Clean Coalition
Making Clean Local Energy Accessible Now

San Diego

Solar Siting Survey

Task 2.2
Final Summary Report: Solar Photovoltaic (PV) Commercial-Scale Sites for 1,000 kWac and Larger

Prepared for
City of San Diego, California

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Executive Summary

The Clean Coalition conducted the SSS for the City of San Diego to determine the technical siting potential for commercial-scale solar photovoltaic (PV) installations throughout the city. While this particular survey focuses on San Diego, the methodology used (Section II.a) builds upon the Clean Coalition's work conducting similar SSS's for other entities, and it can be applied to any defined geographic area. In addition to assessing the technical solar potential, the Clean Coalition also evaluated the Integration Capacity Analysis (ICA) of the nearest feeder line for each of the identified solar sites. By combining the ICA data with analysis of prospective solar sites, the San Diego SSS highlights the optimal locations to connect local solar to the electric grid, where the siting opportunity is excellent, and interconnection is likely to be quick and cost-effective.

The San Diego SSS identifies lower cost and higher value renewable resource opportunities reflecting characteristics of all available sites in relation to existing loads and electric grid infrastructure. The goal of this survey was to identify feasible, commercial-scale sites for installing 1,000 kWac or larger solar PV within the built environment. By highlighting high-quality PV siting opportunities, this survey is designed to guide the development of cost-effective local solar generation within San Diego and to help increase local solar potential in the City.

Figure 1 through Figure 3 show the areas covered by the survey, which was restricted to just the City of San Diego. As shown in Table 4, almost 500 MWac of solar siting potential was found for projects of 1 MWac and above on more than 150 sites on over 740 structures. In addition, Table 7 shows that 10 sites, totaling more than 25 MWac, are in CalEnviroScreen 3.0 top quartile locations and might qualify for additional funding opportunities for disadvantaged communities. More CalEnviroScreen 3.0 details are shown in Figure 8 and Figure 9.

In addition, the value from the ICA map from SDG&E provides an estimate of the nearest feeder and the solar siting potential remaining on the feeder (where available).

The data in this report comes from the previous version: ICA 1.0. The major electrical utilities have released a new version, ICA 2.0 in January 2019. This new version has more features, such as load profiles on the feeders. For more details, see this press release[1].

[1] "*Major upgrades to California utilities' online grid maps will make it easier to develop clean local energy projects*", http://www.clean-coalition.org/press-releases/ica-press-release-january-2019/

About the Clean Coalition

The Clean Coalition is a nonprofit organization whose mission is to accelerate the transition to renewable energy and a modern grid through technical, policy, and project development expertise.

The Clean Coalition drives policy innovation to remove barriers to procurement and interconnection of distributed energy resources (DER) such as local renewables, energy storage, and demand response. The Clean Coalition also establishes programs and market mechanisms that realize the full potential of integrating these solutions. In addition to being active in numerous proceedings before state and federal agencies throughout the United States, the Clean Coalition collaborates with utilities and other load-serving entities, as well as with municipalities and other jurisdictions, to create near-term deployment opportunities that prove the technical and economic viability of local DER.

Ultimately, the Clean Coalition envisions the United States being 100% powered by renewable energy, substantially from local sources. To make this goal a reality, the Clean Coalition is working to achieve these objectives by 2025:

- From 2025 onward, at least 80% of all electricity generated from newly added generation capacity in the United States will be from renewable energy sources.
- **From 2025 onward, at least 25% of all electricity generated from newly added generation capacity in the United States will be from *local* renewable energy sources.**
    - Locally generated electricity does not travel over the transmission grid to get from the location it is generated to where it is consumed.
- By 2025, policies and programs are well established for ensuring successful fulfillment of the other two objectives.
- Policies reflect the full value of local renewable energy.
- Programs prove the superiority of local energy systems in terms of *economics*, *environment*, and *resilience* — as well as *timeliness*.

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I. Background on Solar Siting Surveys

The Clean Coalition conducts Solar Siting Surveys (SSS) to help utilities, cities, and communities assess the potential for local solar generation. These surveys allow communities to work with their utilities to create solar PV investment opportunities that will attract solar developers to build projects where they can be most advantages to the community.

These projects typically are not owned by the cities in which they are built; they are independently owned and operated for profit or net benefit by their owners/developers. Smaller projects, e.g. residential rooftop solar, are typically connected behind the meter (BTM) where the homeowner reaps the benefit as a reduction in the utility bill. Larger projects are often connected in front of the meter (FOM), and the power generated is sold directly to the utility via a feed-in tariff (FIT). The SSS focuses on siting for larger size projects.

The findings of the SSS provide information that can be used to create FITs or to develop city policies that will encourage solar development in specific areas. Construction of solar projects can help to improve the economics of environmentally challenged areas. See

Appendix C: CalEnviroscreen 3.0 overlay for more details.

The data presented here is just an initial assessment of opportunity; it is informational only. Many more investigative steps are required to fully assess whether the site is viable for solar PV installation. It is based upon the best data available at the time of the survey. Minimum project size is selected to focus the survey on the larger opportunities in a given area.

II. Technical Siting Potential

The PV generation potential is an assessment of electrical power that could be generated from a given location based upon a set of reasonable assumptions. The goal is to be within about 20%[2] of the technical solar potential of what a more detailed feasibility assessment would uncover. There was no consideration of structural integrity or other considerations that can only be discovered by performing a deeper and much more detailed study for each individual site. The goal is to identify prospective solar sites that are worth further investigation.

The results of the San Diego SSS can be used to create targeted marketing campaigns that allow the load serving entity and community to focus on those properties with high solar potential.

As shown in Table 4, more than 490 MWac of siting potential was found within the City for projects 1 MWac in size or greater.

a. Methodology

Professional solar PV project developers validated the methodology and assisted in its creation. The survey is performed manually through a multi-step process:

- Scan an aerial survey source, such as Google Earth Pro, for prospective solar sites.
- Measure the usable surface area (roof, parking lot, parking structure) and eliminate obvious portions that are not viable. Trees were ignored since some property owners may elect to top or remove them in order to install PV.
- Assess the probable PV density as explained below.
- Extrapolate the surface area and density assessment to obtain the projected generation capability in Watts kW(W) AC.
- Make best effort identification of most likely feeder for ICA and add to database (Section III. ICA).

[2] The 20% figure comes from working with project developers to develop quick estimating tools. Spot checks on flat roofs have generally come within +/- 10%. Parking lot/garage estimates might be a little low due to variability in how much space is actually utilized. This process is a budgeting exercise to identify opportunity; the next phase is preliminary design where other factors that can impact solar potential are identified and analyzed.

With current and pending solar PV panel efficiencies, high-medium-low density scenarios were examined and direct current (DC) power levels of 8-7-6 W/square feet (sq ft), respectively, were agreed on. For alternating current (AC) output, these numbers were backed off to 7-6-5 W/sq ft, respectively. These numbers are probably more conservative than needed, especially for the medium and low-density scenarios, but it was felt they provided an additional downward margin to allow for increasing roof HVAC gear typically found in older buildings with lower density, but still usable, potential. Again, the goal is to be within 20% of the values that a detailed design would produce, identifying areas of interest that should receive attention for a more detailed examination.

Tools available online (e.g. Google Sunroof[3]) are typically oriented toward residential solar installations. These tools use Light Detection and Ranging (LIDAR) data from aerial surveys conducted by the United States government with a resolution of about one square meter for each data point. They are reasonably accurate for uncluttered residential rooftops where the LIDAR data is combined with government records showing structure boundaries. However, these online tools totally omit parking lots and parking structures, and they overestimate the potential on "busy" flat rooftops because they cannot "see" the vast amount of installed heating, ventilation, and air condition (HVAC) components and piping with 1-meter resolution. Since parking lots and parking structures represent approximately 75% of the potential found in this survey, it is important to include these sites in an assessment of technical solar potential.

For parking lots, the area considered included the single-row edges because modern mounting structures are now cost effective out to the edges. In the past, only the double-row head-in spaces had been considered. There are also large canopy structures available now that can allow parking for larger, less easily steered vehicles (e.g. buses, RVs) which allow open interior space (no posts) for safe maneuvering.

Parking garages are rated at high density because fire truck access space is not required between rows on the roof as it can be with parking lots in some jurisdictions.

b. Minimum Project Size

A minimum project size is established to provide a reasonable stopping point to the survey process. In this survey, 1,000 kWac was chosen as the minimum project size. Some sites that are lower, but still close to this size, are included, especially when part of an aggregated set of buildings or part of a larger entity.

This minimum size was chosen because San Diego has an abundance of sites capable of hosting projects of at least 1,000 kWac. Moreover, projects at the megawatt scale are more

[3] Google Sunroof link: https://www.google.com/get/sunroof/data-explorer/place/ChIJSx6SrQ9T2YARed8V_f0hOg0/

cost and capital efficient than smaller projects, and therefore, have greater potential to attract project developers and investors.

c. Types of Structures

In dense urban environments, rooftops provide a ready source of siting options. The large, flat rooftops found on commercial and industrial buildings are ideal for siting large solar arrays because pitch, azimuth, and layout designs can be optimized. Angled roofs are also included in this survey. South-facing angled roofs generally offer smaller surface areas, but can be useful in the aggregations discussed below. Low-angled roofs facing south-west and south-east may also be feasible (especially during peak energy demand in summer months).

