parcels

Map Page

LiDAR Derived Tree Cover

Rocky Mountain Power
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N

0 20 40 Meters

0 75 150 Feet

ROCKY MOUNTAIN POWER
A DIVISION OF PACIFICORP

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Geographic Information Systems
gisdept@pacificorp.com

Data are projected in Utah State Plane Central, feet.

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Scenario 1 May-September Estimated Average Daily Insolation (kWh/m²)

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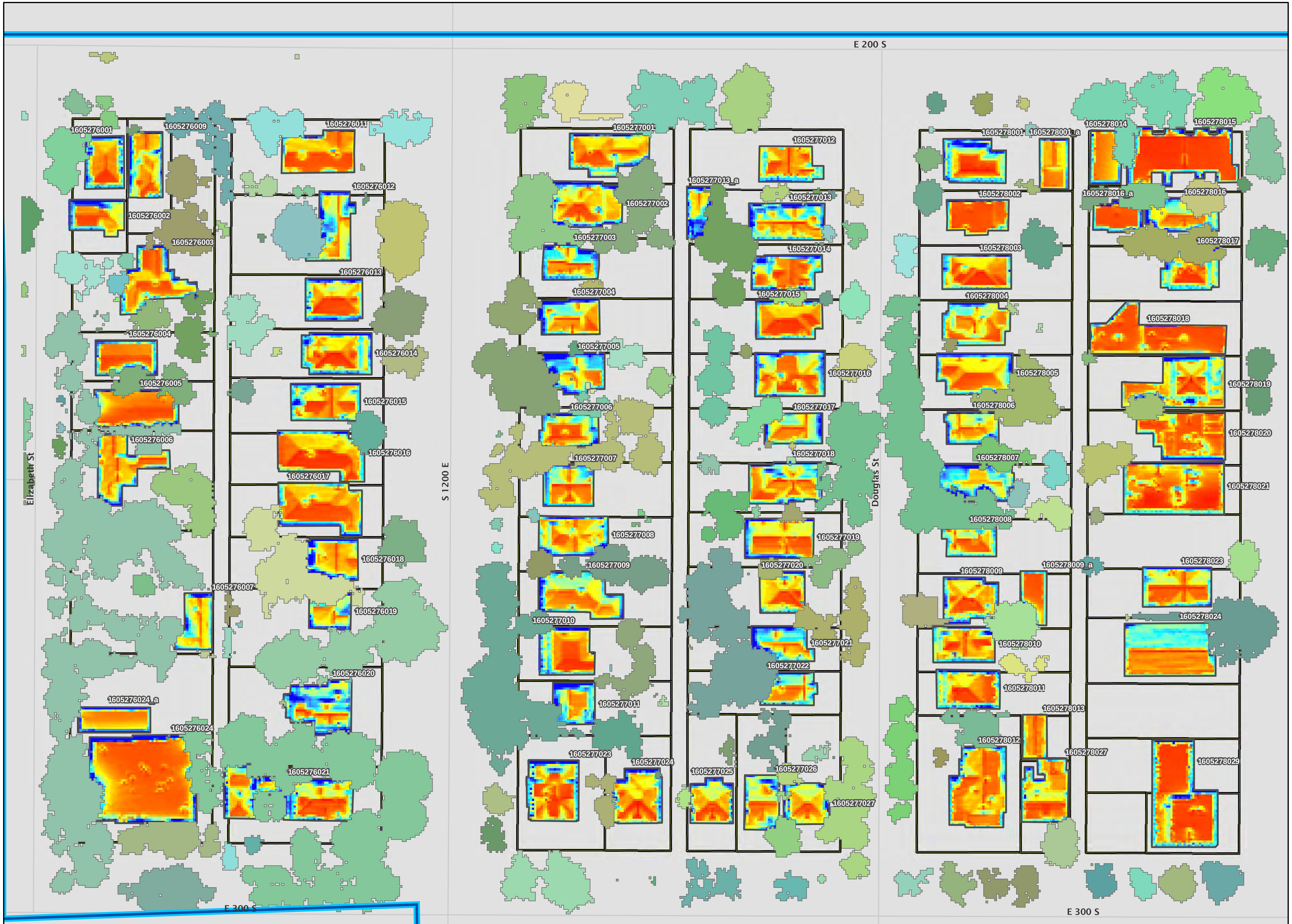

Legend

Study Area

Average Daily Insolation/Summer kWh/m²

High : 7.29

Low : 0.006

Parcels

Map Page

LiDAR Derived Tree Cover

0 20 40 Meters

0 75 150 Feet

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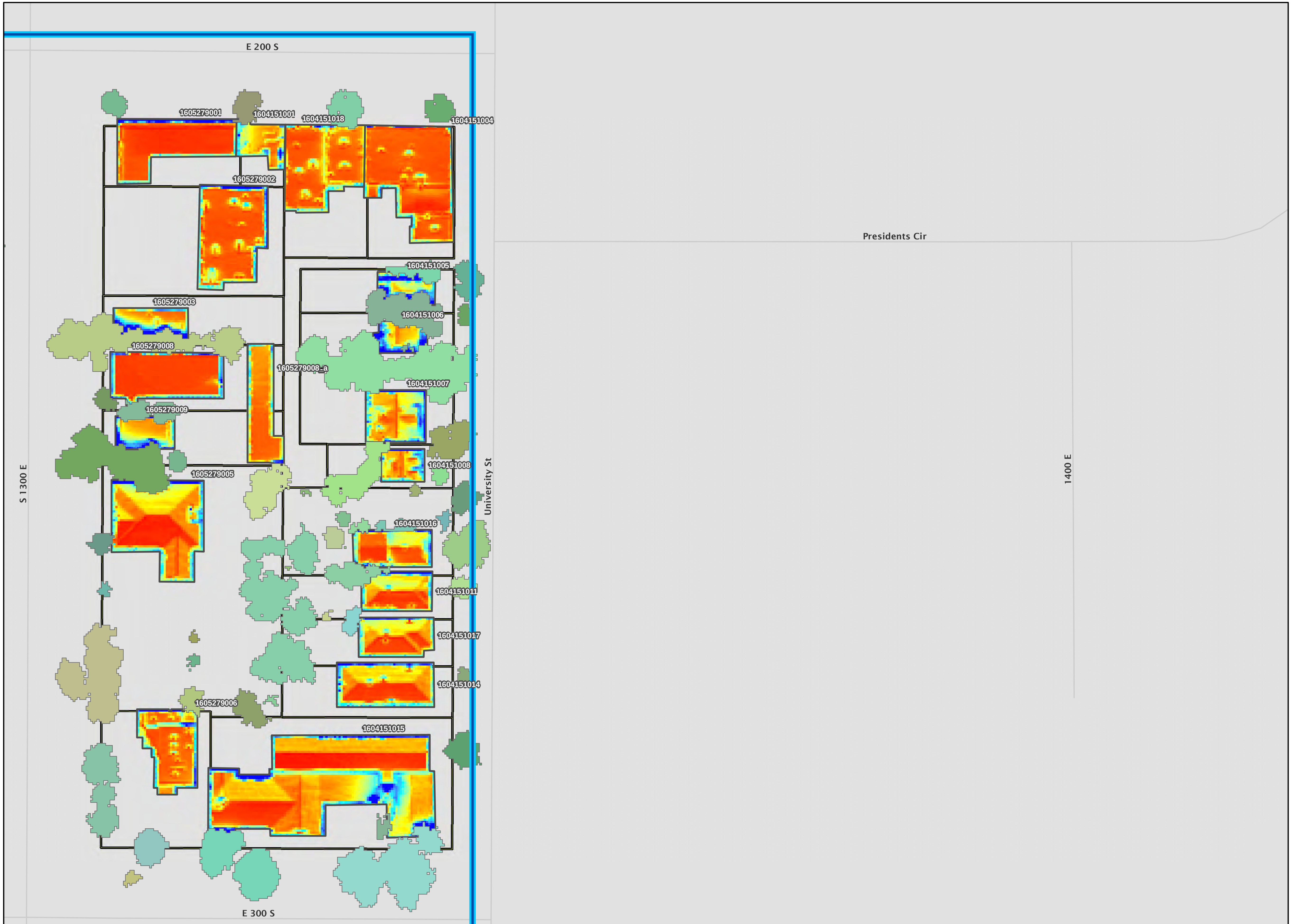
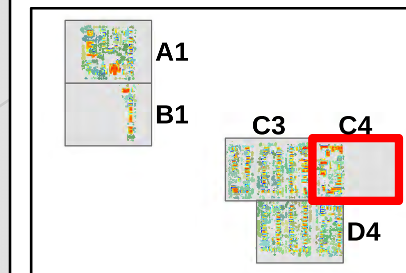


Scenario 1 May-September Estimated Average Daily Insolation (kWh/m²)



Legend

- Study Area
- Average Daily Insolation/Summer kWh/m²
  - High : 7.29
  - Low : 0.006
- Parcels
- Map Page
- LiDAR Derived Tree Cover

