MAPPING THE FUTURE OF THE PEAK PROGRAM IN SOUTHERN CALIFORNIA

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INTRODUCTION

The PEAK Student Energy Actions program (PEAK) has sought to empower students in grades K-8 in becoming smart energy managers since the 1970s. Nestled within The Energy Coalition, a 501(c)(3) nonprofit organization dedicated toward helping communities and individuals engage in energy-efficient projects, the PEAK program serves as the nonprofit's primary educational component.[1] Funding for the program comes directly from grants and contracts with investor-owned utilities (IOUs) throughout the state of California under the auspices of the California Public Utilities Commission (CPUC). Based in Irvine, San Diego, and Oakland, the PEAK program currently serves nearly 250 schools and over 22,000 students statewide.[2]

Recent organizational transitions and restructuring laid the foundation for an even greater expansion of PEAK's offerings and program services. As part of a nonprofit that emphasizes the need for increased attention on environmental sustainability issues, the program's mission to educate young minds about these issues is highly relevant in our current day and age. Our world is increasingly challenged with a growing demand for water and energy, and a rapidly changing environment due to the effects of climate change. Educating as many children as possible about the environmental consequences of water and energy use and how they can take action to be positive citizens for the environment thus becomes a highly salient and necessary mission for our earth's future.

The expansion of the PEAK program is predicated on a variety of factors, including continued funding from the CPUC, sufficient workforce to handle program operations and expansion logistics, and the knowledge of what schools/regions are most effective to target during the initial stages of expansion. This project focuses on the last of these considerations, and through the utilization of Geographic Information Systems (GIS), seeks to provide a visual means by which to envision and initiate strategic planning for the effective future expansion of the PEAK program, specifically in the Southern California region.

METHODOLOGY – *Determining Target Schools*

In assessing which schools represent the best options for the PEAK program to target during its initial stages of expansion in Southern California, several factors were considered and aggregated to create a unique score for each school. The following table (Table I) provides a list of these factors, their respective means of scaling or ranking, and the reasoning behind their inclusion in the school score.

[1] The Energy Coalition. (2015). *Our story*. Retrieved from http://energycoalition.org/our-story/
[2] This data was gleaned from current (2015) PEAK program records reported through Salesforce.

TABLE 1

FACTOR	SCALE	PURPOSE FOR INCLUSION
Distance from PEAK Program Headquarters in Irvine, CA	1 – 5 (where 5 = greatest distance)	The PEAK program involves opportunities for schools to request on-site services such as site visits and assemblies. The associated travel costs are directly proportional to the distance traveled. Nearby schools are thus given a more favorable score due to lesser travel costs.
Qualification as a Low-Income School (based on student FRPM data)	0 = low-income 1 = not low-income	Program contracts require that a minimum of 50% of PEAK enrolled schools qualify as low-income,[3] a designation given to schools where over 35% of the student population qualifies for Free or Reduced Price Meals (FRPM). Schools are assigned a 0 or 1 based on this data.
Located in a School District Containing Other PEAK Schools	0 = yes 1 = no	Districts that already possess one or more PEAK-enrolled schools are more likely to be open to working with the program and integrating it further into the district.

*NOTE: Rankings were assigned based on the predetermined basis that lower scores represent the more favorable and better strategic school options for PEAK program expansion in Southern California.

One specific criterion that would have been significant and helpful to include in the school score is water and energy usage data, given that schools with higher water and energy use may benefit more from the PEAK program's educational services than schools already demonstrating efficient, or better than average, usage rates. Unfortunately this data is highly challenging to obtain due to confidentiality and intellectual property considerations on behalf of the IOUs. Consequently this data for the schools in question was unable to be acquired from Southern California Edison and Southern California Gas (SCE and SCG, respectively) within the timeframe of this project, and is not factored into the overall school score.