Large parking lots and parking structures offer a significant untapped resource within urban and suburban environments. Parking lots have a slightly lower density opportunity due to the openings between rows that must be maintained for fire truck access. Parking structures do not have this requirement and can have very dense canopies of PV arrays covering the top level of the structure. Adding solar to a parking lot or structure provides the added benefit of shade and rain protection for users and may help buildings achieve LEED certification by abating the heat island effect, providing storm water catchment, and integrating EV charging station infrastructure with DER.

d. Exclusions

As per the request from the City of San Diego, this survey does not include Greenfield opportunities. It only includes potential sites on already disturbed ground, such as buildings and parking lots. However, it should be noted that this area is rife with both large and small airports that could provide many tens of megawatts more PV if properly utilized. Airports were included where rooftops and parking lots were available to meet the minimum aggregation size.

e. Structure Aggregations

In the San Diego SSS, siting opportunities are not restricted to individual rooftops. There are logical groupings of structures that may fall under a single ownership or management entity, including shopping centers, business and industrial parks, school campuses, and apartment complexes. Although, individual structures in these groups may not reach the minimum project size, their combined totals can far exceed 1,000 kWac. Aggregations tabulated in this survey match or exceed the 1,000 kWac minimum for their totals; both the individual structures as well as the aggregate total are listed. In many cases, a judgment is made on aggregations based on parking lot configuration and other obvious indications of common ownership.

All attempts have been made to provide accuracy and to err on the conservative side. It's likely that parcel and owner data, which are not available for this survey, would identify additional aggregation sites. Further research may be conducted in the future.

f. Icons Used in Map Files for Structures and Information

Solar sites are indicated on the map using the following icons:

Table 1: Site Icons

Site Type	Icon	Description
Flat Roof		Typically, commercial and industrial rooftops Usually have HVAC, piping clutter, and skylights Shallow pitches are included
Pitched Roof		Typical angled pitched roof found primarily at schools and some apartments
Parking Lot **Parking Structure**		Parking lots are usually just the central double row head-in areas for cars Parking structures usually cover the entire canopy
Water		Water related sites: capped terminals, recharge reservoirs, water treatment ponds, etc. Can be cover mounted, on canopy overhead or floating structures.
Brown Field		Open land in developed area with no structures

Logical clusters of related sites are grouped with the following icons:

Table 2: Aggregation Icons

Aggregation Type	Icon	Description
Apartment		Apartment buildings and parking.
Transit		Public transit parking lots.
Business		Industrial and business complexes or campuses.
Education		School campuses.
Hospital		Hospital grounds, typically mostly parking.

Shopping		Commercial shopping centers.
Storage		Consumer or commercial storage and warehousing facilities.
Airport		Parking lots and large roofs. In some surveys, ground mount around periphery is also considered.
Venue Yellow in Google-Earth White in Google-Maps		Arenas, amusement parks, tracks, churches, and other venues where people gather for a common purpose.
Government Building		Government buildings

Some sites are noted for other reasons. Existing sites have two possible icons, one that denotes interesting local installations in the survey area, and another to identify a goal of what high-density solar installations can look like. A few sites, typically already in the planning stages for PV projects, have been noted as well.

Table 3: Other Informational Icons

Site Type	Icon	Description
Existing, Target **Red in Google-Earth** **White in Google-Maps**		High-density PV examples on selected sites or neighboring buildings that should be used as reference targets for PV density. Icon label is "?? kW" (denotes wattage is unknown).
Existing		Informational notation regarding existing PV on neighboring buildings. No numeric data is provided. Icon label is "?? kW" (denotes wattage is unknown).
More info to come		Site location noted for now without analysis. More information may be added later.

g. Nearest Feeder and PV Capacity Analysis

The nearest feeder is found from San Diego Gas & Electric's ICA Renewable Auction Mechanism (SDG&E ICA RAM) map. The various ICA category values are also obtained from this map and include the hosting capacity estimates.

In the cases where multiple feeder lines serve aggregation sites, the single closest feeder to a logical possible point of interconnection is selected.

See *Section Integration Capacity Analysis* for more details.

h. Distribution of Files

The San Diego SSS results are distributed in two forms, which are found at the URLs in Appendix A:

- .kml (Keyhole Markup Language) files, which can be displayed on Google Earth or imported into Google Maps.
- .xlsx (Excel) spreadsheet with a table containing all the data used to generate the .kml file, as well as summary breakdowns of the findings. The .kml files are generated from the data found in this file.

i. Summary of Solar Siting Survey

The San Diego SSS identified over 490 MWac of technical PV siting potential on over 100 discrete sites. A site is defined as a unique address (or group of related addresses) with the potential to host at least 1,000 kWac on rooftops, parking lots, parking structures, and logical aggregations thereof.

Figure 1 below provides an overview of San Diego and the SSS locations. The northern portion shows much area that has not yet been built up; the southern portion has the bulk of the siting potential. This survey focuses on already-built environments.

Earlier versions of this report had the city divided into northern and southern areas. That has been eliminated in this final version since it did not add value to the findings. ZIP code summaries are utilized for area-specific summaries.

The Clean Coalition defines Communities of Concern via the CalEnviroscreen (as agreed upon with the City of San Diego). However, further discussions with the City are warranted in this critical area. For the purpose of this report, the City agrees to use CalEnviroscreen as analysis. Stakeholder outreach is ongoing and the City desires to find the most appropriate regional definition to Communities of Concern.

Figure 1: Overview of Solar Siting Potential in San Diego

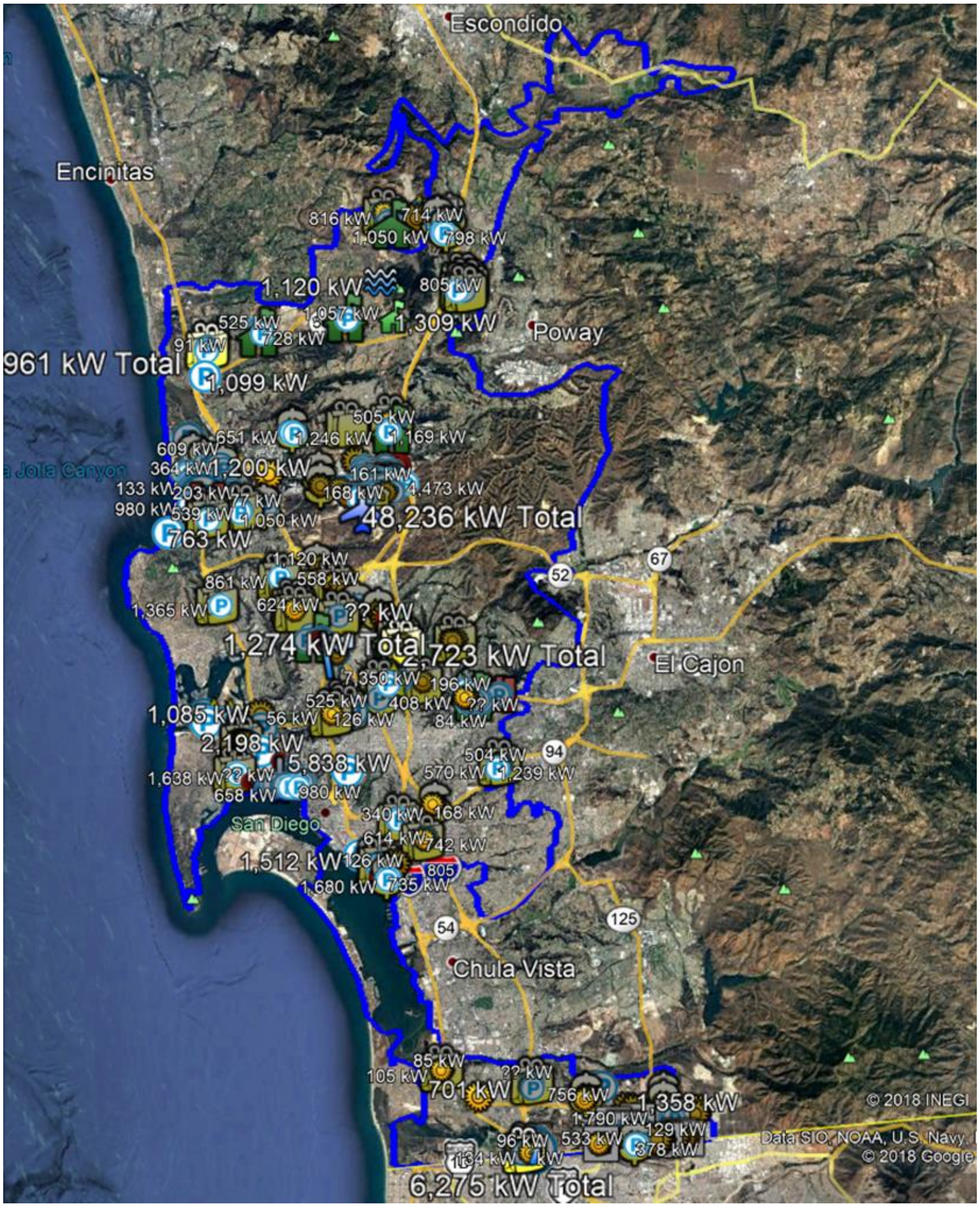


Figure 2 below is a closer view of the southern portion. Some of the icon and text sizing can be seen in this picture. Stand-alone structures have a nominal icon and text size of 100%. Aggregations have a nominal icon size of 150% and text size of 125% with the word "Total" added after the estimated PV size number for the group. Components of an aggregation have a nominal icon and text size of 75%.

