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County of San Diego

County of San Diego Airports Sustainability Management Plan

Baseline Assessment and Inventory

Reference: CoSD Airports Baseline Assessment and Inventory Report_FINAL

Final | May 4, 2023

Job number 289094

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Document Verification

Project title	County of San Diego Airports Sustainability Management Plan
Document title	Baseline Assessment and Inventory
Job number	289094
Document ref	
File reference	CoSD Airports Baseline Assessment and Inventory Report_FINAL

Revision	**Date**	**Filename**	CoSD Airports Baseline Assessment and Inventory Report_03082023		
		Description	Draft		
			Prepared by	**Checked by**	**Approved by**
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		Filename	CoSD Airports Baseline Assessment and Inventory Report_Final		
		Description	Final		
			Prepared by	**Checked by**	**Approved by**
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		Filename			
		Description			
			Prepared by	**Checked by**	**Approved by**
		Name			
		Signature			

Issue Document Verification with Document ✓

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1. Introduction

This report presents and summarizes the baseline data intended to be used for development of the County of San Diego Airports system Sustainability Management Plan (SMP). More information about the overall SMP project can be found on the project website.

Baseline analysis is a fundamental component of sustainability management planning and implementation because it provides a starting point against which progress can be measured. By conducting a baseline assessment, the current level of sustainability practices and resource usage (i.e., energy, water) within the airport system can be determined based on utility data and activities reported or estimated based on industry standards. The data presented is an overview of FY18-19 greenhouse gas emission, energy demand and usage, water consumption, wastewater generation, and solid waste generation for the airport system. This data is essential for establishing a benchmark for improvement and identifying areas where changes can be made to improve efficiency, reduce waste, and lower costs. Once the updated SMP is implemented the baseline data can be used to track progress and measure the impact of sustainability the objectives and measures in place.

The sustainability impact categories being considered in the SMP project include:

- Greenhouse gas (GHG) emissions (carbon dioxide equivalents "CO2e")
- Energy use (electricity, natural gas, aircraft fuels, and ground vehicle fuels)
- Water use
- Wastewater generation
- Solid waste generation

The chapters of this report are organized according to these impact categories. Greenhouse gas emissions and energy use are reported in subchapters according to their three main sources within the airports system: buildings, aircraft, and ground vehicles. The chapters on water use, wastewater generation, and solid waste generation report results from estimates based on buildings, as ground vehicles and aircraft do not consume significant amounts of water or generate significant amounts of wastewater or solid waste. Data supporting each impact category is presented by airport and typology. Typology refers to the categorization or classification of data according to specific criteria or characteristics. The purpose of typology is to identify patterns and trends in the data that can help to inform decision-making and develop strategies.

The main chapters summarize the baseline results and methodology behind them. The appendices contain more detailed data that will be used to develop the SMP, including ranking sustainability strategies according to their potential impact reductions at each airport and identifying Key Performance Indicators (KPIs).

1.1 Airport Facilities and Operations

The County of San Diego governs eight airports: Gillespie Field, McClellan-Palomar Airport, Fallbrook Airpark, Ramona Airport, Borrego Valley Airport, Ocotillo Airport, Agua Caliente Airport, and Jacumba Airport. As part of developing these inventories, for each airport, the project team identified the number of buildings on site and estimated square footage based on mapping imagery, and assigned each building a use type and number of stories per coordination with the County Airports team. A spreadsheet containing this data and associated calculations is available upon request.

2. Baseline Inventories

There are uncertainties involved in baselining the airport system for the development of the County of San Diego Airports system Sustainability Management Plan (SMP). While the County is responsible for collecting and managing its own data, the responsibility for monitoring tenant data is not established. Therefore, any presentation of tenant data within this report should be taken with reservation, even though the data is based on federal agency data sets, informed assumptions, and widely used industry standards. It is recommended that the County prioritize efforts to establish clear data monitoring protocols for tenants to improve the accuracy and reliability of future projections.

2.1 Overview: sectors of largest impact

Figure 1 shows that the major GHG emissions from the airports system divided amongst different sources. Buildings are the largest sector of emissions, with tenant-owned and operated buildings responsible for the vast majority of building emissions. Agriculture is also a very large emissions category, although as discussed below, this data needs to be verified and represents a ceiling estimate based on the activities reported on site. Aviation emissions and ground vehicle emissions are also substantial. The SMP will propose specific strategies to reduce emissions across all these sectors of emissions as well as strategies aimed at water, waste, and wastewater impacts.