N

0 20 40 Meters

0 75 150 Feet

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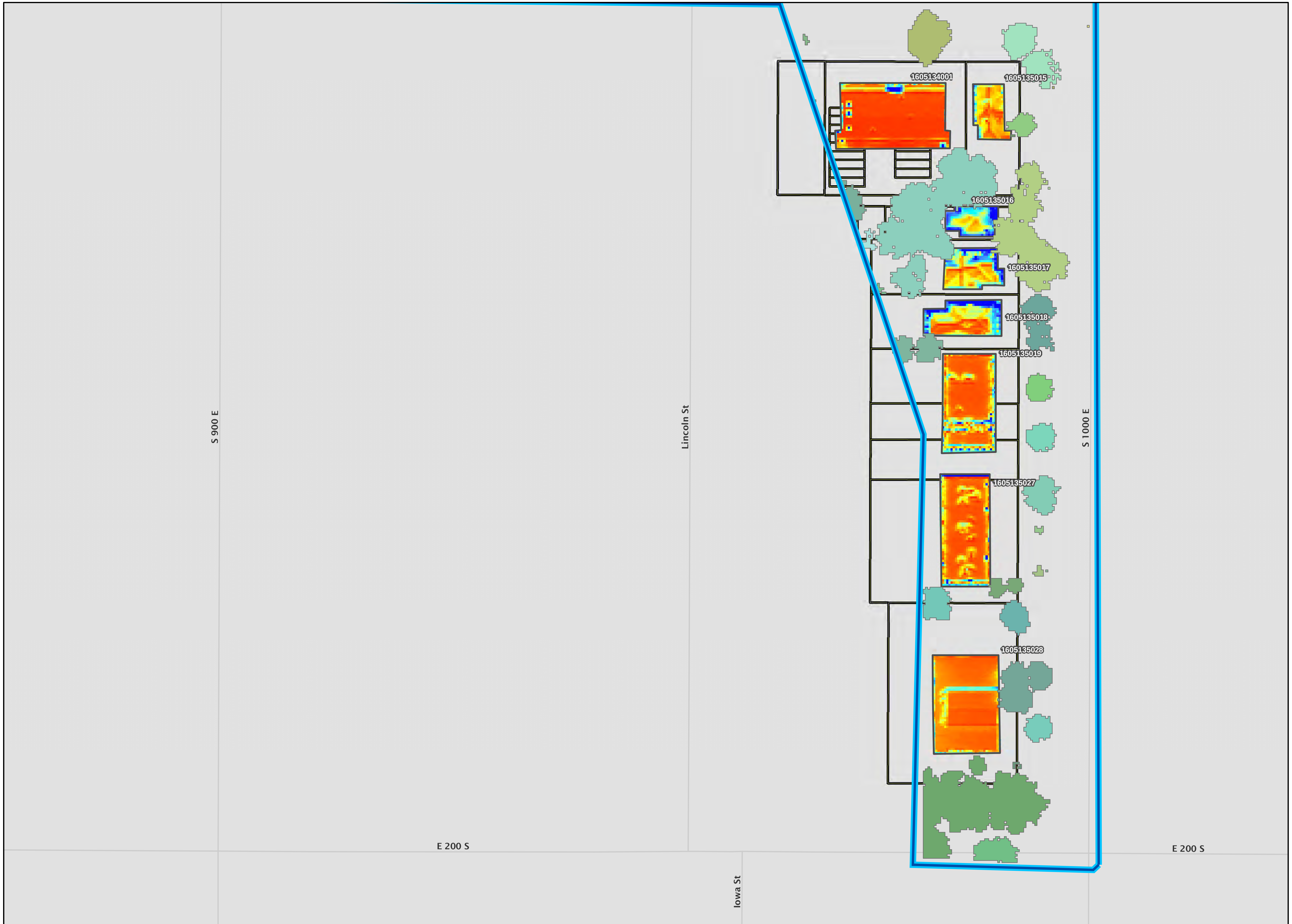
Scenario 1 May-September Estimated Average Daily Insolation (kWh/m²)



A1
B1
C3
C4
D4

Legend

Study Area

Average Daily Insolation/Summer

kWh/m²

High : 7.29

Low : 0.006

Parcels

Map Page

LiDAR Derived Tree Cover

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 60 of 80
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N

0 20 40 Meters

0 75 150 Feet

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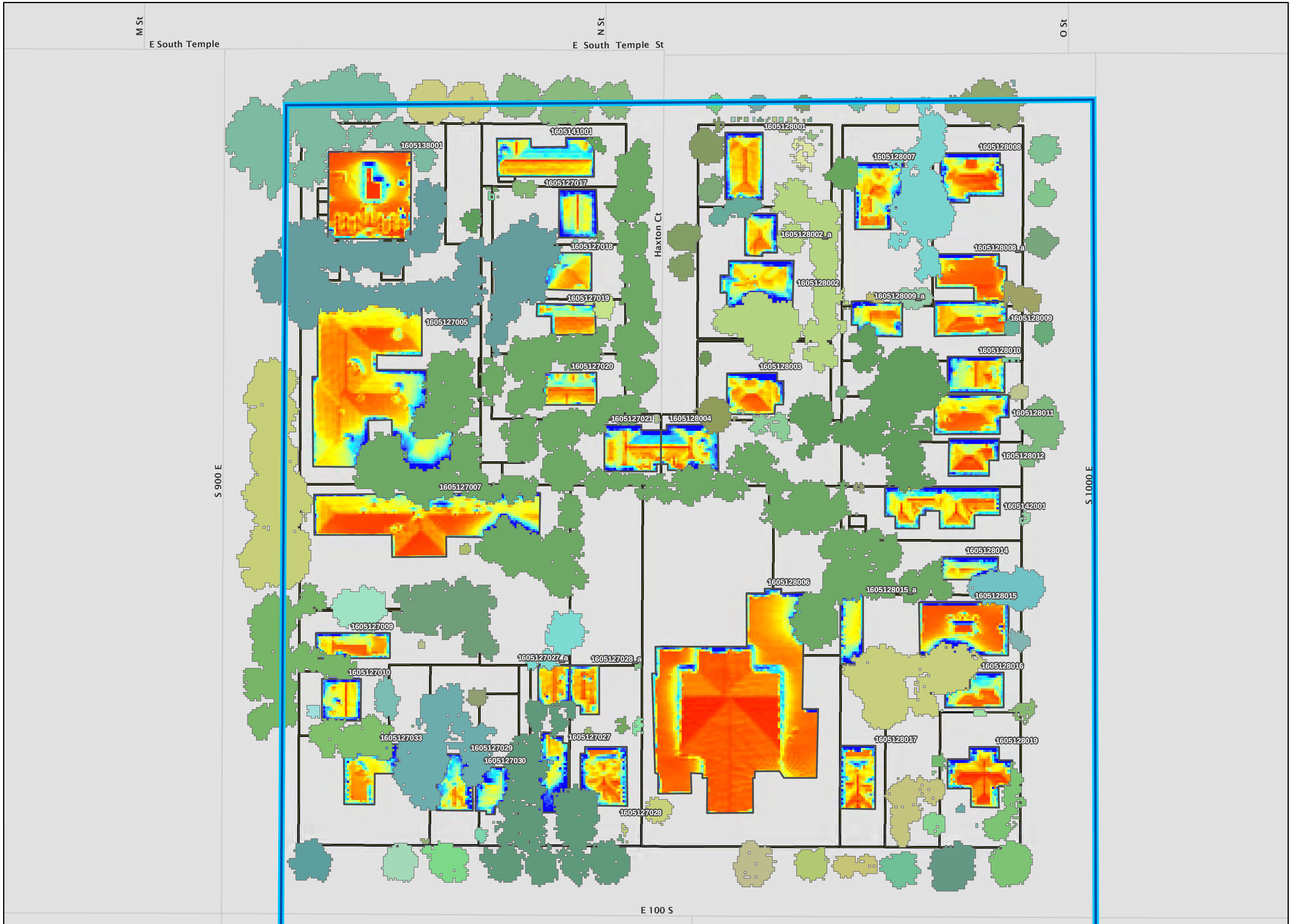

Scenario 1 May-September Estimated Average Daily Insolation (kWh/m²)

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A1
B1
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C4
D4

Legend

Study Area

Average Daily Insolation/Summer

kWh/m²

High : 7.29

Low : 0.006

Parcels

Map Page

LiDAR Derived Tree Cover

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 61 of 80
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N

0 20 40 Meters

0 75 150 Feet

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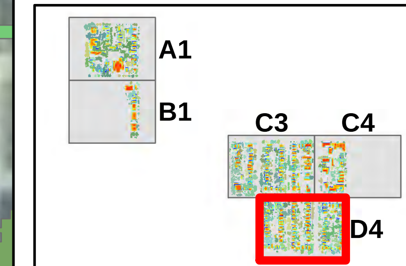
Scenario 1
of Panels and Estimated Average Daily Energy Output (kWh)

Page 1 of 5



Legend

Study Area

Parcels

Two PV Panels

One PV Panel

LiDAR Derived Tree Cover

N

0 15 30 Meters

0 75 150 Feet

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 62 of 80
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Witness: Douglas L. Marx

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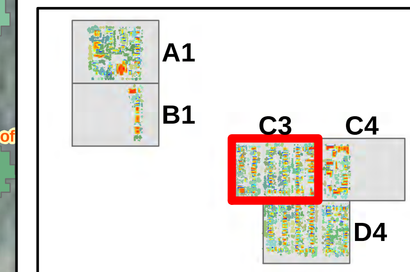
Scenario 1
of Panels and Estimated Average Daily Energy Output (kWh)