Figure 2: Southern portion of Solar Siting Survey

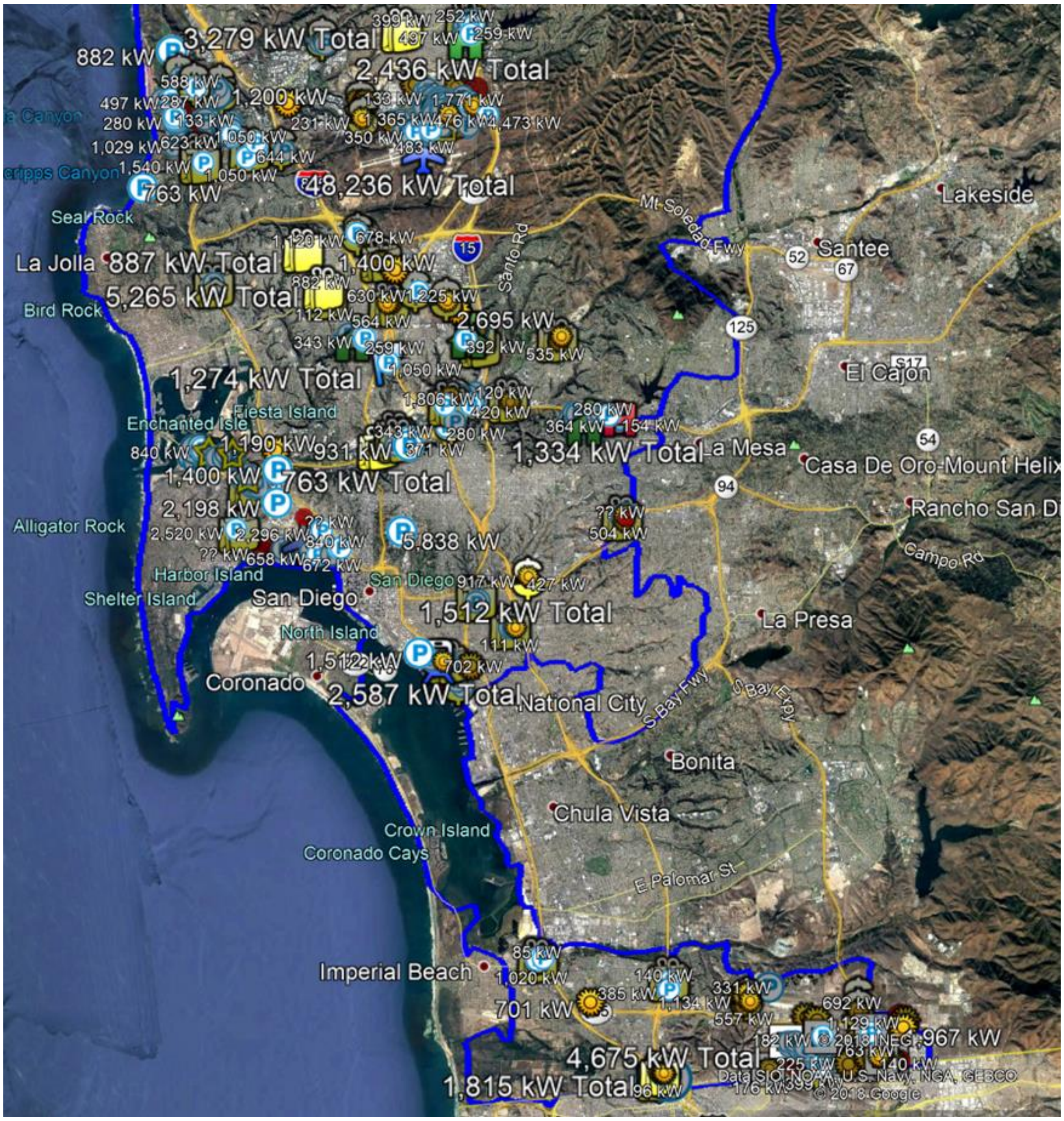
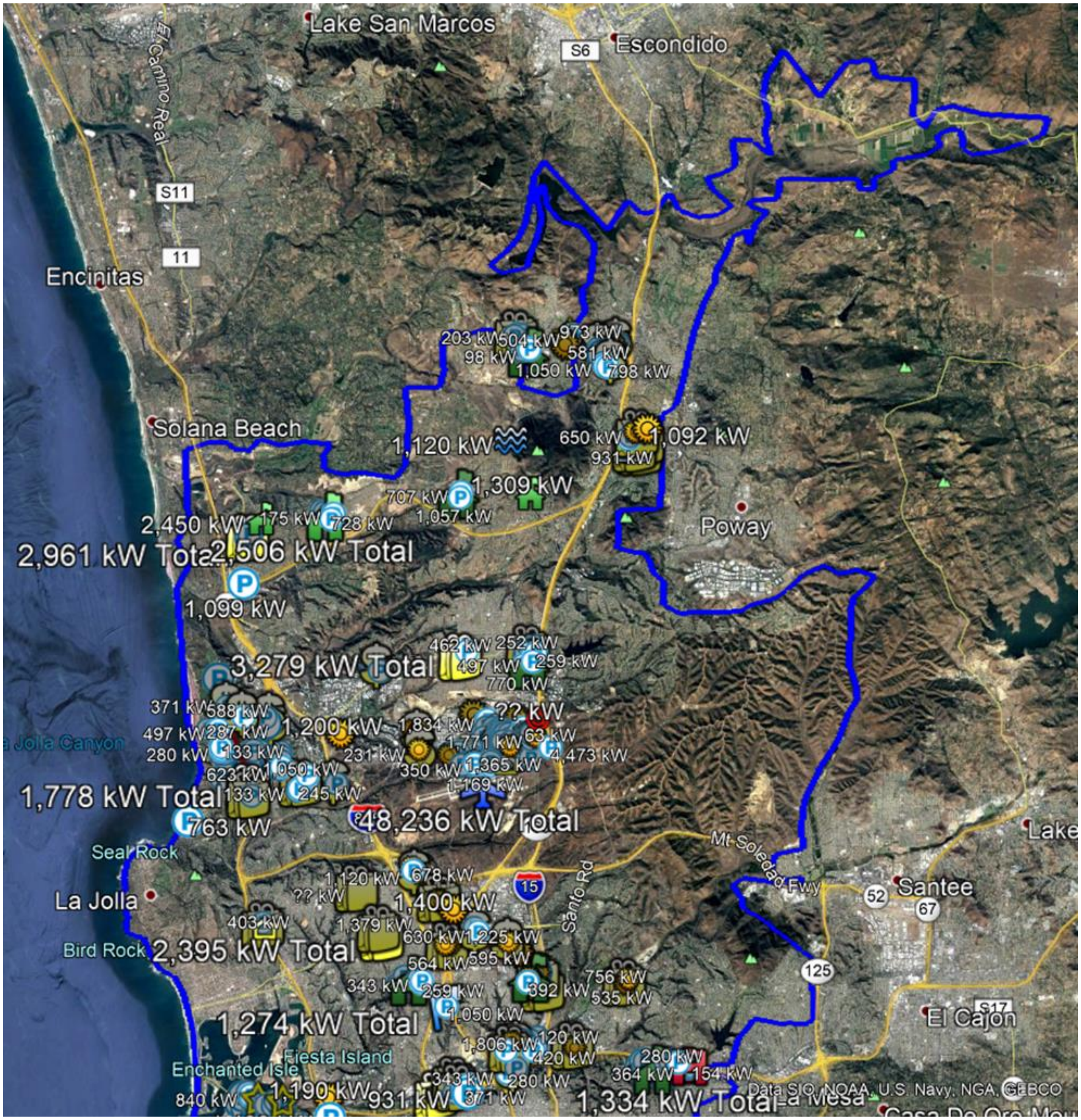


Figure 3 below gives a closer view of the northern portion.