Calculating the Scores

In order to calculate the score for each school based on the aforementioned criteria, it was necessary for all of the pertinent data to exist in one cohesive table from which to add fields for the individual rankings and overall school score calculations to occur. This data table will heretofore be referred to as the "Unified Data Table." In order to create this table, the California Department of Education data table containing the Free Reduced Price Meals (FRPM) data was exported into Excel and used as the base file for the Unified Data Table. The initial step in preparing this table involved first filtering the data to solely include the 15 counties located within SCE/SCG service territory: Fresno, Imperial, Inyo, Kerns, Kings, Los Angeles, Madera, Mono, Orange, Riverside, San Bernardino, Santa Barbara, Tuolumne, Tulare, and

[3] PEAK. (2014). *PEAK Annual Report*. Irvine, CA: The Energy Coalition.

Ventura.[4] The following subsections discuss the process undertaken for determining each criterion:

- Low-Income Ranking:
  To determine if a school qualified as low-income or not (i.e. 35% or more of the student population eligible for FRPM) the Unified Data Table was first filtered by ascending percentages of eligibility for the schools. The schools were then assigned a ranking of 1 if less than 35%, and a ranking of 0 if 35% or greater.

- Located in PEAK School District:
  The numeric ranking to distinguish schools located in school districts that currently possess (or have possessed in the past three years) at least one school enrolled in the PEAK program was calculated by first filtering the Unified Data Table in Excel by ascending county names. The adjacent columns included school district and school name data, which was cross-checked for PEAK districts and schools using data downloaded into Excel through a PEAK program Salesforce report. PEAK school districts from the current and past three years totaled 40 in number, and districts matching these from the Unified Data Table were given a score of 0. Schools located in districts not found in the list of PEAK school districts were given s score of 1.

  Finally, PEAK schools located in PEAK school districts from the Salesforce report were given a score of 8 to distinguish them as current PEAK schools when aggregating school locations by score on the map. (The purpose of this project is to visualize the most strategic schools for PEAK program expansion; however, by assigning PEAK schools a value of 8, it was then also possible to showcase where the PEAK program services are currently located and what the distribution looks like.)

- Distance from PEAK Headquarters:
  To determine the distance between each school location and PEAK Headquarters in Irvine, CA, the latitude and longitude for each school location was added to the Unified Data Table in Excel from the California Department of Education Schools & Districts downloadable files (previously filtered by SCE/SCG counties and K-8 schools for PEAK program alignment).[5] Coordinates for PEAK Headquarters were then derived using its address and an online coordinate calculator,[6] and all coordinates were subsequently converted to radians using the Excel function "=RADIANS(cell)" in order to prepare them for inclusion in the trigonometric formula for calculating the distance between the two points taking into consideration their location on the spherical earth. This formula, also referred to as the Haversine formula,[7] was then used to calculate the approximate

[4] Southern California Edison (SCE). (2015). *Incorporated cities and counties served by SCE*. Retrieved from http://www.edison.com/content/dam/eix/documents/aboutus/our-companies/SCETerritory.pdf
[5] California Department of Education. (2015). *Public schools database*. Retrieved from http://www.cde.ca.gov/ds/si/ds/pubschls.asp
[6] Address: 47 Discovery, Irvine, CA 92618; Online Latitude/Longitude Coordinator: http://itouchmap.com/latlong.html
[7] Wyatt, A. (2015, February 14). Calculating the distance between points. *Excel Tips*. Retrieved from http://excel.tips.net/T003275_Calculating_the_Distance_between_Points.html

distance between each school and PEAK Headquarters. This formula utilized in Excel appears as follows:

=ACOS(((sin(lat1))*(sin(lat2)))+((cos(lat1))*(cos(lat2))*(cos((lon2)-(lon1)))))*3443.89849

The resulting distances were then converted from nautical miles to standard miles using the conversion rate of 1 nautical mile to 1.1508 miles.[8] These new distances were initially given rankings based on equal intervals of distance, which resulted in the following ranking system for distance:

	Min	Max
Rank 1	1.414661	69.64411
Rank 2	69.64412	137.8736
Rank 3	137.8737	206.103
Rank 4	206.104	274.3325
Rank 5	274.3326	342.5619

When entering the ranks into the Excel spreadsheet however, it was observed that a majority of schools fell into the category for a ranking of 1. Upon further investigation, it was discovered that roughly 84% of schools would rank as 1 if the above interval system of ranking was utilized. As such, an alternative approach was undertaken in which the number of schools was divided by 5 and the data table was filtered to show an of schools (i.e. the nearest 720 schools were given a ranking of I, the next set of 720 schools was assigned a ranking of 2, and so forth.)