Legend

- Study Area
- Parcels
- Two PV Panels
- One PV Panel
- LiDAR Derived Tree Cover

0 15 30 Meters

0 75 150 Feet

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 63 of 80
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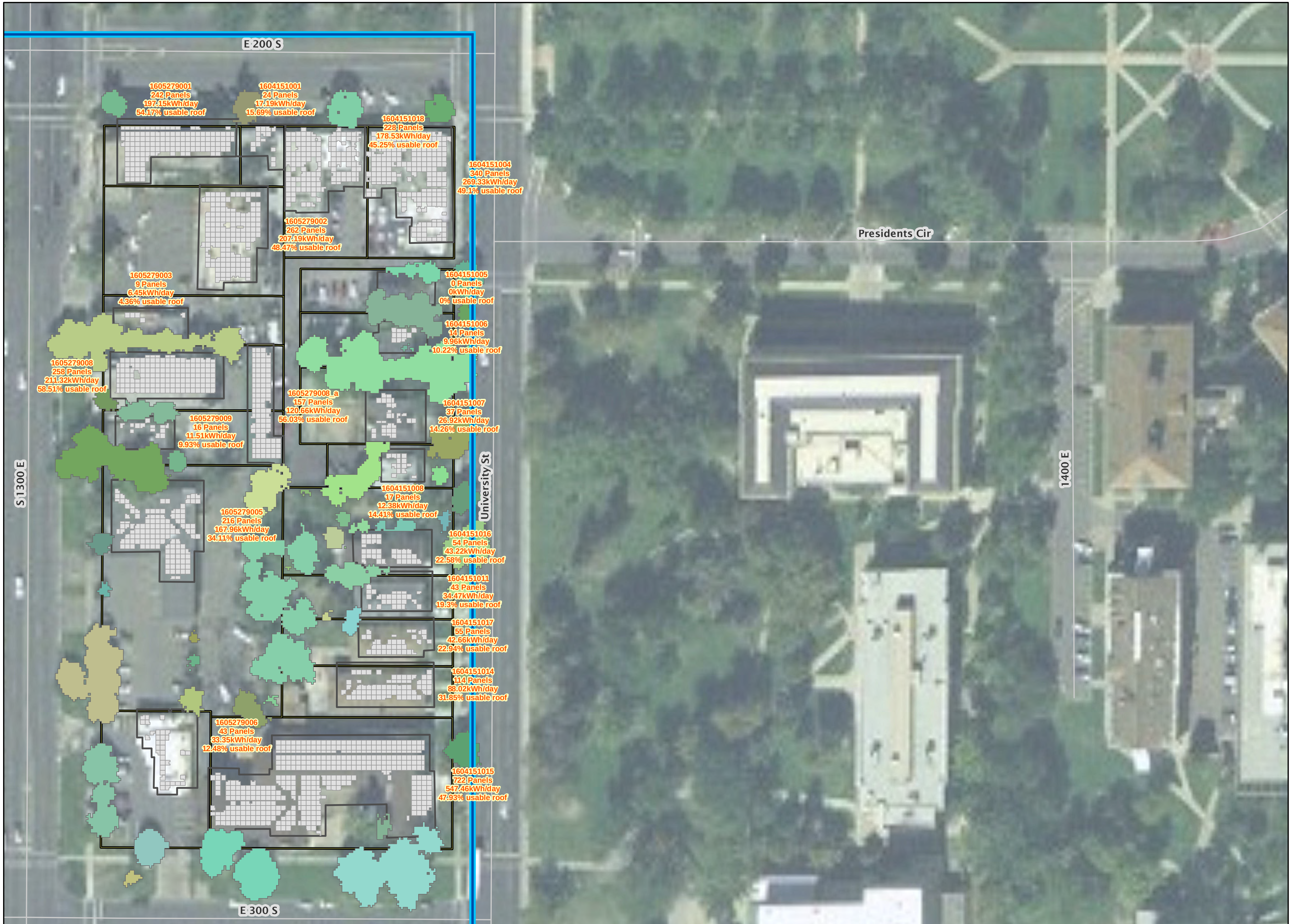
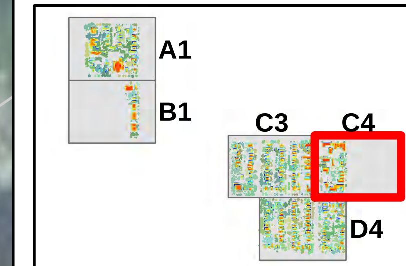
Scenario 1
of Panels and Estimated Average Daily Energy Output (kWh)

Page 3 of 5





Legend

- Study Area
- Parcels
- Two PV Panels
- One PV Panel
- LiDAR Derived Tree Cover

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 64 of 80
Docket No. 13-035-184
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N

0 15 30 Meters
0 75 150 Feet

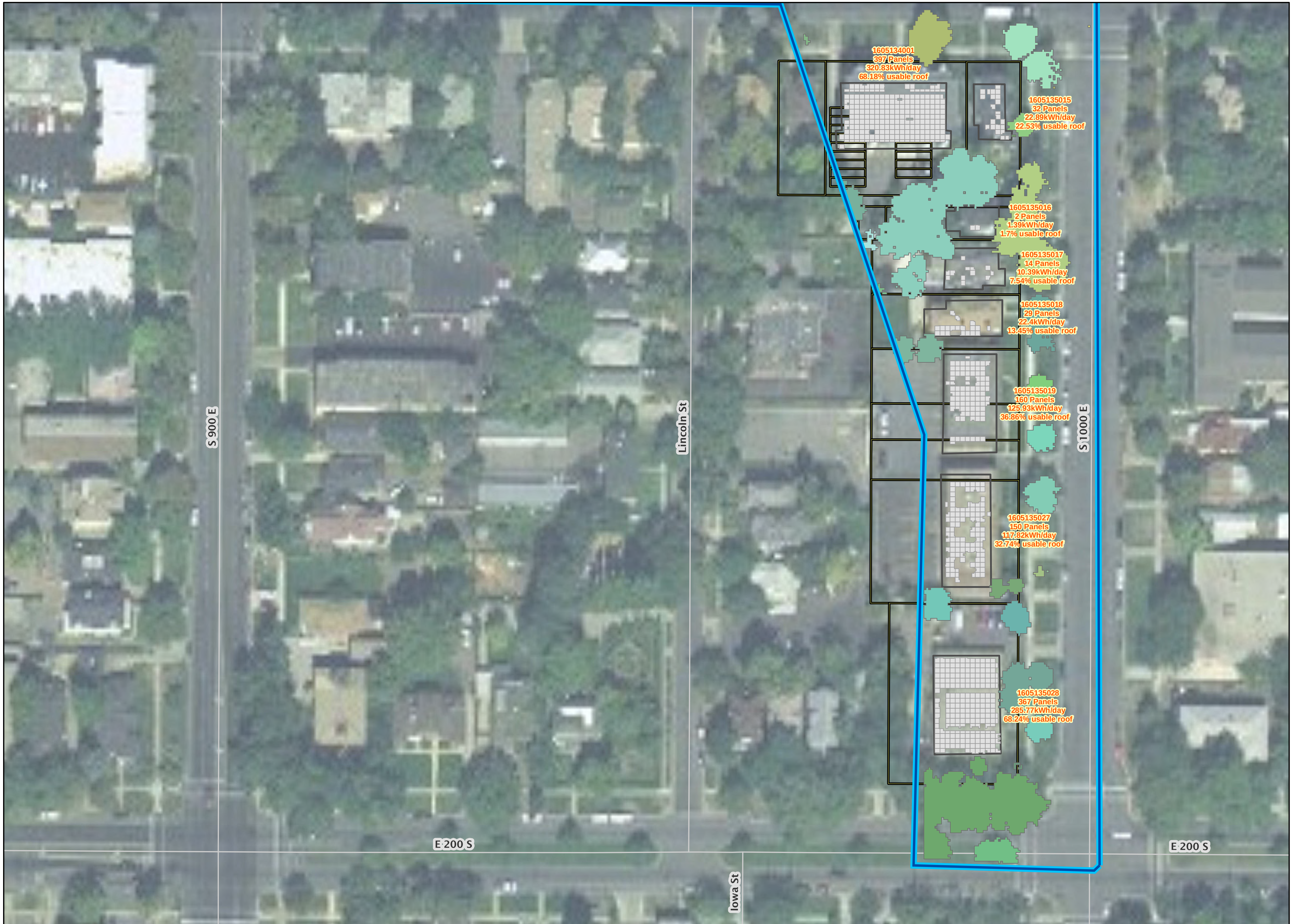
ROCKY MOUNTAIN POWER
A DIVISION OF PACIFICORP

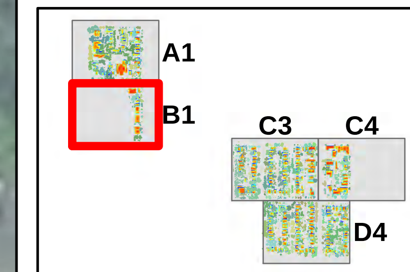
Data Management/
Geographic Information Systems
gisdept@pacificorp.com

Data are projected in Utah State Plane Central, feet.