Figure 3: Northern portion of Solar Siting Survey



A summary of sites, grouped by siting potential and city, is shown in the tables below. The spreadsheet with the complete summary can be found in Appendix B. An excerpt of the summary tables by ZIP Code is shown below in Table 4, Table 5, and Table 6.

Table 4: Summary by PV Structure Size (kWac) and ZIP Code

Summary by Structures

		Count	Count	kW_Total	PV W_AC >=	1,000 kW	> and >=	500 kW	Less than	500 kW
		Sites	Structures		Structures		Structures		Structures	
Totals:		157	745	498,653 kW	148	254,996 kW	208	144,154 kW	389	99,503 kW
ZIP	Rank	Sites	Structures		Structures		Structures		Structures	
92037	19	4	12	7,871	2	2,740	6	4,060	4	1,071
92093	11	1	28	17,815	6	6,818	9	6,489	13	4,508
92101	4	9	24	40,418	11	31,850	11	7,798	2	770
92102	25	3	7	3,739	1	1,183	2	1,531	4	1,026
92105	31	1	3	1,547	-	-	1	826	2	721
92106	23	1	3	5,306	3	5,306	-	-	-	-
92108	2	8	48	51,286	12	35,007	14	10,122	22	6,157
92109	6	8	22	24,542	15	21,777	2	1,400	5	1,365
92110	8	8	27	23,151	10	15,295	7	5,204	10	2,652
92111	9	9	35	21,858	8	10,486	10	6,492	17	4,880
92113	12	6	29	13,284	4	5,425	4	2,900	21	4,959
92115	20	1	8	6,136	2	2,618	5	3,176	1	342
92117	27	2	6	3,536	1	1,365	2	1,575	3	596
92120	18	4	20	7,997	1	1,698	4	2,860	15	3,439
92121	10	12	31	19,421	8	10,307	8	5,033	15	4,081
92122	21	2	13	5,789	2	2,100	3	1,918	8	1,771
92123	7	11	29	24,067	10	15,253	7	5,600	12	3,214
92126	14	4	23	12,082	2	2,233	9	6,157	12	3,692
92127	5	11	41	27,734	6	8,887	20	14,367	15	4,480
92128	13	5	24	12,654	2	2,156	8	5,781	14	4,717
92129	24	4	7	5,278	3	3,486	1	707	3	1,085
92130	15	5	19	10,451	2	3,549	5	3,507	12	3,395
92131	29	1	2	1,778	1	1,505	-	-	1	273
92134	30	1	3	1,673	-	-	2	1,246	1	427
92136	26	1	5	3,667	1	1,680	2	1,484	2	503
92145	3	1	114	48,236	9	18,088	21	13,053	84	17,096
92154	1	28	90	71,758	25	42,791	30	20,797	35	8,170
92161	28	1	6	2,443	-	-	2	1,190	4	1,253
92173	16	3	33	8,865	-	-	3	1,949	30	6,916
92182	17	1	25	8,523	-	-	6	3,836	19	4,687
92199	22	1	8	5,748	1	1,393	4	3,097	3	1,258

Table 5: Summary by Structure Type and ZIP Code

Summary by Structure Types

ZIP	Rank	Roof_Flat	kW_Total	Pkg_Lot	kW_Total	Pkg_Garage	kW_Total	Roof_Angled	kW_Total	Water	kW_Total
Total:	% of survey:	24.0%		72.9%		2.8%		0.2%		0.2%	
Totals:		237	119,630 kW	478	363,748 kW	25	14,189 kW	5	1,086 kW	1	1,120 kW
92037	19	3	1,746	9	6,125	-	-	-	-	-	-
92093	11	-	-	25	16,674	3	1,141	-	-	-	-
92101	4	4	5,040	18	32,242	2	3,136	-	-	-	-
92102	25	3	1,512	4	2,227	-	-	-	-	-	-
92105	31	-	-	3	1,547	-	-	-	-	-	-
92106	23	-	-	3	5,306	-	-	-	-	-	-
92108	2	6	1,292	38	48,419	4	1,575	-	-	-	-
92109	6	-	-	22	24,542	-	-	-	-	-	-
92110	8	14	9,200	13	13,951	-	-	-	-	-	-
92111	9	13	7,004	22	14,854	-	-	-	-	-	-
92113	12	6	3,092	23	10,192	-	-	-	-	-	-
92115	20	3	1,432	5	4,704	-	-	-	-	-	-
92117	27	1	26	3	2,940	-	-	2	571	-	-
92120	18	11	5,071	9	2,926	-	-	-	-	-	-
92121	10	8	3,762	23	15,659	-	-	-	-	-	-
92122	21	4	707	6	3,724	3	1,358	-	-	-	-
92123	7	13	7,715	14	15,533	2	819	-	-	-	-
92126	14	7	2,758	15	8,827	1	497	-	-	-	-
92127	5	11	8,365	30	19,369	-	-	-	-	-	-
92128	13	9	4,149	15	8,505	-	-	-	-	-	-
92129	24	1	210	6	5,068	-	-	-	-	1	1,120
92130	15	2	301	16	9,051	1	1,099	-	-	-	-
92131	29	1	273	1	1,505	-	-	-	-	-	-
92134	30	-	-	-	-	3	1,673	-	-	-	-
92136	26	-	-	5	3,667	-	-	-	-	-	-
92145	3	29	8,054	82	39,668	-	-	3	515	-	-
92154	1	56	38,565	34	33,193	-	-	-	-	-	-
92161	28	-	-	5	2,198	1	245	-	-	-	-
92173	16	21	4,922	12	3,944	-	-	-	-	-	-
92182	17	6	1,383	14	4,494	5	2,646	-	-	-	-
92199	22	5	3,053	3	2,695	-	-	-	-	-	-

Table 6: Summary by Site Count and ZIP Code

Summary by Sites

ZIP	Count Sites	kW_Total	PV W_AC >= 3,000 kW Sites	PV W_AC >= 3,000 kW	> and >= 1,000 kW Sites	> and >= 1,000 kW	Less than 1,000 kW Sites	Less than 1,000 kW
Totals:	157	498,653 kW	39	304,686 kW	102	180,664 kW	16	13,302 kW
92037	4	7,871	1	4,448	1	1,778	2	1,645
92093	1	17,815	1	17,815	-	-	-	-
92101	9	40,418	3	29,799	6	10,619	-	-
92102	3	3,739	-	-	3	3,739	-	-
92105	1	1,547	-	-	1	1,547	-	-
92106	1	5,306	1	5,306	-	-	-	-
92108	8	51,286	3	45,010	3	4,582	2	1,694
92109	8	24,542	1	13,972	7	10,570	-	-
92110	8	23,151	3	15,920	5	7,231	-	-
92111	9	21,858	1	5,265	8	16,593	-	-
92113	6	13,284	1	3,996	4	8,399	1	889
92115	1	6,136	1	6,136	-	-	-	-
92117	2	3,536	-	-	1	2,650	1	887
92120	4	7,997	1	3,613	3	4,384	-	-
92121	12	19,421	-	-	12	19,421	-	-
92122	2	5,789	1	4,893	-	-	1	896
92123	11	24,067	1	3,590	10	20,477	-	-
92126	4	12,082	2	8,736	1	2,436	1	910
92127	11	27,734	3	12,219	8	15,515	-	-
92128	5	12,654	1	6,153	3	5,521	1	980
92129	4	5,278	-	-	4	5,278	-	-
92130	5	10,451	-	-	5	10,451	-	-
92131	1	1,778	-	-	1	1,778	-	-
92134	1	1,673	-	-	1	1,673	-	-
92136	1	3,667	1	3,667	-	-	-	-
92145	1	48,236	1	48,236	-	-	-	-
92154	28	71,758	9	45,367	13	21,764	6	4,627
92161	1	2,443	-	-	1	2,443	-	-
92173	3	8,865	1	6,275	1	1,815	1	775
92182	1	8,523	1	8,523	-	-	-	-
92199	1	5,748	1	5,748	-	-	-	-

An additional category has been added to this survey which will aid in identifying communities that may be eligible for additional funding opportunities due to their disadvantaged status. Sites that are in the CalEnviroScreen 3.0 top quartile (minimum CES level of 75 out of 100) have been marked in the database; their counts are summarized in the following table. Also see Appendix C: CalEnviroscreen 3.0 overlay for overview pictures.