Despite the fact that this ranking system places a heavier weight on distance over the other factors, it was maintained in favor of a system with less weight due to two key factors. The first being that distance is the most important of the three criteria when evaluating whether a school could be enrolled in the PEAK program (pending the creation of a PEAK satellite office) and secondly that a wider scale for ranking allows nearer schools to be better separated (i.e. there are a lower quantity of schools with a ranking of 1 in the current ranking system than there would be if it were ranked on a 1-3 scale, for example). Although this method may prove a more coherent way to assign distance rankings to schools, there remain a variety of ranking methods to choose from, depending on what emphasis is desired on delineating between closer schools and those farther away. Additionally this ranking system may be easily modified if one wanted to visualize the differentiation between school scores on a smaller regional scale.

Following all of the assignments of rankings for each factor, the overall school score was determined by creating an additional column in the Unified Data Table in Excel that summed up the factors into one score ranging from 1-13 (with PEAK schools ranking from 8-13).

[8] Metric Conversions. (2015). *Nautical miles to miles*. Retrieved from http://www.metric-conversions.org/length/nautical-miles-to-miles.htm

DATA ANALYSIS – *Setting Up the Map*

Following the determination of criteria and ultimate scores by which to differentiate schools within the SCE/SCG territory for rating purposes, it was necessary to gather data to begin creating the project map. The following are the steps involved in that process:

1. Map Area (SCE/SCG service territory): derived using California shapefiles for county boundaries from the U.S. Census Bureau, and then joining these with zip code data for the SCE/SCG service territory in order to isolate the target region given PEAK's contract with SCE/SCG and the requirement to provide services under that contract solely within their territory.

2. School Locations: determined utilizing the latitude and longitude coordinates from the California Department of Education Schools and Districts data (already contained and filtered for SCE/SCG territory within the Unified Data Table) and then plotted on the map using the "Display XY Data" function in ArcMap after uploading the Unified Data Table to the project map.

The data sources for these map features, as well as the data used for determining the individual school scores for rating purposes, are summarized in Table 2 below.

TABLE 2

MAP FEATURE/DATA	DATA SOURCE	SPECIFIC DATA
California Geography	United States Census Bureau (2010)	Shapefiles for California counties and boundaries
School Locations	California Department of Education	California school latitude and longitude coordinates
Low-Income School Data	California Department of Education	School qualification as low-income or not
PEAK School Districts	Salesforce	History of school districts as either PEAK-enrolled or not

Once school locations were plotted on the map, additional map layers were created based on the following selections by attribute, namely PEAK schools in SCE/SCG territory and non-PEAK schools in SCE/SCG territory, as well as the creation of separate map layers by school score (with rankings 5-7 grouped into one due to the large distances attributed to these rankings). In order to then create maps that would best visualize expansion strategies for the PEAK program based on the scores for non-PEAK schools, a series of maps were made that utilize slightly different ranking systems in hopes of creating an effective visual for identifying target schools. These maps are located in the Appendix, beginning on page 8.

LIMITATIONS & CHALLENGES

The principal limitations associated with this project are related to creating an accurate and meaningful score for each of the schools in question. As mentioned previously, a criterion that would be helpful and significant to include is energy and water usage data for the schools. This would benefit the schools scores immensely by really honing in on which schools have a greater need for implementing programs that promote energy and water conservation through both knowledge acquisition and fostering active behavior change towards sustainability. Additionally, although the weights and ranking systems used in calculating the school scores have been given much thought and consideration, it may prove beneficial to modify these weights and/or rankings based on the needs of the PEAK program as well as the contract goals and deliverables outlined in the utility partner contracts. With more information regarding both the short and long-term vision of the PEAK program with regards to expansion, the school scores could better reflect the desires and vision of the program.