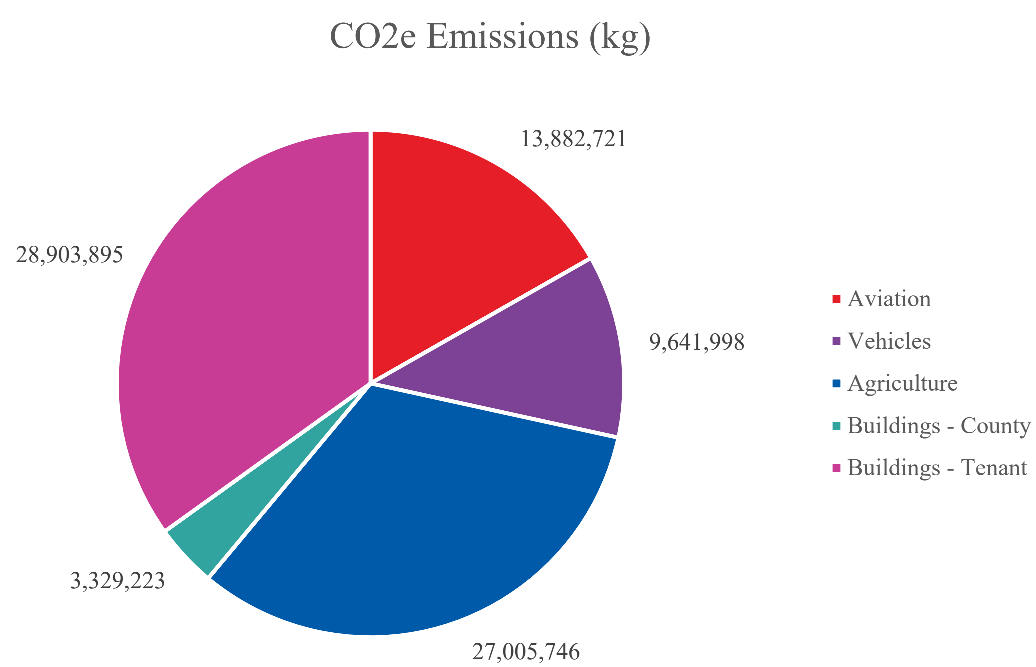

Figure 1 - CO2e Emissions by source for total airport system

2.2 GHG Emissions

2.2.1 Buildings

Results

Figure 2 shows the distribution of carbon emissions from local electric grid emissions and on-site natural gas combustion across the eight airports. Gillespie has the most emissions followed by Palomar. Emissions are generally associated with more square feet of occupied buildings.

Figure 2 shows Fallbrook buildings with its agriculture called out separately. The agricultural land use data is based on assumption and is likely a high estimate, as this data represents the rate of enclosed commercial greenhouses. The agriculture at Fallbrook is confirmed to be enclosed with portable heaters and lighting, but the exact consumption of electricity and natural gas is unknown. Because the agricultural structures are largely hoop houses and plastic tents with no permanent heating or lighting, the GHG emissions are likely lower than what is currently shown.

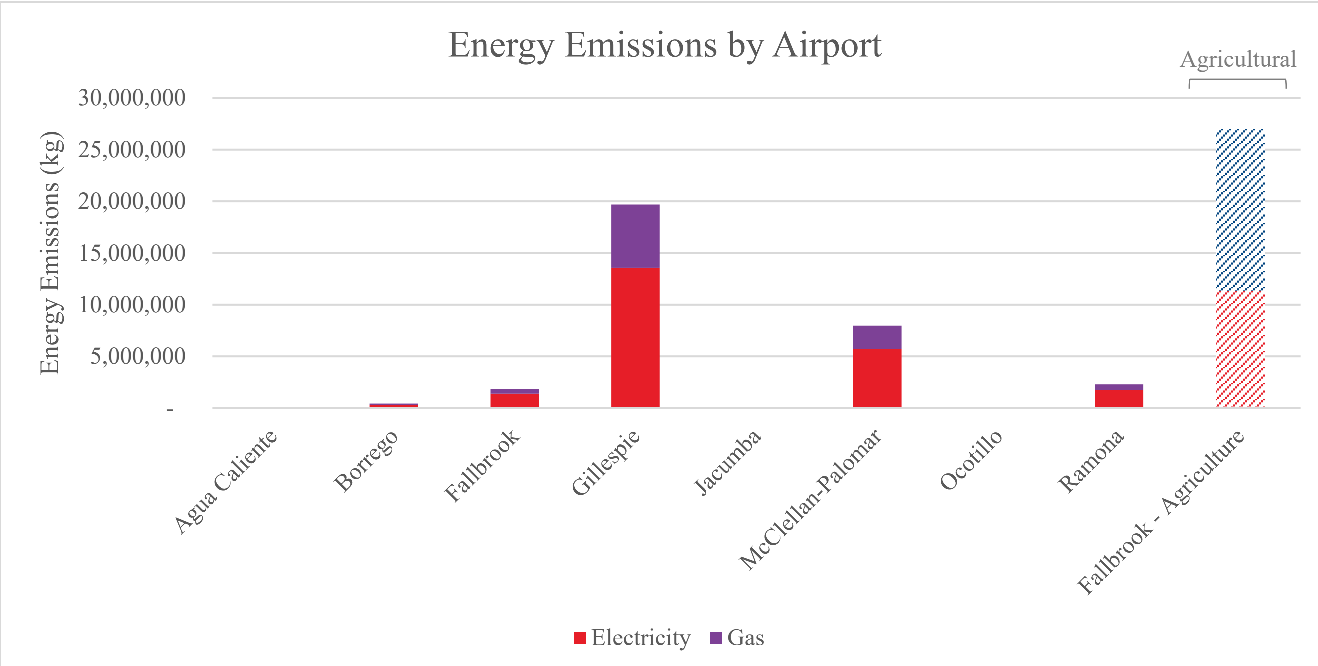

Figure 2 - Energy CO2e Emissions per Airport

Figure 3 shows the breakdown of County vs tenant electricity and natural gas building emissions by airport. Tenants generate the majority of emissions in comparison to County-operated facilities, as is expected given that most airport space is tenant occupied. Tenants at Gillespie Field generate the greatest energy emissions across all airports. A.3 A.3shows tenant use typology and emissions for each airport in more detail.