Table 7: Site Summary for CalEnviroScreen 3.0 Top Quartile

Min CES3.0: 75

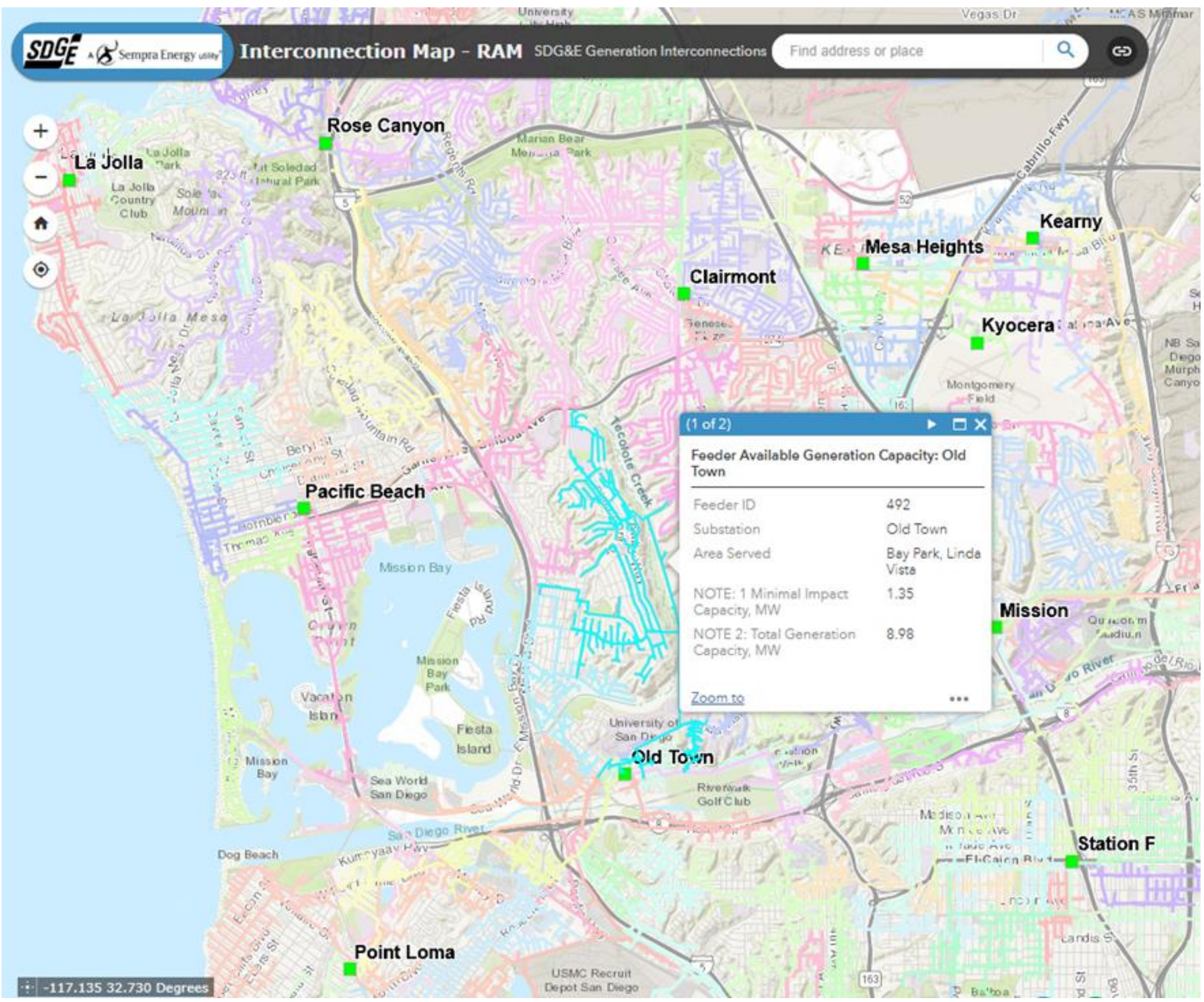
	Sites		Structures	
Totals:	10	25,019 kW	69	25,019 kW
ZIP				
92037	-	-	-	-
92093	-	-	-	-
92101	-	-	-	-
92102	1	1,044	3	1,044
92105	-	-	-	-
92106	-	-	-	-
92108	-	-	-	-
92109	-	-	-	-
92110	-	-	-	-
92111	-	-	-	-
92113	5	11,443	28	11,443
92115	-	-	-	-
92117	-	-	-	-
92120	-	-	-	-
92121	-	-	-	-
92122	-	-	-	-
92123	-	-	-	-
92126	-	-	-	-
92127	-	-	-	-
92128	-	-	-	-
92129	-	-	-	-
92130	-	-	-	-
92131	-	-	-	-
92134	-	-	-	-
92136	1	3,667	5	3,667
92145	-	-	-	-
92154	-	-	-	-
92161	-	-	-	-
92173	3	8,865	33	8,865
92182	-	-	-	-
92199	-	-	-	-

III. Integration Capacity Analysis (ICA)

The ICA segment of the San Diego SSS provides inputs from SDG&E's ICA database at the feeder sections that appear to be closest for interconnection at the proposed site. The ICA calculations are only done for the 3-phase segments of the distribution grid (see Figure 4). Notice that the substations are also displayed on the ICA map; 3-phase lines are the ones seen on power poles bringing power from the utility substations into business and residential areas. One, two, or sometimes all three phases are then brought to the homes and businesses where the power is consumed.

When a feeder line is selected, its important parameters are displayed (see Figure 4). The significant parameters for PV siting have been captured and placed into the database and are shown in Google Earth when a site is selected (see Figure 5). A best effort is made to select the most likely feeder based upon proximity to the proposed PV structure. To know the actual feeder in use, one must review the customer's utility bill.

Figure 4: ICA Map Example



SDG&E's ICA mapping tool description is found at:
https://www.sdge.com/more-information/customer-generation#map

The data in this report comes from the previous version: ICA 1.0. As of January 2019, the major electrical utilities have released a new version, ICA 2.0.

The ICA map capabilities have been enhanced as of 2019, after this survey was performed. The new instructions for using the ICA map are found at:
https://www.sdge.com/node/11431

However, SGD&E has posted the following message on their ICA mapping tool webpage:

"AS OF 1/1/19, ALL USERS WILL BE REQUIRED TO REAPPLY FOR ICA AND RAM MAP ACCESS AND OBTAIN A NEW PASSWORD AND LOGIN.

In order to view the map, you are required to register with SDG&E. Once registered, an email that contains a web link, username, password, and instructions to access and use the map will be sent to your email address. "

The link to the new online registration application form is: https://www.sdge.com/node/7121

It is encouraged that customers apply for interconnection using DER capacities that are less than the reported Minimal Impact Capacity value to improve the probability of passing the interconnection Fast Track screening process criteria. Higher values maybe possible pending engineering analysis process from the LSE.

Figure 5: PV Site ICA Information Example

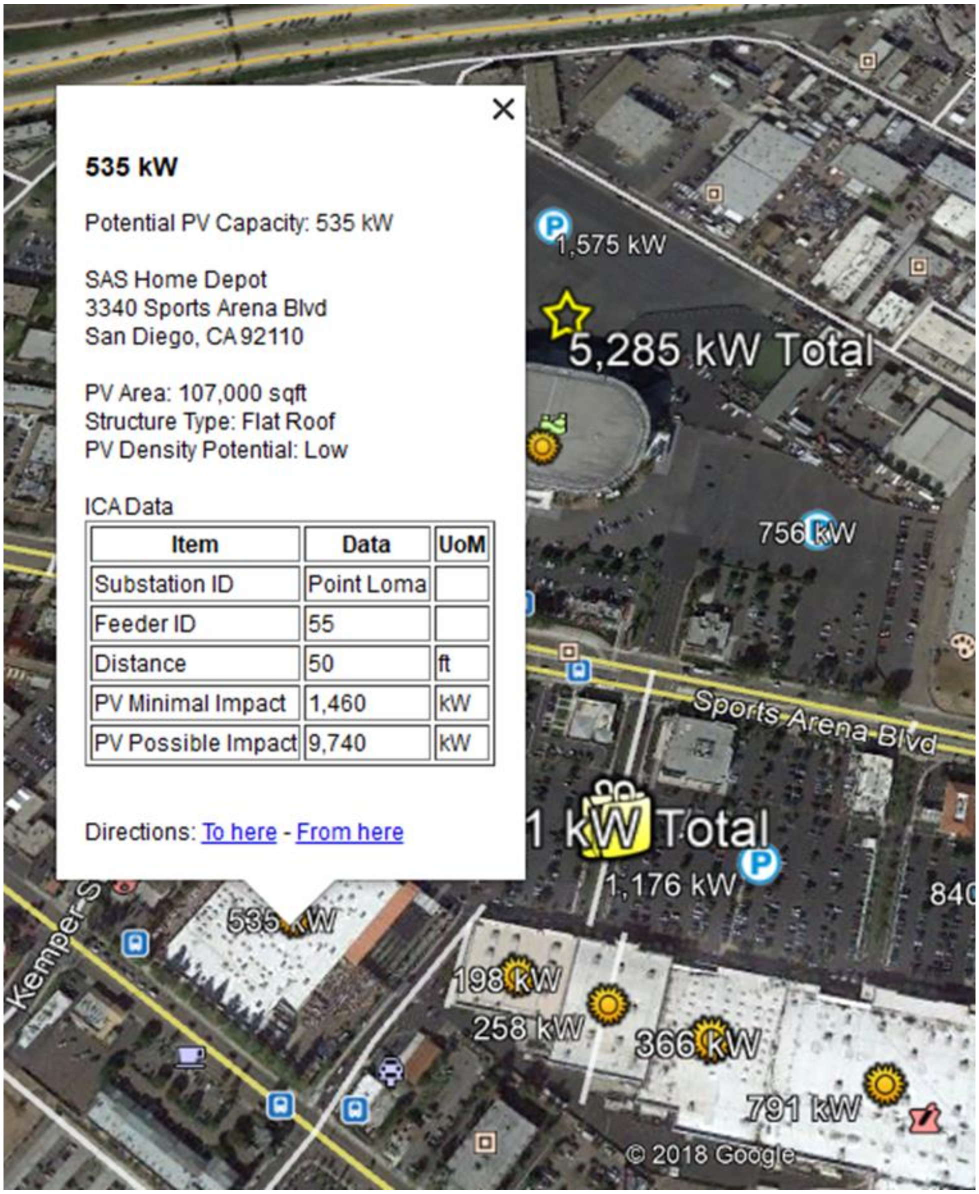


Table 8 is an example that summarizes the major ICA findings by feeder. The complete table can be found in the Appendix A.