RECOMMENDATION & CONCLUSION

Based on the maps created for this project, it may be observed that the most effective schools to target for the PEAK program's initial expansion are located within Orange County itself, and/or consider the creation of a PEAK satellite office farther into the Inland Empire of Riverside and San Bernardino Counties that could more efficiently and effectively handle program operations for high priority schools in that area as evidenced by Map 4. That said, there does appear to be a wealth of schools and districts within close range of PEAK Headquarters that have yet to be enrolled in the program and experience its benefits, as shown in Map 5. Further investigation and analysis may be best undertaken with a focus on modifying the weights of the individual factors included in the school scores so that they most accurately reflect the consideration given to them by program staff and utility partner funders. Despite potential alterations in the rankings, however, the recommendation stands to look towards untapped schools and districts within Orange County to spell success in the beginning phases of PEAK program expansion.

REFERENCES

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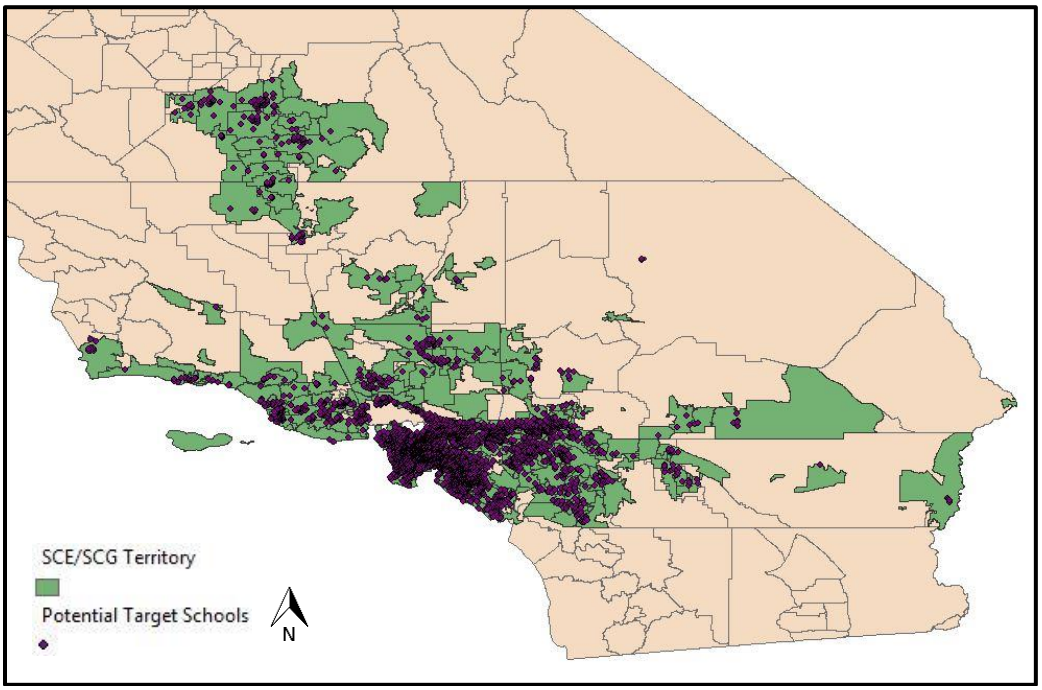
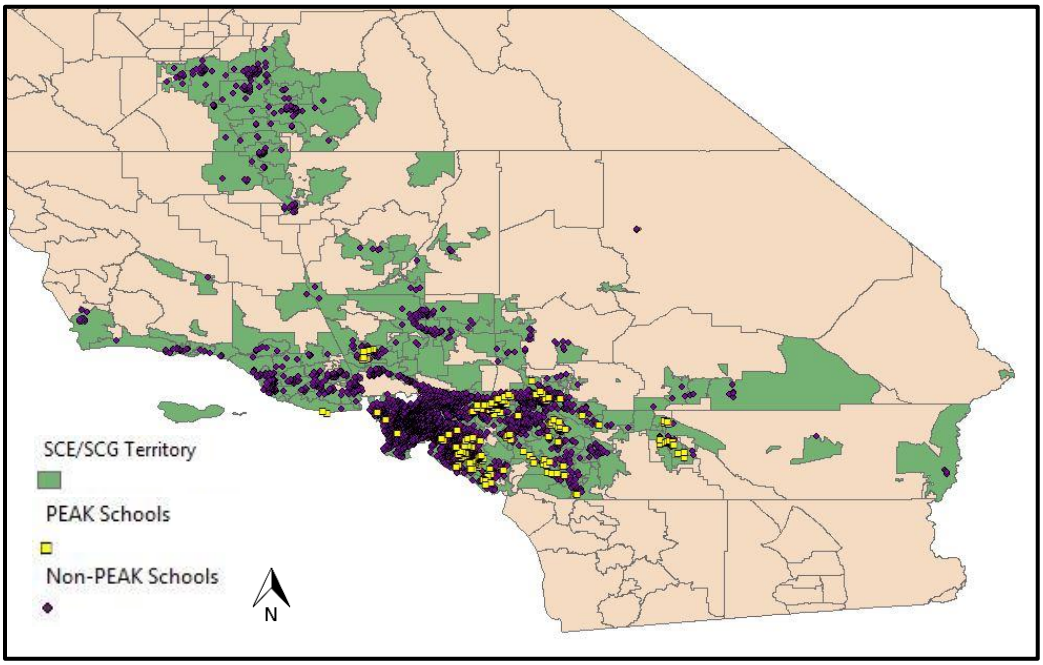
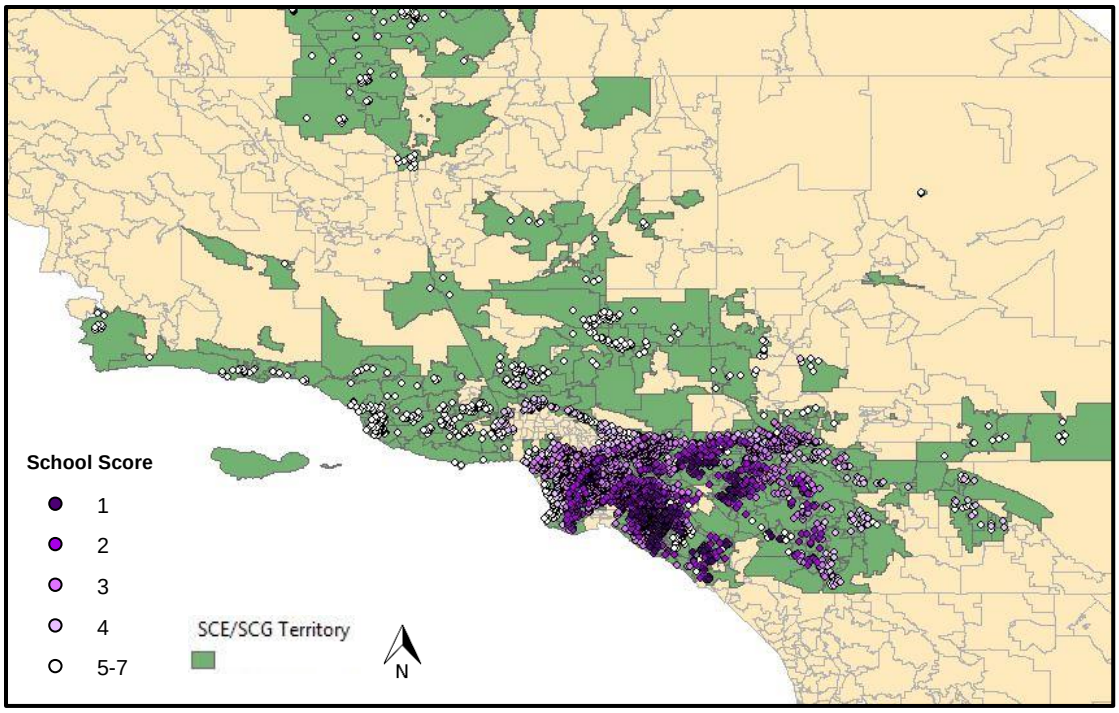
APPENDIX