U:\Projects\2010\10-229\Scenario1a Maps.mxd 12/31/10 gisdept@pacificorp.com

Scenario 1
of Panels and Estimated Average Daily Energy Output (kWh)





Legend

- Study Area
- Parcels
- Two PV Panels
- One PV Panel
- LiDAR Derived Tree Cover

N

0 15 30 Meters

0 75 150 Feet

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 65 of 80
Docket No. 13-035-184
Witness: Douglas L. Marx

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Data are projected in Utah State Plane Central, feet.

Scenario 1
of Panels and Estimated Average Daily Energy Output (kWh)

Page 5 of 5

A1
B1
C3
C4
D4

Legend

Study Area

Parcels

Two PV Panels

One PV Panel

LiDAR Derived Tree Cover

N

0 15 30 Meters

0 75 150 Feet

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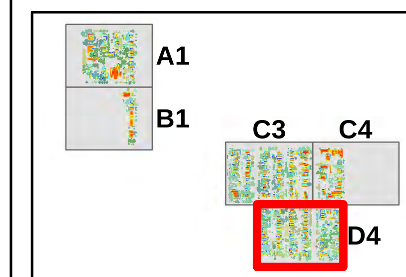
Scenario 2
Estimated Average Daily Insolation/Year (kWh/m^2)

Page 1 of 5



Legend

Study Area

Average Daily Insolation/Year

kWh/m^2

High : 5.3

Low : 0.005

Parcels

Map Page

LiDAR Derived Tree Cover

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 67 of 80
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N

0 20 40 Meters

0 85 170 Feet

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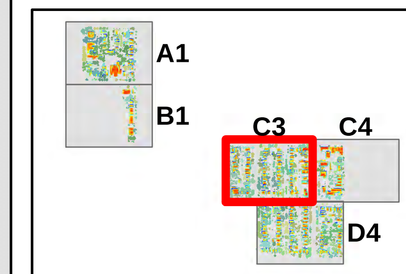
Scenario 2 Estimated Average Daily Insolation/Year (kWh/m²)



Legend

Study Area

Average Daily Insolation/Year

kWh/m²

High : 5.3

Low : 0.005

Parcels

Map Page

LiDAR Derived Tree Cover

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 68 of 80
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N

0 20 40 Meters

0 85 170 Feet

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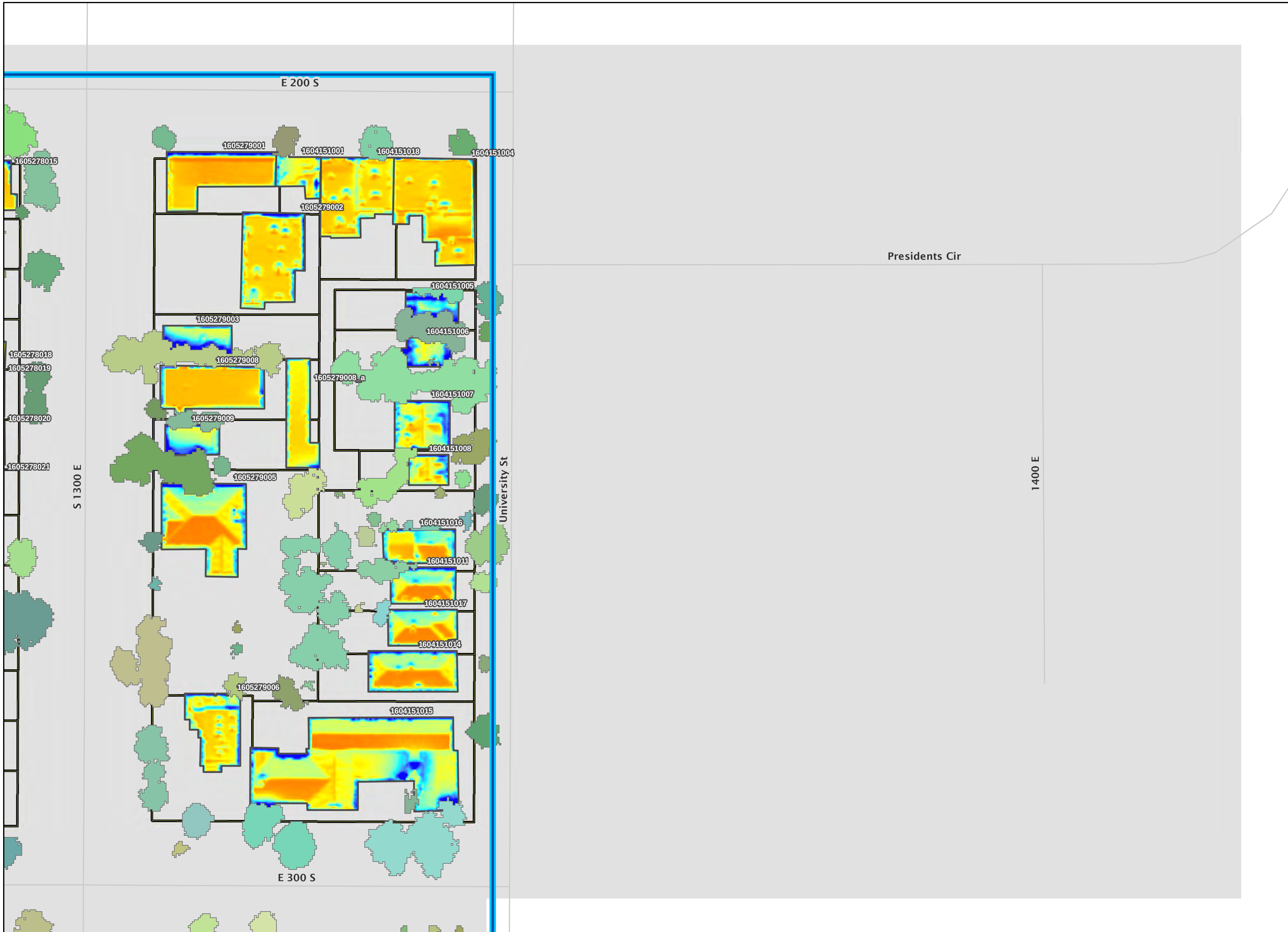
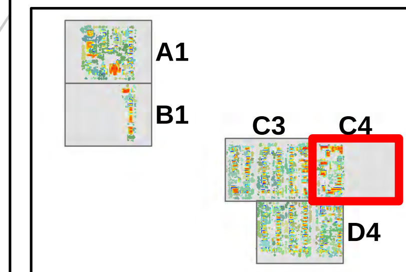
U:\Projects\2010\10-229\Scenario 2 Maps.mxd 12/31/10 gisdept@pacificorp.com

Scenario 2
Estimated Average Daily Insolation/Year (kWh/m^2)



Page 3 of 5



Legend

Study Area

Average Daily Insolation/Year

kWh/m^2

High : 5.3

Low : 0.005

Parcels

Map Page

LiDAR Derived Tree Cover

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 69 of 80
Docket No. 13-035-184
Witness: Douglas L. Marx

N

0 20 40 Meters

0 85 170 Feet

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Scenario 2 Estimated Average Daily Insolation/Year (kWh/m²)

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 70 of 80
Docket No. 13-035-184
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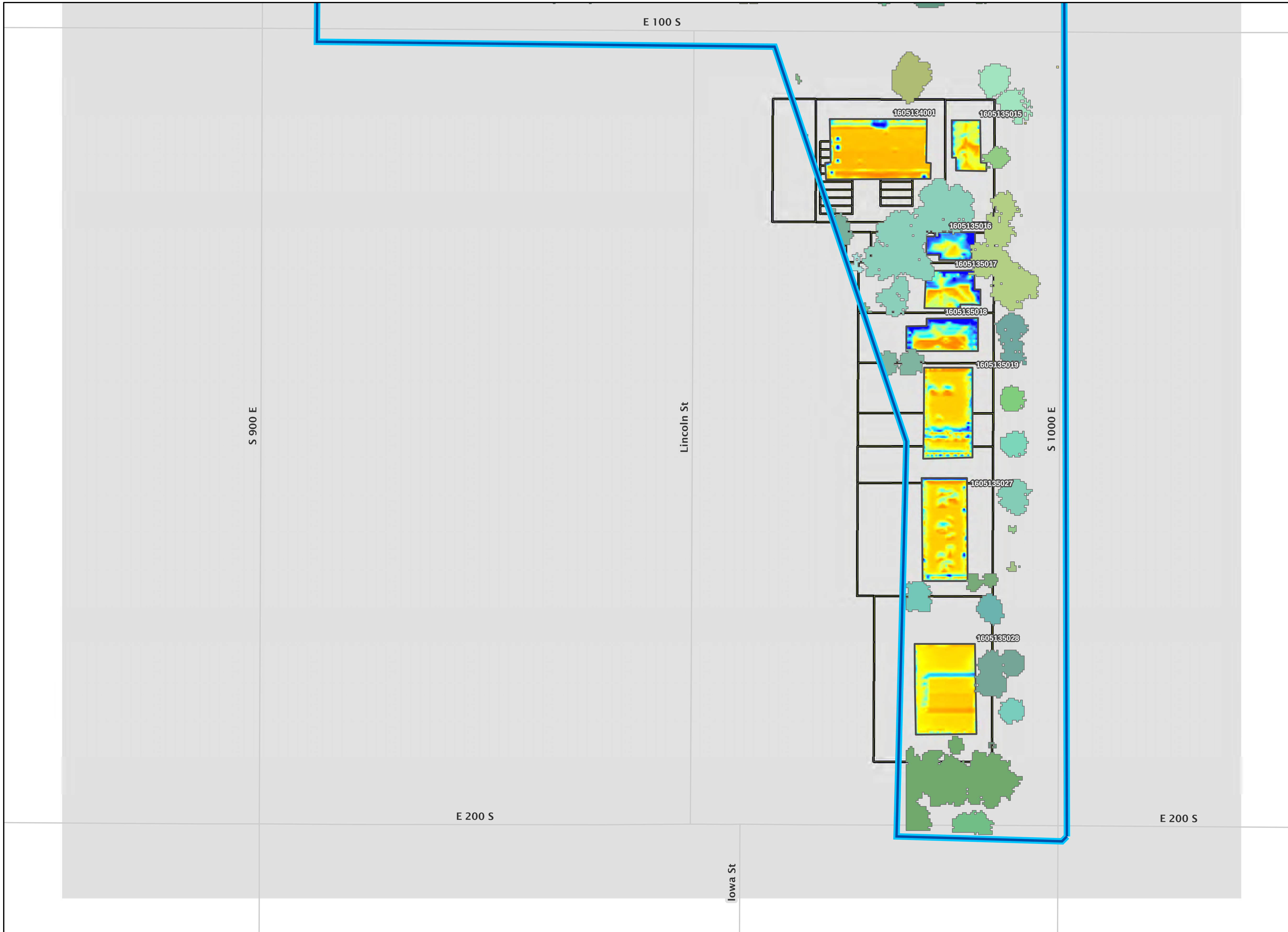