Table 8: Sample Portion of ICA Findings by Feeder

PV Sites		ICA	
Substation Name	Substation Survey Siting Potential [MW]	Substation Minimal Impact [MW]	Substation Possible Impact [MW]
Feeder ID	Feeder Survey Siting Potential [MW]	PV Feeder Minimal Impact [MW]	PV Feeder Possible Impact [MW]
Artesian	6.52	1.23	8.18
1104	3.36	0.88	5.27
1100	1.39	1.23	8.18
1102	1.76	1.23	8.17
Bernardo	22.98	1.75	11.65
534	2.95	1.75	11.65
537	4.33	1.46	9.75
292	1.79	1.27	8.47
543	7.48	1.49	9.90
540	0.00	1.44	9.60
577	3.86	1.48	9.90
575	2.58	1.50	10.00
Border	52.59	1.46	9.76
533	30.61	1.35	8.99
534	5.63	1.03	6.87
535	5.01	1.41	9.40
1160	11.34	1.46	9.76
Chicarita	3.51	1.08	7.19
500	2.43	1.04	6.91
910	1.09	1.08	7.19
Chollas West	6.14	1.23	8.19
164	6.14	1.23	8.19
Clairmont	8.55	1.32	8.77
274	6.92	1.17	7.78
277	0.74	1.27	8.47
279	0.89	1.32	8.77
Division	3.67	1.50	10.00
48	3.67	1.50	10.00

Note that there are many feeders on which the proposed PV generation exceeds the minimal or possible impact capacities. This is normal and exemplifies why those who apply for interconnection first on a feeder can have potentially lower interconnection costs if their projects are under the impact levels that the utility has pre-calculated. This is a first-mover advantage.

IV. Spreadsheet and Google Earth .kml File Content

a. Summary Sheets

The PV Summary sheet is derived from the data sheet described below. Totals are given for solar PV siting potential, broken down by Zip Code combinations and by structure type as well as by site count. See Table 4, Table 5, and Table 6 for excerpts from the summary. Also, a breakdown of aggregations is provided by City, Zip Code and aggregation type.

The legend symbols used in the map are defined on the PV Summary sheet as well as in Table 1 and Table 2. The ZIP codes with the top 5 highest potentials are also listed in the summary.

The ICA Summary sheet is also derived from elements in the data sheet. It contains the table in Figure 5 as described in Section III. Integration Capacity Analysis.

b. Data

The spreadsheet columns are clearly labeled. All information appearing in the .kml map is derived from the data sheet. For roofs that do not fit easily into a rectangular definition or may have cutouts or shade exclusions, notes can be found in the *Area_ft2* formula entries with comments that explain which portions of the rooftops were assessed ("+") or excluded ("-").

c. Map Content

The output of the survey process is a .kml file that is viewable in Google Earth. The legend for the symbols used on the map is found on the spreadsheet summary page and in *Section II.f., Icons Used in Map Files for Structures and Information*. The technical solar PV capacity for each structure and for relevant aggregations is shown next to the icon. When the icon is clicked, a pop-up screen appears with the relevant information for that site, as found in the data sheet. Aggregation icons are scaled to be slightly larger than their components constituents.

The controls in Google Earth allow for viewing of the city and county outlines. Use the "Borders and Labels" option under the Layers menus.

The .kml file can also be imported into Google Maps for viewing, but it loses several features when viewed with this tool, such as:

- The estimated site capacity no longer appears next to the map icon, but does appear in the folder on the left.
- The Aggregation symbol is not larger than its constituents.
- Certain icons that are colored in Google Earth (e.g. the red target for ideal example rooftops with high density PV) are not colored in Google Maps.
- The folders on the left do not collapse.

In spite of these shortcomings, the Google Maps version is still accurate and useful because many potential viewers may not have the Google Earth application.

Figure 6: Close-up View of Commercial and Industrial Aggregations Near Miramar NAS

d. Structure Types

The major structure types examined are flat roofs, angled roofs, parking lots, and parking structures. In San Diego, flat roofs and parking lots comprise 97% of the technical hosting sites identified. They are easily identified by their symbols as defined in Table 1.

e. Aggregations

As shown in Table , aggregation sites total over 366 MWac, or about 84% of the PV capacity in this survey. Aggregations are easily identified by their symbols, defined in Table 2. Table 9 also displays a breakdown of the four largest aggregation categories by ZIP code.

Table 8: Summary of Aggregation Facility Sites by Type

Summary by **Aggregation Type**: PV at All Sites

Aggregation Type	Count	kW_Total	PV W_AC >=	3,000 kW	> and >=	1,000 kW	Less than	1,000 kW
Airport	2	69,152	2	69,152	-	-	-	-
Government	2	2,609	-	-	2	2,609	-	-
Biz	25	57,810	6	25,755	18	31,159	1	896
Edu	11	28,333	1	8,523	10	19,810	-	-
Shopping	39	132,082	17	89,759	19	39,692	3	2,630
Storage	11	37,237	5	27,232	5	9,009	1	996
Train	1	2,587	-	-	1	2,587	-	-
Venue	8	59,927	4	52,752	4	7,175	-	-
Totals:	**99**	**389,736 kW**	**35**	**273,173 kW**	**59**	**112,041 kW**	**5**	**4,522 kW**
% of total:		78.2%		54.8%		22.5%		0.9%

Table 9: Summary of Four Largest Aggregation Facility Types by ZIP Code

Summary of Aggregate Facilities by City/ZIP

	Shopping		Airport		Venue		Biz	
San Diego, CA	Num_Sites	kW_Total	Num_Sites	kW_Total	Num_Sites	kW_Total	Num_Sites	kW_Total
92037	2	6,226	-	-	-	-	-	-
92101	-	-	1	20,916	3	5,467	-	-
92102	1	1,044	-	-	-	-	1	1,512
92105	1	1,547	-	-	-	-	-	-
92106	1	5,306	-	-	-	-	-	-
92108	4	17,591	-	-	1	30,450	2	2,314
92109	-	-	-	-	3	18,725	-	-
92110	2	7,611	-	-	1	5,285	-	-
92111	4	12,758	-	-	-	-	2	3,437
92113	2	6,456	-	-	-	-	-	-
92115	1	6,136	-	-	-	-	-	-
92117	2	3,536	-	-	-	-	-	-
92120	2	5,302	-	-	-	-	-	-
92121	-	-	-	-	-	-	7	13,020
92122	1	4,893	-	-	-	-	1	896
92123	2	6,313	-	-	-	-	3	6,234
92126	2	8,736	-	-	-	-	-	-
92127	1	2,713	-	-	-	-	3	12,219
92128	4	11,562	-	-	-	-	-	-
92129	1	1,085	-	-	-	-	-	-
92130	1	2,961	-	-	-	-	1	1,435
92131	1	1,778	-	-	-	-	-	-
92136	-	-	-	-	-	-	1	3,667
92145	-	-	1	48,236	-	-	-	-
92154	2	10,437	-	-	-	-	4	13,077
92173	2	8,090	-	-	-	-	-	-
92199	-	-	-	-	-	-	-	-
Totals:	**39**	**132,082**	**2**	**69,152**	**8**	**59,927**	**25**	**57,810**