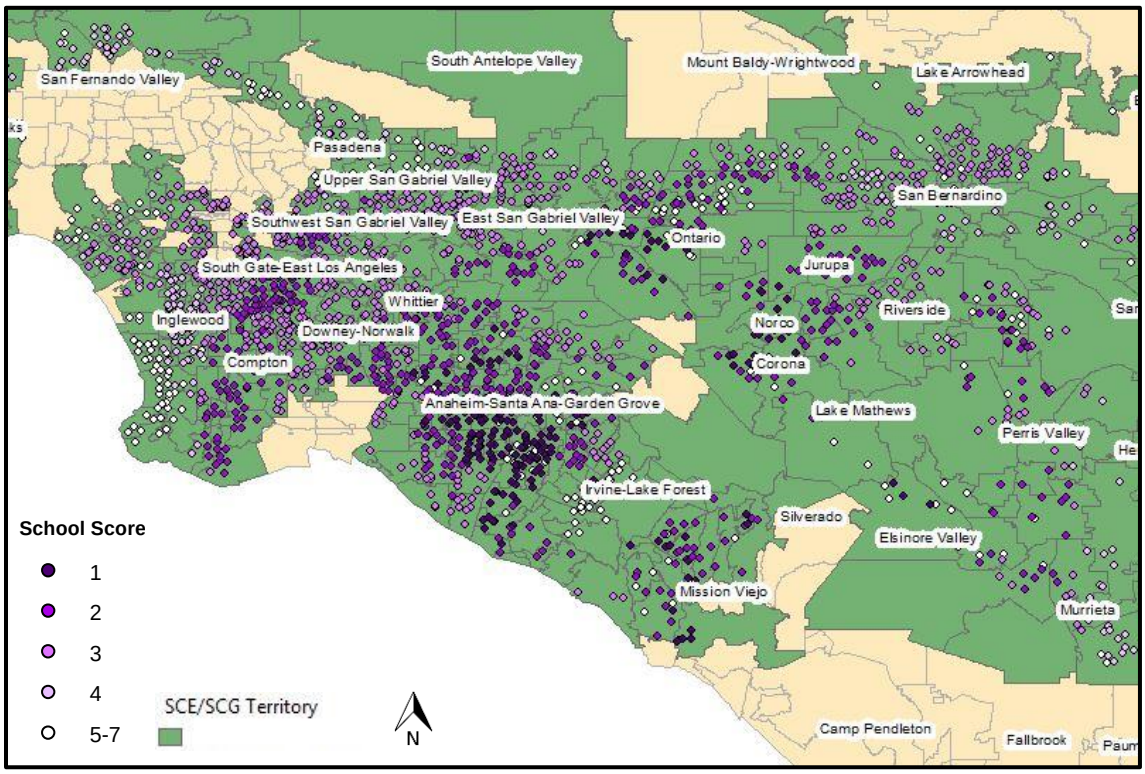
Map 1: PEAK and non-PEAK Schools in SCE/SCG Territory