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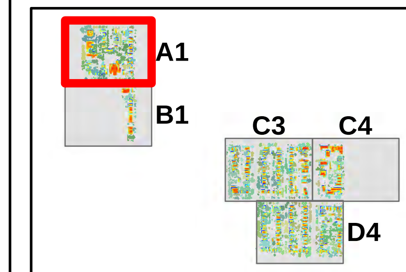
Scenario 2
Estimated Average Daily Insolation/Year (kWh/m^2)



Legend

- Study Area
- **Average Daily Insolation/Year** (kWh/m^2)
  - High : 5.3
  - Low : 0.005
- Parcels
- Map Page
- LiDAR Derived Tree Cover

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 71 of 80
Docket No. 13-035-184
Witness: Douglas L. Marx

N

0 20 40 Meters
0 85 170 Feet

ROCKY MOUNTAIN POWER
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gisdept@pacificorp.com

Data are projected in Utah State Plane Central, feet.

Scenario 2
of Panels and Estimated Daily Energy Outpu (kWh)

A1
B1
C3
C4
D4

Legend

Study Area

Parcels

Two PV Panels

One PV Panel

LiDAR Derived Tree Cover

N

0 15 30 Meters

0 75 150 Feet

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 72 of 80
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Scenario 2
of Panels and Estimated Daily Energy Outpu (kWh)

Page 2 of 5

Legend

Study Area

Parcels

Two PV Panels

One PV Panel

LiDAR Derived Tree Cover

N

0 15 30 Meters

0 75 150 Feet

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 73 of 80
Docket No. 13-035-184
Witness: Douglas L. Marx

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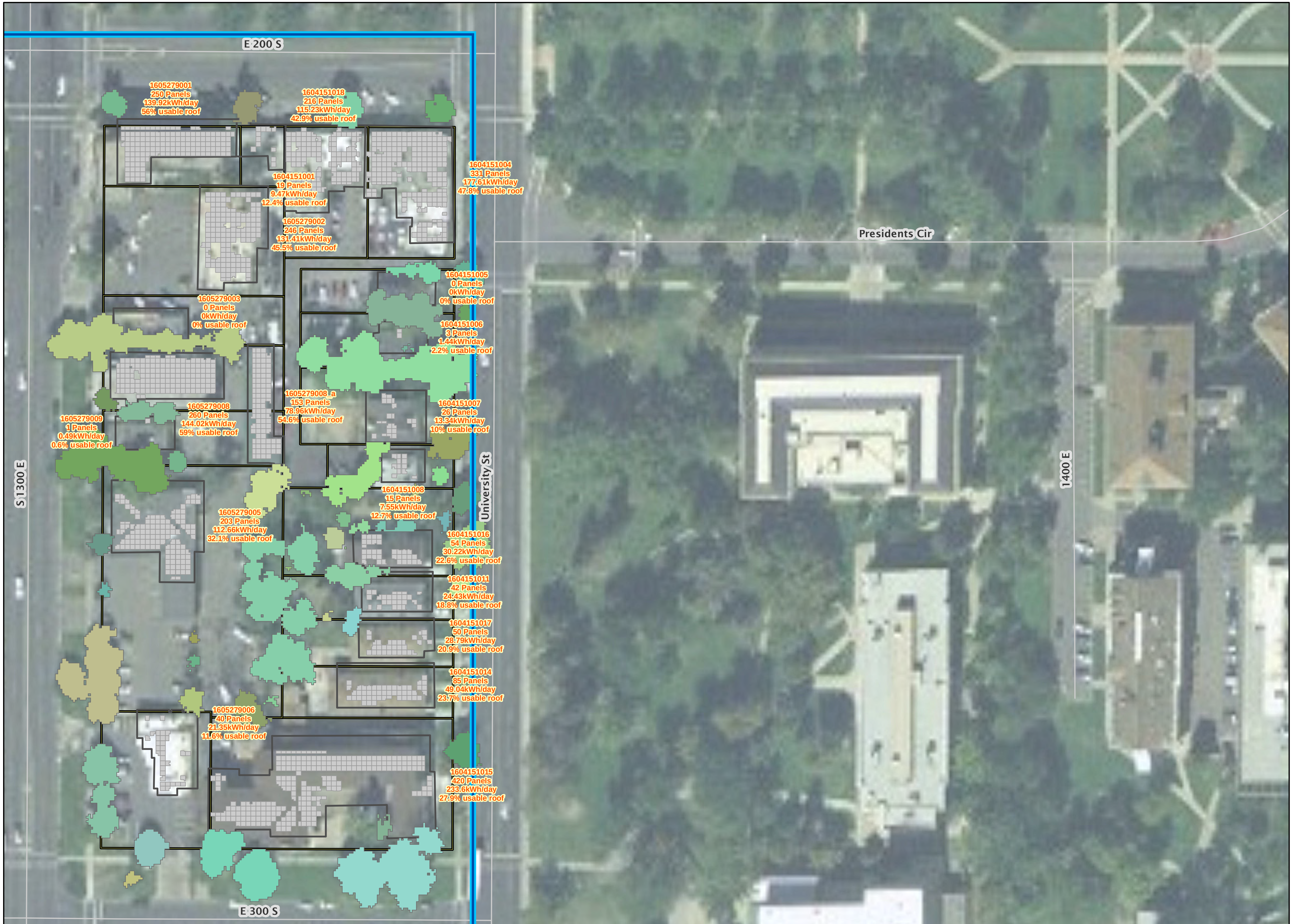
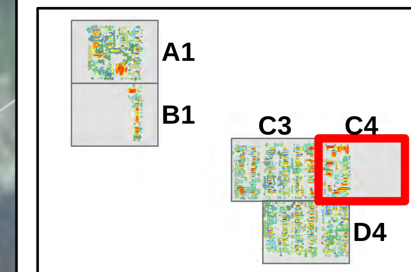
U:\Projects\2010\10-229\Scenario 2 Maps.mxd 12/31/10 gisdept@pacificorp.com



Scenario 2
of Panels and Estimated Daily Energy Outpu (kWh)