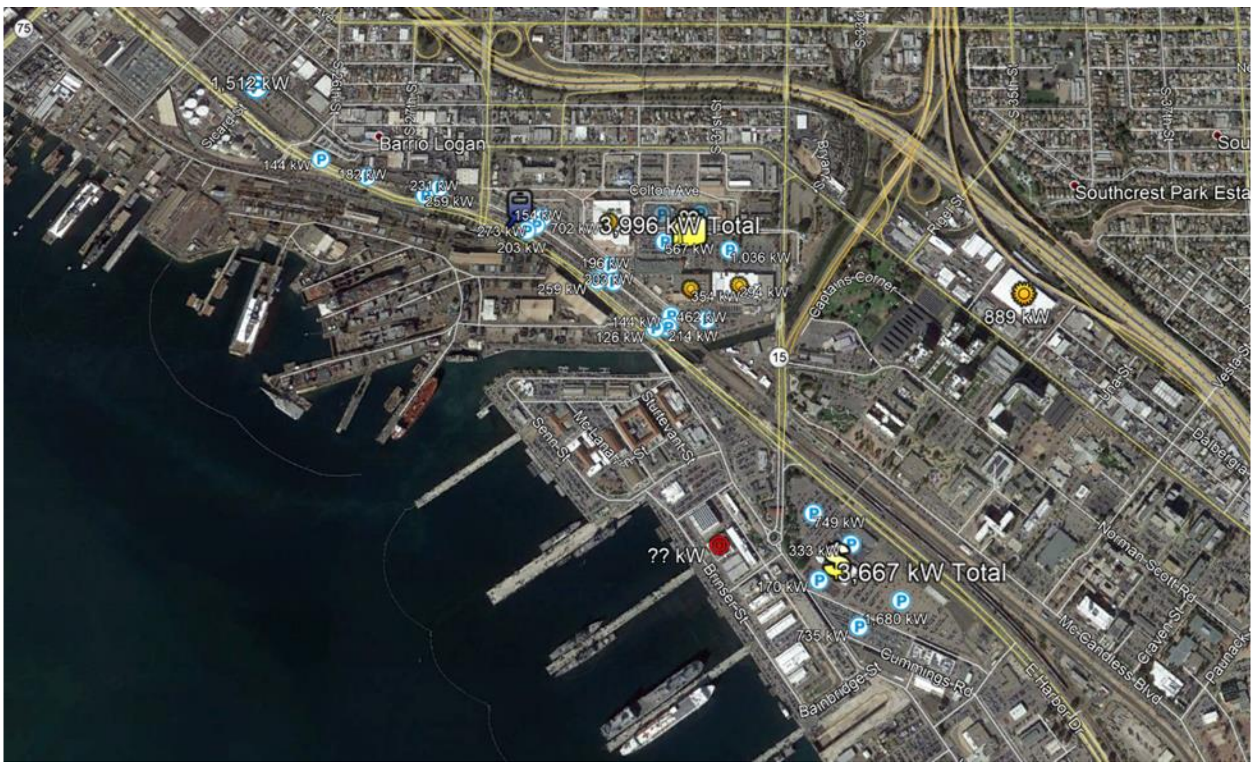
f. Other observations

San Diego has plenty of of solar siting opportunities found in most communities around shopping centers, business/industrial parks, and schools. Many opportunities still exist on the University of California San Diego and San Diego State University campuses and in the business parks around them. Also, the sprawling land and giant warehouses of Otay Mesa are ideal candidates for solar development.

San Diego also has opportunities that might not exist in other communities e.g., there are many large parking lots and large buildings around the naval shipyards.

In addition, one example was sited around the parking lots that support the Trolley station near the naval shipyards. These parking lots are long, narrow strips of land that have little other use. If the policies and building codes allow building structures near the tracks, the parking areas could provide a significant source of land that otherwise cannot be developed for any other purpose. Figure 7 shows the Trolley opportunity at the top and some of the shipyard parking at the bottom.

Figure 7: PV Sites Near the Shipyards



San Diego is fortunate to have a plethora of airports. Parking lots and large buildings were found in abundance around the San Diego International Airport and Miramar Naval Air Station (see Figure 6). In addition, San Diego has many small private and business airports scattered throughout the area. As mentioned in the Section II.e. Exclusions, greenfield opportunities were specifically omitted from this survey, but the open space around all these small airports could provide tens of thousands MWac of PV siting opportunities.

Although some of these opportunities may not be within the juridisction of the City, there is an abundance of opportunties for the City to partner with local agencies and organizations to further access PV siting.

V. Conclusion

There is tremendous opportunity to expand local solar PV generation in San Diego. To facilitate development of local renewable energy, the Clean Coalition conducted the San Diego SSS, which identified over 490 MWac of technical solar PV siting potential across more than 120 sites, with each site being able to host a solar PV system of at least 1,000 kWac. Notably, more than 75% of this siting potential is on parking lots and parking structures, which are often overlooked as siting opportunities for clean local energy. The breakdown of data can be found in Table 5.

While this survey identified solar siting opportunities of at least 1 MWac in size, there is also siting potential for smaller PV projects in San Diego. With a minimum project size of 500 kWac, the Clean Coalition expects the technical solar siting potential will increase dramatically.

Developing the local solar projects identified in this survey can help create a stronger, more resilient grid in San Diego. By pairing distributed solar with other distributed energy resources, such as energy storage, demand response, and electric vehicle charging infrastructure, the city can establish Community Microgrids and Solar Emergency Microgrids. These innovative configurations can be designed to provide indefinite, renewables-based, backup power to critical facilities in the event of regional power outages. With the addition of energy storage combined with solar, many of the large solar sites identified in this survey are prime candidates for these microgrid applications.

VI. Appendices

a. Appendix A: San Diego Solar Siting Survey Files

The following files are available with the Solar Siting Survey information at http://www.clean-coalition.org/resource/solar-siting-surveys/san-diego/

- Spreadsheet data file (.xlsx)
- Google Earth files:
  - SSS Google Earth file (.kml)
  - Substation Google Earth file (.kmz)
  - Total City of San Diego Google Earth outline polygon file (.kmz)
  - San Diego Google Earth southern portion outline polygon file (.kmz)

If you are unable to open any of the Google Earth files (i.e. .kml, .kmz) via the above URL, please follow the below instructions:

1) Install Google Earth app onto your computer.
2) From the above link, select the file you wish to download to your computer, right click your mouse, select *download* and save to your computer.
3) Open the Google Earth app, click on "File", then click on "Open"; finally, select the file you wish to open.

A Google-Maps viewable version of the .kml file that is accurate but has fewer viewing features than when viewed in Google-Earth:

https://drive.google.com/open?id=1iYQ8bABpgUO22OYf9mNiSxTP89uNn4Eb&usp=sharing

b. Appendix B: San Diego ICA Summary

Note: data are from ICA 1.0 which has been replaced by ICA 2.0 as of 1-Jan-2019, after this report was completed.

Table 10: ICA Tables

PV Sites		ICA	
Substation Name	Substation Survey Siting Potential [MW]	Substation Minimal Impact [MW]	Substation Possible Impact [MW]
Feeder ID	Feeder Survey Siting Potential [MW]	PV Feeder Minimal Impact [MW]	PV Feeder Possible Impact [MW]
Artesian	6.52	1.23	8.18
1104	3.36	0.88	5.27
1100	1.39	1.23	8.18
1102	1.76	1.23	8.17
Bernardo	22.98	1.75	11.65
534	2.95	1.75	11.65
537	4.33	1.46	9.75
292	1.79	1.27	8.47
543	7.48	1.49	9.90
540	0.00	1.44	9.60
577	3.86	1.48	9.90
575	2.58	1.50	10.00
Border	52.59	1.46	9.76
533	30.61	1.35	8.99
534	5.63	1.03	6.87
535	5.01	1.41	9.40
1160	11.34	1.46	9.76
Chicarita	3.51	1.08	7.19
500	2.43	1.04	6.91
910	1.09	1.08	7.19
Chollas West	6.14	1.23	8.19
164	6.14	1.23	8.19
Clairmont	8.55	1.32	8.77
274	6.92	1.17	7.78
277	0.74	1.27	8.47
279	0.89	1.32	8.77
Division	3.67	1.50	10.00
48	3.67	1.50	10.00

PV Sites		ICA	
Substation Name	Substation Survey Siting Potential [MW]	Substation Minimal Impact [MW]	Substation Possible Impact [MW]
Feeder ID	Feeder Survey Siting Potential [MW]	PV Feeder Minimal Impact [MW]	PV Feeder Possible Impact [MW]
Eastgate	2.57	1.50	10.00
Elliot	3.61	1.32	8.77
385	3.61	1.32	8.77
Friars	11.39	1.50	9.98
Multiple	0.00	0.00	0.00
39	6.31	1.50	9.98
1060	2.28	1.46	9.74
35	2.79	1.39	9.25
Genesee	30.72	1.50	10.00
268	4.22	1.49	9.95
271	3.47	1.49	9.90
272	2.32	1.34	8.95
Multiple	0.00	0.00	0.00
273	9.56	1.48	9.89
270	4.45	1.50	10.00
748	1.71	1.50	10.00
745	4.99	1.46	9.74
Grant Hill	1.04	1.37	9.11
1434	1.04	1.37	9.11
Imperial Beach	3.59	1.40	9.33
723	3.59	1.40	9.33
Kearney	9.86	1.50	9.97
711	1.40	1.50	9.97
348	1.56	0.78	5.23
254	1.46	1.45	9.66
Kettner	20.92	1.50	10.00
134	13.40	1.50	10.00
135	5.35	1.41	9.40
458	2.17	1.40	9.33