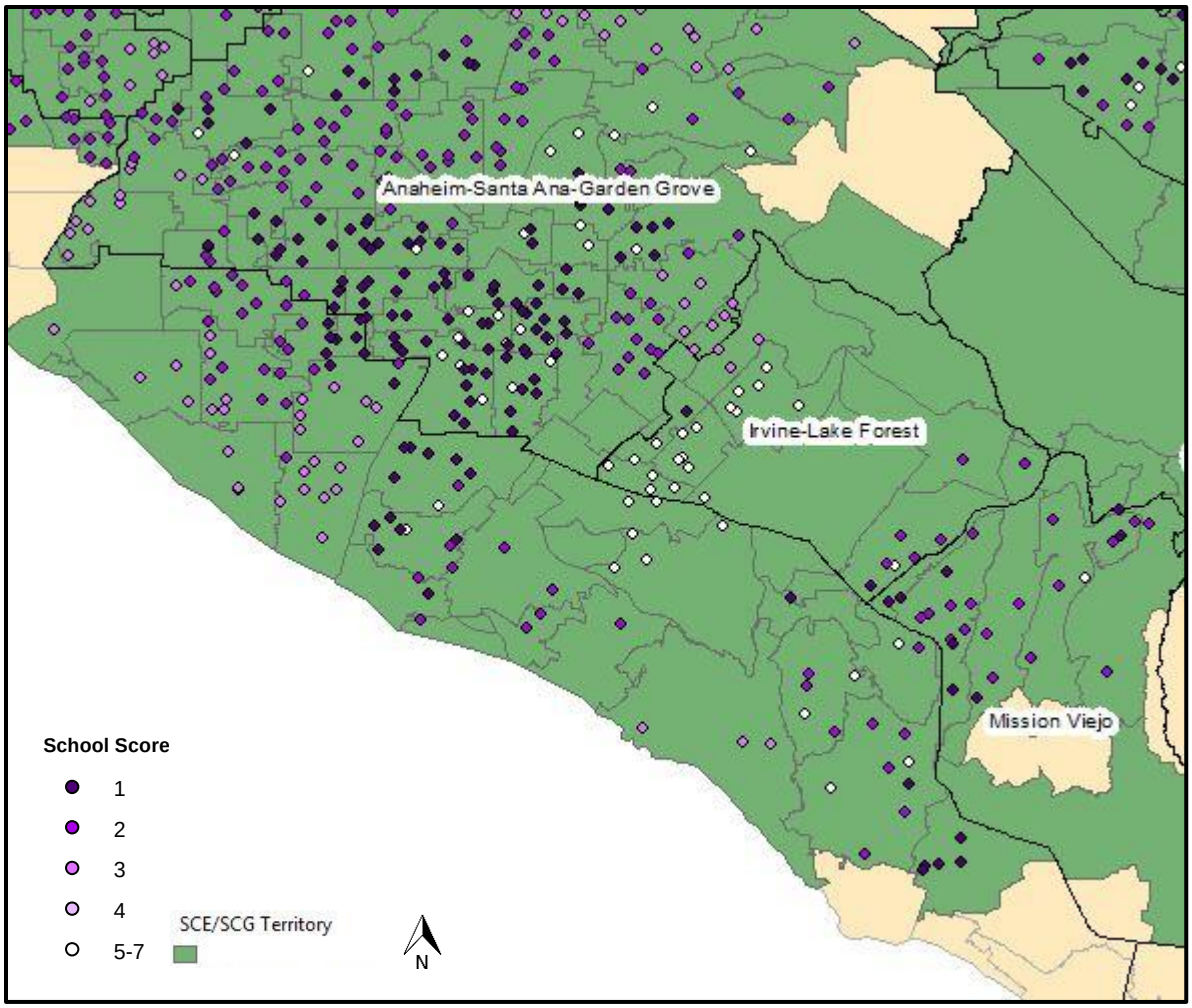
Map 2: PEAK School Distribution in SCE/SCG Territory, 2014-15 School Year



MAP 3: Distribution of Potential PEAK Target Schools by Score
(where 1 = most favorable and 7 = least favorable)



MAP 4: Distribution of Potential PEAK Target Schools by Score, Southern California
(where 1 = most favorable and 7 = least favorable)



MAP 5: Distribution of Potential PEAK Target Schools by Score, Orange County
(where 1 = most favorable and 7 = least favorable)