Page 3 of 5



Legend

Study Area

Parcels

Two PV Panels

One PV Panel

LiDAR Derived Tree Cover

N

0 15 30 Meters

0 75 150 Feet

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 74 of 80
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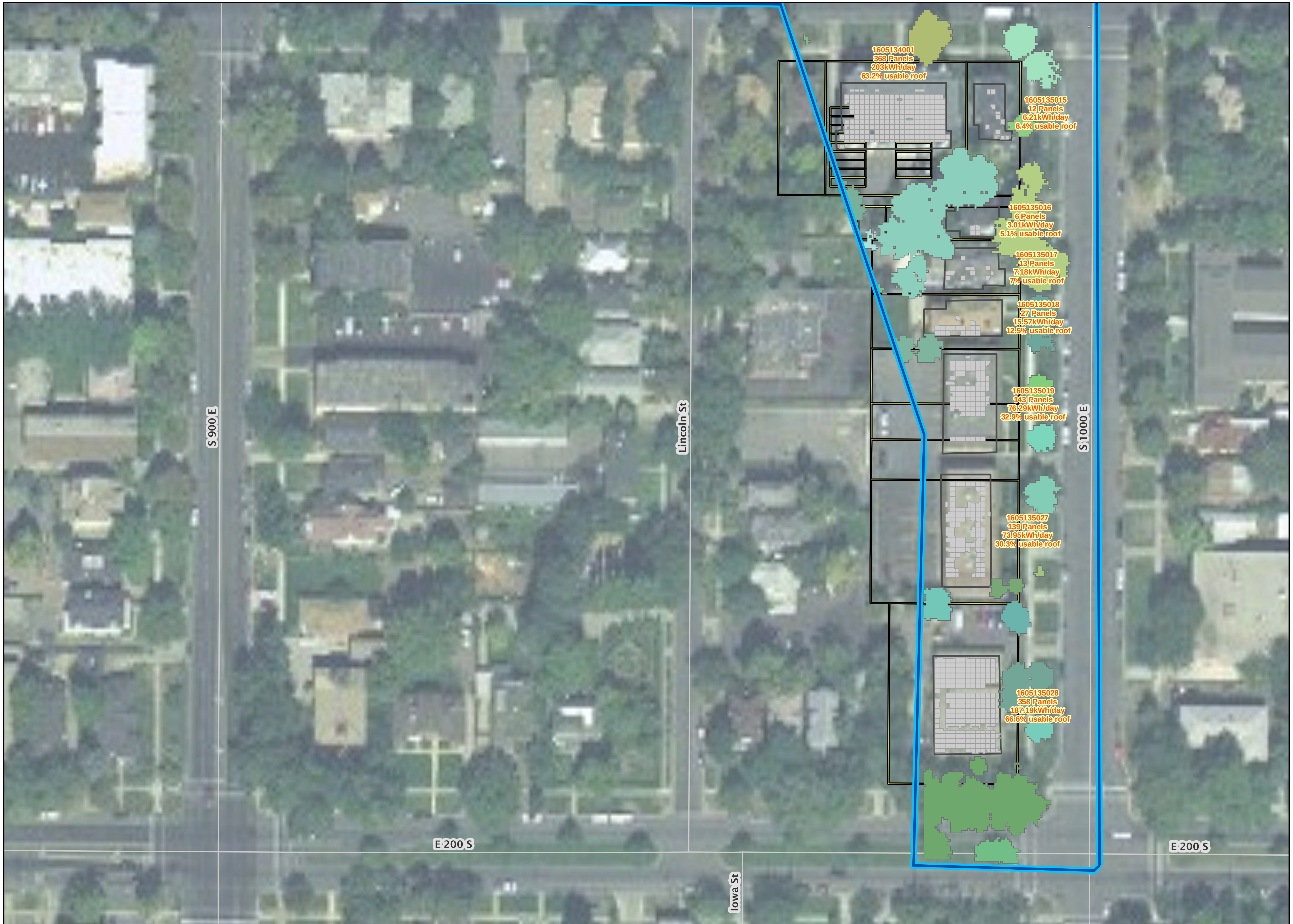
U:\Projects\2010\10-229\Scenario 2 Maps.mxd 12/31/10 gisdept@pacificorp.com



Scenario 2
of Panels and Estimated Daily Energy Outpu (kWh)

A1
B1
C3
C4
D4

Legend

Study Area

Parcels

Two PV Panels

One PV Panel

LiDAR Derived Tree Cover

N

0 15 30 Meters

0 75 150 Feet

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 75 of 80
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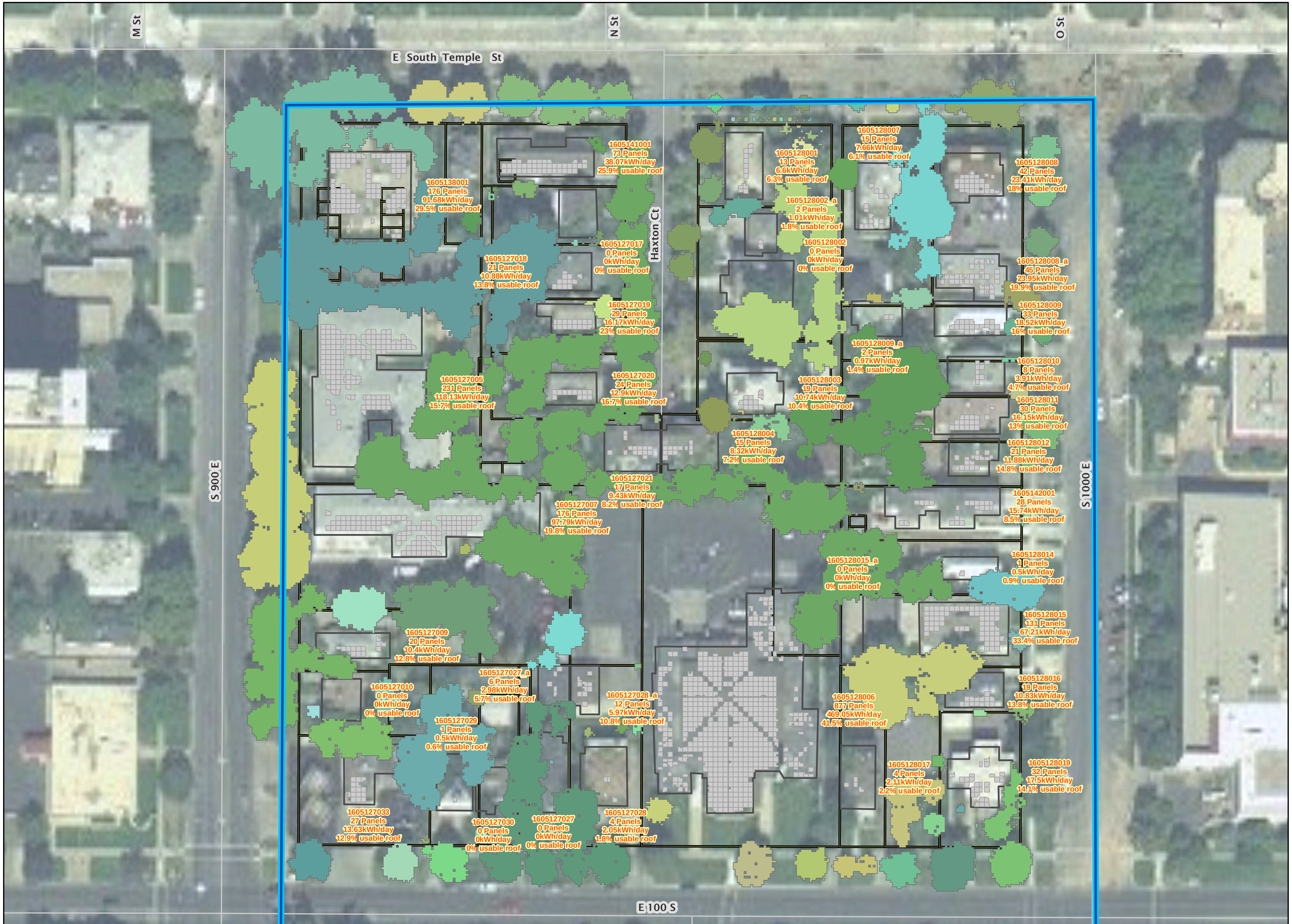
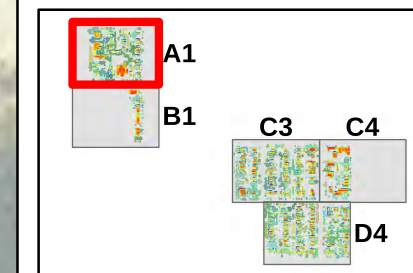


Scenario 2
of Panels and Estimated Daily Energy Outpu (kWh)

Page 5 of 5



Legend

- Study Area
- Parcels
- Two PV Panels
- One PV Panel
- LiDAR Derived Tree Cover

N

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0 75 150 Feet

Rocky Mountain Power
Exhibit RMP___(DLM-1R) Page 76 of 80
Docket No. 13-035-184
Witness: Douglas L. Marx

ROCKY MOUNTAIN POWER
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Geographic Information Systems
gisdept@pacificorp.com

Data are projected in Utah State Plane Central, feet.

APPENDIX E

NASA Surface Meteorology and Solar Energy Report

and

WBAN24127 Station Report

NASA Surface meteorology and Solar Energy - Available Tables

Monthly Averaged Insolation Clearness Index (0 to 1.0)

Lat 40.75 Lon -111.88	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
22-year Average K	0.55	0.56	0.58	0.57	0.59	0.63	0.63	0.60	0.62	0.60	0.54	0.55	0.58
Minimum K	0.48	0.47	0.52	0.49	0.51	0.56	0.57	0.56	0.55	0.52	0.45	0.48	0.52
Maximum K	0.62	0.63	0.66	0.65	0.65	0.69	0.67	0.68	0.69	0.70	0.60	0.61	0.65

Monthly Averaged Insolation Normalized Clearness Index (0 to 1.0)

Lat 40.75 Lon -111.88	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
22-year Average	0.51	0.51	0.53	0.52	0.54	0.58	0.57	0.55	0.56	0.55	0.49	0.50

Monthly Averaged Clear Sky Insolation Clearness Index (0 to 1.0)

Lat 40.75 Lon -111.88	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
22-year Average	0.75	0.77	0.80	0.80	0.79	0.76	0.74	0.71	0.74	0.75	0.75	0.74

Monthly Averaged Clear Sky Insolation Normalized Clearness Index (0 to 1.0)

Lat 40.75 Lon -111.88	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
22-year Average	0.69	0.71	0.73	0.73	0.72	0.70	0.68	0.64	0.68	0.69	0.69	0.68

Parameters for Tilted Solar Panels:

Monthly Averaged Radiation Incident On An Equator-Pointed Tilted Surface ($kWh/m^2/day$)