PV Sites		ICA	
Substation Name	Substation Survey Siting Potential [MW]	Substation Minimal Impact [MW]	Substation Possible Impact [MW]
Feeder ID	Feeder Survey Siting Potential [MW]	PV Feeder Minimal Impact [MW]	PV Feeder Possible Impact [MW]
Mesa Heights	13.38	1.77	11.82
776	2.13	1.73	11.50
775	2.55	1.77	11.82
1286	4.77	1.76	11.75
774	3.93	1.77	11.79
772	0.00	1.76	11.73
Mesa Rim	2.50	1.49	9.93
959	2.50	1.49	9.93
Mira Mesa	1.07	1.41	9.37
962	1.07	1.41	9.37
Miramar	55.51	1.48	9.84
223	48.24	1.42	9.47
761	2.08	1.43	9.54
224	1.00	1.48	9.84
229	0.91	1.37	9.10
228	3.28	1.42	9.46
Missing ICA	8.03	0.00	0.00
-	8.03	0.00	0.00
Mission	46.95	1.50	10.00
144	2.89	1.26	8.42
706	10.86	1.36	9.06
707	1.19	1.50	10.00
145	0.93	1.43	9.54
147	6.20	1.37	9.13
146	1.13	1.45	9.66
149	15.16	1.50	10.00
704	6.91	1.50	10.00
143	1.69	1.42	9.44
Murray	4.99	1.38	9.17
85	3.65	0.58	3.88
88	1.33	1.38	9.17
North City West	9.02	1.50	9.98
831	3.55	1.33	8.88
830	0.92	1.50	9.98
833	2.04	1.40	9.35
832	2.51	1.01	6.75

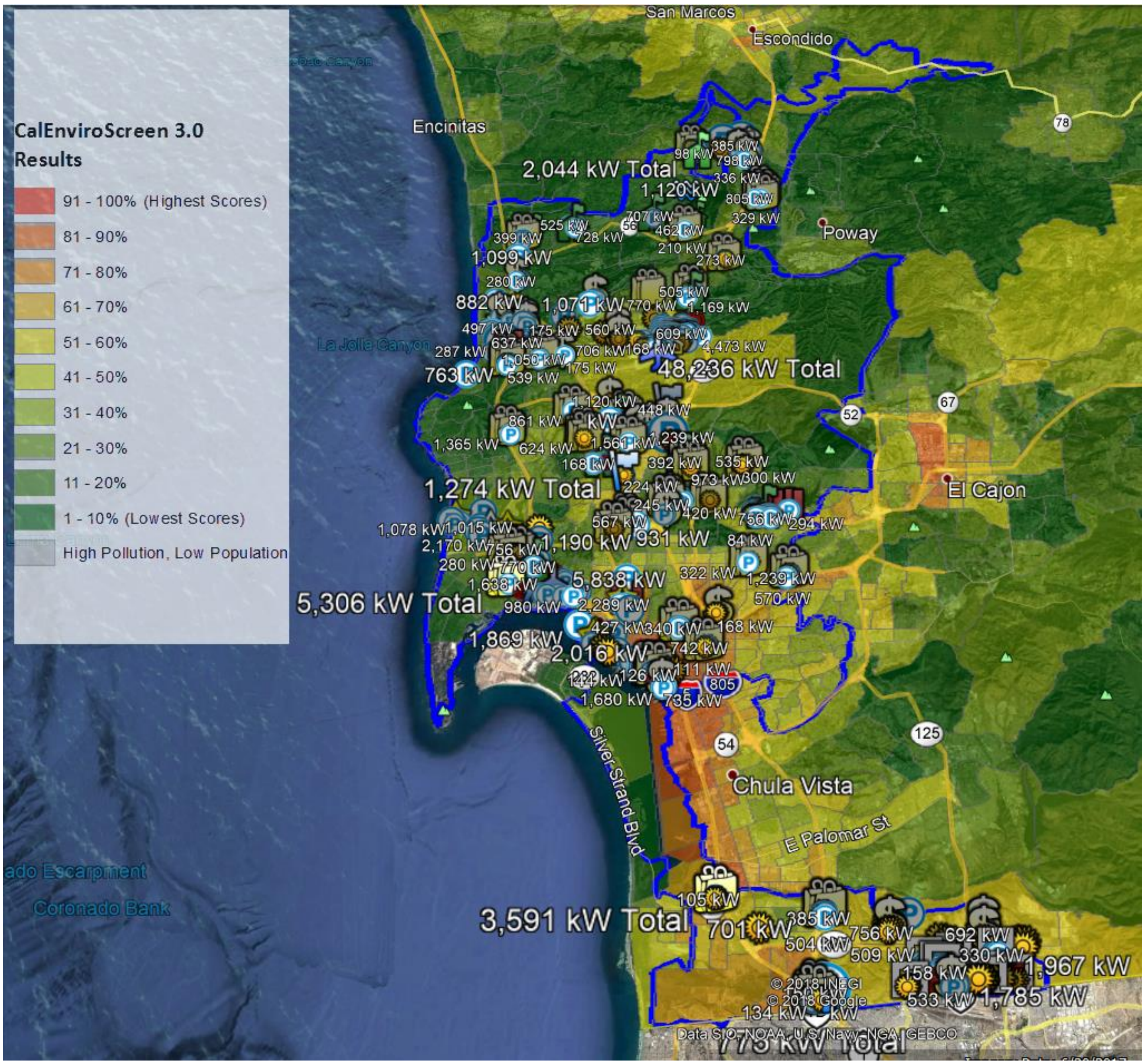
PV Sites		ICA	
Substation Name	Substation Survey Siting Potential [MW]	Substation Minimal Impact [MW]	Substation Possible Impact [MW]
Feeder ID	Feeder Survey Siting Potential [MW]	PV Feeder Minimal Impact [MW]	PV Feeder Possible Impact [MW]
Old Town	32.01	1.50	9.98
100	17.37	1.46	9.75
136	4.31	1.49	9.96
491	3.60	1.50	9.98
60	1.27	1.19	7.92
124	5.47	0.79	5.26
Pacific Beach	6.16	1.45	9.70
546	2.25	1.45	9.70
545	3.91	1.43	9.56
Paradise	2.46	1.33	8.87
323	2.46	1.33	8.87
Point Loma	16.10	1.50	10.00
50	5.31	1.44	9.62
55	2.15	1.46	9.74
740	4.20	1.29	8.62
741	4.45	1.50	10.00
Rancho Carmel	18.40	1.49	9.91
934	8.88	1.49	9.91
937	3.78	1.40	9.33
936	2.99	1.38	9.23
930	2.76	1.03	6.85
Rose Canyon	11.67	1.48	9.89
65	7.29	1.24	8.26
120	0.76	1.40	9.31
273	0.97	1.48	9.89
69	2.65	1.44	9.63
Sampson	18.57	1.59	10.60
128	2.26	1.50	10.00
129	4.32	1.44	9.66
130	2.40	1.35	9.02
131	7.30	1.59	10.60
123	2.29	1.48	9.84

PV Sites		ICA	
Substation Name	Substation Survey Siting Potential [MW]	Substation Minimal Impact [MW]	Substation Possible Impact [MW]
Feeder ID	Feeder Survey Siting Potential [MW]	PV Feeder Minimal Impact [MW]	PV Feeder Possible Impact [MW]
Scripps	**9.67**	**1.36**	**9.07**
438	3.13	1.21	8.05
435	4.76	1.31	8.76
729	1.78	1.36	9.07
Station B	**1.87**	**1.22**	**8.12**
756	1.87	1.22	8.12
Station F	**8.39**	**1.41**	**9.41**
362	8.39	1.41	9.41
Streamview	**9.29**	**1.59**	**10.60**
167	1.51	0.47	3.12
168	3.19	1.29	8.61
430	3.04	1.59	10.60
169	1.55	1.31	8.71
Torrey Pines	**4.77**	**1.50**	**10.00**
735	0.88	1.50	10.00
737	2.45	1.50	10.00
266	1.44	1.14	7.57
Urban	**12.74**	**1.49**	**9.96**
426	10.07	1.41	9.39
465	1.67	0.88	5.87
427	1.00	1.49	9.96
Grand Total	**498.65**	**1.77**	**11.82**

c. Appendix C: CalEnviroscreen 3.0 overlay

"CalEnviroScreen identifies California communities by census tract that are disproportionately burdened by, and vulnerable to, multiple sources of pollution."[4] Table 9 below shows how the CalEnviroscreen 3.0 overlay map applies to the City of San Diego. The more orange or red the color, the higher the pollution is on a given area.

Figure 8: CalEnviroscreen 3.0 Overlay of the City of San Diego



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4 https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30

Figure 9 below provides a closer view of the highest rated areas covered in this survey. It shows that the most vulnerable areas are on the coast, near the shipyards. Several prime sites were found in this area, including around parking for the Trolley.

Figure 9: Closeup of Most Vulnerable Areas Near Shipyard and Trolley Station