Lat 40.75 Lon - 111.88	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
SSE HRZ	2.33	3.19	4.51	5.57	6.59	7.38	7.14	6.14	5.18	3.79	2.48	2.08	4.70
K	0.55	0.56	0.58	0.57	0.59	0.63	0.63	0.60	0.62	0.60	0.54	0.55	0.58
Diffuse	0.69	0.97	1.31	1.77	2.04	2.02	1.96	1.79	1.35	1.01	0.78	0.61	1.36
Direct	4.75	5.22	6.19	6.35	7.14	8.26	8.04	7.05	6.92	6.08	4.63	4.56	6.27
Tilt 0	2.32	3.11	4.47	5.54	6.55	7.40	7.08	6.11	5.10	3.76	2.46	2.07	4.67
Tilt 25	3.68	4.28	5.45	5.95	6.52	7.05	6.93	6.36	5.96	5.07	3.71	3.47	5.38
Tilt 40	4.24	4.67	5.65	5.79	6.07	6.41	6.36	6.07	6.05	5.48	4.19	4.06	5.42
Tilt 55	4.54	4.80	5.54	5.33	5.31	5.45	5.47	5.47	5.81	5.59	4.44	4.40	5.18
Tilt 90	4.20	4.06	4.16	3.40	2.95	2.79	2.88	3.26	4.08	4.61	4.00	4.17	3.71
OPT	4.60	4.80	5.65	5.95	6.65	7.40	7.15	6.39	6.06	5.59	4.46	4.49	5.77
OPT ANG	64.0	55.0	42.0	25.0	12.0	3.00	9.00	19.0	37.0	52.0	62.0	67.0	37.1

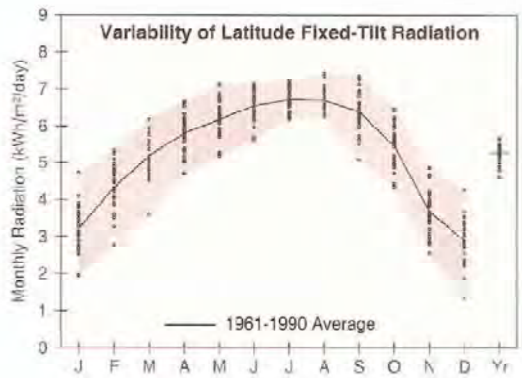
NOTE:	*Diffuse radiation, direct normal radiation and tilted surface radiation are not calculated when the clearness index (K) is below 0.3 or above 0.8.*

Salt Lake City, UT

WBAN NO. 24127

LATITUDE: 40.77° N
LONGITUDE: 111.97° W
ELEVATION: 1288 meters
MEAN PRESSURE: 872 millibars

STATION TYPE: Primary



Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	1.9	2.9	4.1	5.4	6.5	7.4	7.3	6.5	5.2	3.7	2.2	1.7	4.6
	Min/Max	1.5/2.4	2.2/3.3	3.0/4.7	4.5/6.1	5.5/7.5	6.2/8.1	6.7/7.9	6.0/7.2	4.3/5.9	3.1/4.2	1.8/2.7	1.1/2.1	4.2/4.9
Latitude -15	Average	2.9	4.0	5.0	5.9	6.6	7.2	7.3	7.0	6.3	5.0	3.3	2.5	5.2
	Min/Max	1.9/4.1	2.7/4.8	3.5/5.9	4.8/6.8	5.5/7.6	6.1/7.9	6.7/7.9	6.5/7.7	5.0/7.2	4.1/5.9	2.3/4.3	1.3/3.6	4.6/5.6
Latitude	Average	3.2	4.3	5.2	5.8	6.2	6.6	6.7	6.7	6.4	5.4	3.7	2.9	5.3
	Min/Max	2.0/4.7	2.8/5.3	3.6/6.2	4.7/6.7	5.2/7.1	5.6/7.1	6.2/7.2	6.3/7.4	5.1/7.3	4.3/6.5	2.5/4.9	1.4/4.3	4.6/5.7
Latitude +15	Average	3.4	4.4	5.1	5.4	5.5	5.6	5.8	6.1	6.1	5.5	3.9	3.1	5.0
	Min/Max	2.0/5.1	2.8/5.6	3.5/6.1	4.3/6.2	4.6/6.3	4.9/6.1	5.4/6.3	5.7/6.7	4.8/7.1	4.4/6.6	2.6/5.2	1.4/4.6	4.3/5.5
90	Average	3.2	3.9	3.9	3.5	3.0	2.8	2.9	3.6	4.3	4.5	3.5	2.9	3.5
	Min/Max	1.6/4.8	2.4/5.0	2.6/4.7	2.9/4.0	2.6/3.3	2.5/2.9	2.7/3.2	3.3/3.9	3.4/5.0	3.6/5.5	2.2/4.7	1.3/4.4	2.9/3.9

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day), Uncertainty ±9%

Axis Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	2.7	4.0	5.6	7.3	8.8	10.0	10.1	9.2	7.6	5.5	3.2	2.3	6.4
	Min/Max	1.7/3.8	2.7/5.0	3.7/6.8	5.9/8.6	6.9/10.5	8.0/11.6	8.8/11.3	8.1/10.6	5.9/9.1	4.2/6.7	2.3/4.1	1.2/3.3	5.4/7.0
Latitude -15	Average	3.4	4.8	6.3	7.7	8.9	10.0	10.2	9.6	8.5	6.5	4.0	3.0	6.9
	Min/Max	2.0/5.1	3.0/6.1	4.1/7.7	6.2/9.2	7.1/10.8	8.0/11.6	8.9/11.4	8.5/11.1	6.4/10.0	4.9/7.9	2.7/5.3	1.4/4.5	5.9/7.6
Latitude	Average	3.7	5.1	6.5	7.7	8.7	9.6	9.8	9.4	8.6	6.8	4.3	3.3	7.0
	Min/Max	2.0/5.6	3.1/6.5	4.1/7.9	6.1/9.1	6.8/10.4	7.7/11.1	8.6/11.1	8.3/10.9	6.5/10.2	5.2/8.4	2.9/5.8	1.5/5.0	5.8/7.6
Latitude +15	Average	3.8	5.2	6.4	7.4	8.2	9.0	9.2	9.0	8.4	6.9	4.5	3.4	6.8
	Min/Max	2.1/5.9	3.1/6.7	4.1/7.9	5.8/8.8	6.4/9.9	7.1/10.4	8.0/10.4	7.9/10.4	6.3/10.0	5.2/8.4	2.9/6.0	1.5/5.3	5.6/7.5

Solar Radiation for 2-Axis Tracking Flat-Plate Collectors (kWh/m²/day), Uncertainty ±9%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	3.9	5.2	6.5	7.8	9.1	10.3	10.4	9.6	8.6	6.9	4.5	3.5	7.2
	Min/Max	2.1/5.9	3.1/6.7	4.2/8.0	6.2/9.2	7.1/10.9	8.2/11.9	9.0/11.7	8.5/11.1	6.5/10.2	5.2/8.5	2.9/6.1	1.5/5.4	6.0/7.9

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day), Uncertainty ±8%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1-Axis, E-W	Average	2.0	2.7	3.2	3.7	4.5	5.6	5.8	5.2	4.8	4.1	2.6	1.9	3.8
Horiz Axis	Min/Max	0.6/4.0	0.9/4.0	1.6/4.3	2.5/4.8	3.1/5.9	3.8/6.8	4.7/6.8	4.3/6.4	3.4/6.1	2.9/5.3	1.4/3.9	0.3/3.6	3.1/4.4
1-Axis, N-S	Average	1.4	2.4	3.6	4.8	6.1	7.4	7.6	6.9	5.8	4.1	2.0	1.2	4.5
Horiz Axis	Min/Max	0.5/2.8	0.9/3.5	1.7/4.9	3.3/6.2	4.1/8.0	5.0/9.2	6.3/9.1	5.5/8.6	4.1/7.5	2.7/5.4	1.1/3.0	0.2/2.4	3.6/5.1
1-Axis, N-S	Average	2.2	3.3	4.2	5.1	5.9	7.0	7.3	7.1	6.6	5.2	2.9	2.0	4.9
Tilt=Latitude	Min/Max	0.7/4.3	1.1/4.8	2.0/5.8	3.5/6.6	4.0/7.8	4.7/8.7	6.0/8.7	5.7/8.8	4.5/8.5	3.5/6.8	1.6/4.4	0.3/3.8	3.9/5.6
2-Axis	Average	2.3	3.3	4.3	5.2	6.3	7.6	7.9	7.3	6.6	5.3	3.1	2.2	5.1
	Min/Max	0.8/4.6	1.2/4.9	2.0/5.8	3.6/6.7	4.2/8.2	5.1/9.5	6.5/9.4	5.8/9.0	4.6/8.5	3.6/6.9	1.7/4.6	0.4/4.1	4.0/5.9

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-2.3	1.2	5.4	9.8	14.9	20.6	25.5	24.2	18.4	11.8	4.9	-1.3	11.1
Daily Minimum Temp	-7.1	-4.1	-0.3	3.3	7.6	13.0	17.6	16.6	10.6	4.6	-0.6	-5.8	4.6
Daily Maximum Temp	2.4	6.4	11.2	16.3	22.2	28.2	33.4	31.9	26.2	18.9	10.4	3.2	17.6
Record Minimum Temp	-30.0	-34.4	-16.7	-10.0	-3.9	1.7	4.4	2.8	-2.8	-8.9	-25.6	-29.4	-34.4
Record Maximum Temp	16.7	20.6	25.6	29.4	33.9	40.0	41.7	40.0	37.8	31.7	23.9	19.4	41.7
HDD, Base 18.3°C	639	481	399	258	119	28	0	0	60	207	403	608	3203
CDD, Base 18.3°C	0	0	0	0	13	97	222	183	63	4	0	0	582
Relative Humidity (%)	74	70	60	53	49	41	36	39	46	56	66	74	55
Wind Speed (m/s)	3.5	3.8	4.3	4.4	4.2	4.2	4.3	4.3	4.2	3.8	3.8	3.4	4.0

Rocky Mountain Power
Docket No. 13-035-184
Witness: Gregory N. Duvall

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF UTAH

ROCKY MOUNTAIN POWER

Rebuttal Testimony of Gregory N. Duvall

June 2014

Q. Are you the same Gregory N. Duvall who submitted direct and rebuttal testimony in the revenue requirement portion of this proceeding on behalf of PacifiCorp dba Rocky Mountain Power ("the Company")?

A. Yes.

Purpose and Summary of Rebuttal Testimony

Q. What is the purpose of your rebuttal testimony?

A. My rebuttal testimony responds to the direct testimonies on the issue of solar valuation as it applies to net metering. Specifically, I respond to testimony on this issue submitted by Mr. Nathanael Miksis for The Alliance for Solar Choice ("TASC"), Mr. Rick Gilliam and Ms. Sarah Wright for Utah Clean Energy ("UCE"), and Mr. Dustin Mulvaney for the Sierra Club. In my rebuttal testimony, I will focus on the value of solar as it relates to capacity and energy. Mr. Douglas L. Marx will address the value of solar as it relates to avoidance of transmission and distribution costs. I also respond to the public notice issued by the Public Service Commission of Utah ("Commission") on April 16, 2014 in response to Senate Bill ("S. B.") 208.

Response to the Commission Determinations Required by S.B 208 (now codified as Utah Code Ann. § 54-15-105.1)

Q. What does S. B. 208 require of the Commission?

A. S. B. 208 requires the following of the Commission who is referred to in S. B. 208 as the "governing authority":

The governing authority shall:

(1) determine, after appropriate notice and opportunity for public comment, whether costs that the electrical corporation or other customers will

incur from a net metering program will exceed the benefits of the net metering program, or whether the benefits of the net metering program will exceed the costs; and

(2) determine a just and reasonable charge, credit, or ratemaking structure, including new or existing tariffs, in light of the costs and benefits.

Q. With regard to part (1), do the costs that the Company or other customers will incur from a net metering program exceed the benefits of the net metering program?

A. Yes. Net energy metered ("NEM") customers are compensated for the power they produce at their retail price, which ranges from 8.8 cents per kilowatt-hour ("kWh") to 14.4 cents per kWh depending on which pricing block is being displaced at the time the NEM customer production is being applied to avoid paying for energy from the grid. In another docket, the Commission addressed the value of solar as it applies to Qualifying Facilities ("QFs"). The benefit of the freed-up power in 2015 is about $30/MWh[1]. This value reflects an energy only value, since the Company does not need new capacity until 2027 based on the 2013 Integrated Resource Plan ("IRP") Update.

Q. Does the Company's proposal for a NEM charge of $4.65 per month satisfy part (2) of S. B. 208?

A. Yes. Given the 5.8 to 11.4 cents/kWh difference between the costs and benefits of net metering, the $4.65 per month charge is reasonable and probably on the low end of the costs.

[1] See Docket No. 14-035-T04, In the Matter of Rocky Mountain Power's Proposed Revisions to Electric Service Schedule No. 37, Avoided Cost Purchases from Qualifying Facilities.

Response to Opposing Parties

Q. What does Mr. Mulvaney of the Sierra Club recommend?

A. Mr. Mulvaney recommends that the Commission reject the Company's proposed net metering facilities charge "because the benefits provided by residential net metering customers far outweigh any revenues that the new charge would take in."[2] In support of this assertion, Mr. Mulvaney concludes that the avoided cost per NEM customer bill is $56.27, while the NEM charge per customer bill is $4.25[3].

Q. Do you agree with this conclusion?

A. No. Mr. Mulvaney's recommendation is based on a flawed analysis because he does not consider the value received by the NEM customer related to the fixed costs of the facilities the customer avoids paying for and he overstates avoided costs.

Q. Please describe the approach Mr. Mulvaney has taken to determine avoided costs.

A. Mr. Mulvaney used what he claims is a method used in California which results in avoided costs for the test period of $61/MWh[4] as compared to the Utah method that shows a result of about $30/MWh as previously noted. Mr. Mulvaney's method assigns a capacity value to a NEM facility based on the avoidance of a Simple Cycle Combustion Turbine ("SCCT") during the period of resource sufficiency which runs through 2026 based on the Company's recently filed 2013 IRP Update. This approach was recently litigated and rejected by the Commission

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[2] Mulvaney, COS/RD Direct, p. 5.
[3] *Id.* p. 2.
[4] *Id.* p. 22.

in its order issued August 16, 2013 in Docket No. 12-035-100 where the price to pay solar QFs was determined.

Q. Do you have any other observations regarding Mr. Mulvaney's avoided cost calculation?

A. Yes. On page 21 of Mr. Mulvaney's testimony, he shows that the highest value of energy occurs in May. This is not intuitive since May is typically in the middle of the hydro run-off period when energy costs are normally at their lowest. This counterintuitive result raises suspicion about the validity of the remainder of Mr. Mulvaney's analysis.

Q. What does Mr. Miksis representing TASC recommend regarding the value of solar?

A. Mr. Miksis recommends "that the Commission defer approving any new charge or credit for net metering customers until it can first develop a proper methodological framework.[5]"

Q. Is the record in this case sufficient enough for the Commission to adopt the Company's proposed $4.65 per month NEM charge?

A. Yes. As previously described, the Commission has already addressed the value of solar to Utah customers as it relates to QF power in another docket and the Company has identified the costs shifted to non-NEM customers when an existing residential customer becomes a NEM customer. Given the large difference between the costs and benefits, there should be no question that a charge to NEM customers is warranted.

[5] Miksis, COS/RD Direct, p. 9.

Q. Did Mr. Miksis present a specific proposal for quantifying the cost and benefits of net metering?

A. No.

Q. What advice did Mr. Miksis provide to assist the Commission in quantifying the cost and benefits of net metering?

A. Mr. Miksis indicated that "There is no need for the Commission to reinvent the wheel to make a cost-benefit determination for the purposes of this proceeding.[6]"

Q. Do you agree with this advice?

A. Yes. The Commission addressed the value of solar recently in Docket No. 12-035-100 where it determined the avoided cost applicable to solar QFs and does not need to reinvent the wheel now. There is no reason to apply different standards to rooftop solar versus a QF with regard to energy value, capacity value, integration costs or the imputation of environmental costs or other adders. These were all decided in Docket No. 12-035-100.

Q. Does Mr. Miksis present any potential methodologies for the Commission's consideration?

A. Yes. Mr. Miksis presents his Exhibits B and C indicating they represent best practices for methodological approaches to quantify the costs and benefits of net metering for distributed solar, but fails to include the method recently adopted by the Commission in Utah for valuation for solar QFs.

Q. What do Ms. Wright and Mr. Gilliam for UCE recommend with regard to solar valuation?

A. They recommend that "no net metering charge should be implemented without

[6] *Id.* p. 9.

consideration of a full cost/benefit analysis across all customer classes.[7]" In other words, they recommend, similar to Mr. Miksis, that the Commission put off approval of the $4.65 NEM charge until another day.

Q. Does UCE provide an estimate of the value of solar in this docket?

A. Yes. Ms. Wright presents her view of the value of solar in Utah in UCE Exhibit 2.1 where she concludes that the 25-year value of solar is $116/MWh. This study was prepared for UCE by Clean Power Research and is not consistent with the Commission's valuation of solar QF projects. For example, it appears to include a capacity value in the resource sufficiency period for deferring a CCCT, as well as including adders for environmental and other costs that were specifically rejected by the Commission in Docket No. 12-035-100.

Q. Ms. Wright notes that the 2013 IRP selected all of the available distributed solar in every scenario and therefore brings value and benefit to customers. How do you respond?

A. The Company's 2013 IRP sought to find the lowest cost/risk portfolio for customers on a wholesale basis over a 20-year planning horizon. The cost of distributed solar generation in the 2013 IRP was based on the costs the Company would incur to acquire it and did not consider the costs incurred by the customer to install the distributed solar generation. The implicit assumption in the 2013 IRP is that each individual customer pays for its cost of service. That is what the NEM charge is intended to do. Ms. Wright essentially argues that as long as distributed solar generation is selected by the IRP models, then NEM customers should not have to pay their share of system costs. This is not a reasonable conclusion.

[7] Wright, COS/RD Direct, p. 5.

Q. Does Ms. Wright offer any advice to the Commission?

A. Yes. Just like Mr. Miksis, Ms. Wright states the "Commission would not need to reinvent the wheel" with regard to the valuation of solar. Again, I agree with this advice as the Commission has already decided many of the issues associated with solar valuation in Docket No. 12-035-100.

Q. Does this conclude your rebuttal testimony?

A. Yes.