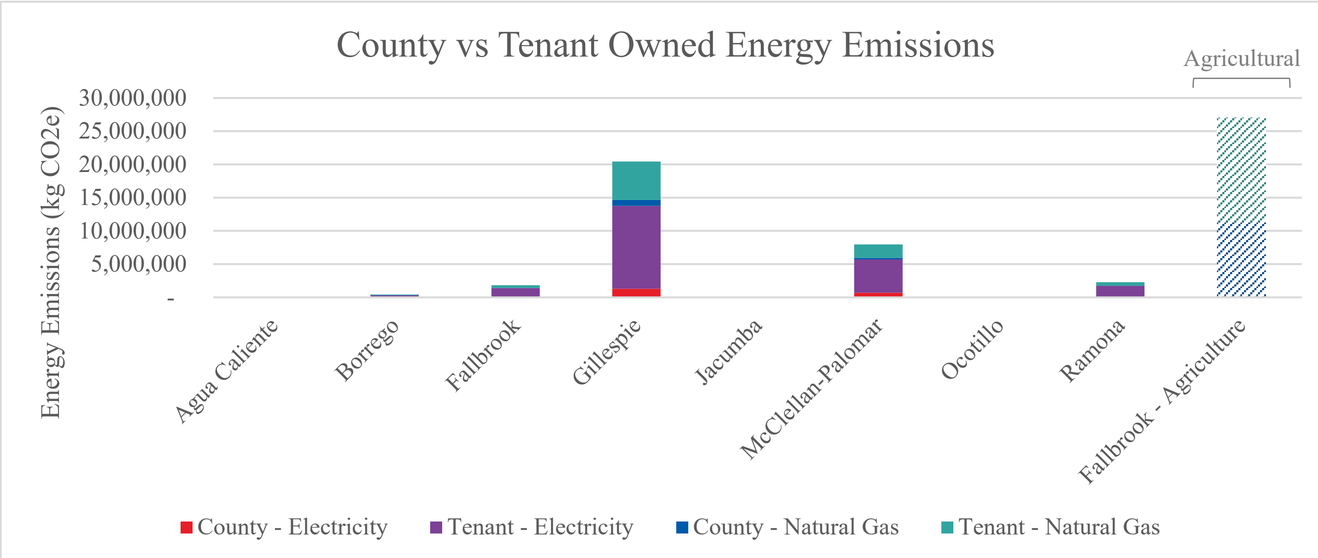

Figure 3 - Airport Emissions Distributed by County and Tenant Owned

Methodology

Each airport has a unique set of "use typologies" which are categorization of land or buildings based on their primary or intended use. Most of these facilities are tenant occupied and building-level metered data is not acquired yet. Though the project team has been working with SDG&E to acquire what data is available within their privacy protections and research allowances. Data is expected to be obtained by July 2023. County emissions data is pulled from the 2020 Airports Sustainability Guidance Plan, prepared by the Department of Public Works Airports Division. For each tenant Use Typology, the typical electricity and natural gas usage was estimated based on the U.S. Energy Information Administration (EIA) data on Energy Use Intensity (EUI) for electricity and natural gas consumption by building usage type. EUI is a measure of energy use per square foot of floor area. EUI was multiplied by the square footage of each building to estimate the annual electricity consumption (kWh) and natural gas consumption (therms) per building per airport based on square footages of each building. Annual energy usage was multiplied by the San Diego grid emissions factor for electricity and by the EIA CO_2e factor for home and business natural gas use, as appropriate (there are small residential uses for crew quarters in some buildings). The SDG&E electricity emission factor used was provided by the County of San Diego County website and is equivalent to 537 lb. CO_2e/MWh[1].

See Appendix A.1 for building floor area by Use Typology and Appendix A.3 for more detailed graphs and tables for associated emissions by airport.

2.2.2 Aircraft

Results

Total emissions from aircraft landing and takeoff operations were also calculated. Take-off operations including idle, taxi, take-off, and climb-out as well as approach operations including approach, final approach, taxi, and idle were assumed for calculations. The County is not responsible nor is in charge of the number of aircraft operations at airports because they are within the FAA purview. Aircraft emissions are shown by the type of aircraft (single engine, multi engine, jet, or helicopter) in Figure 4 and by flight type (commercial, air taxi and commuter, flight training, emergency operations, private/business traffic, or military) in Figure 5. McClellan-Palomar Airport and Gillespie Field unsurprisingly have the largest amount of aircraft emissions as the busiest

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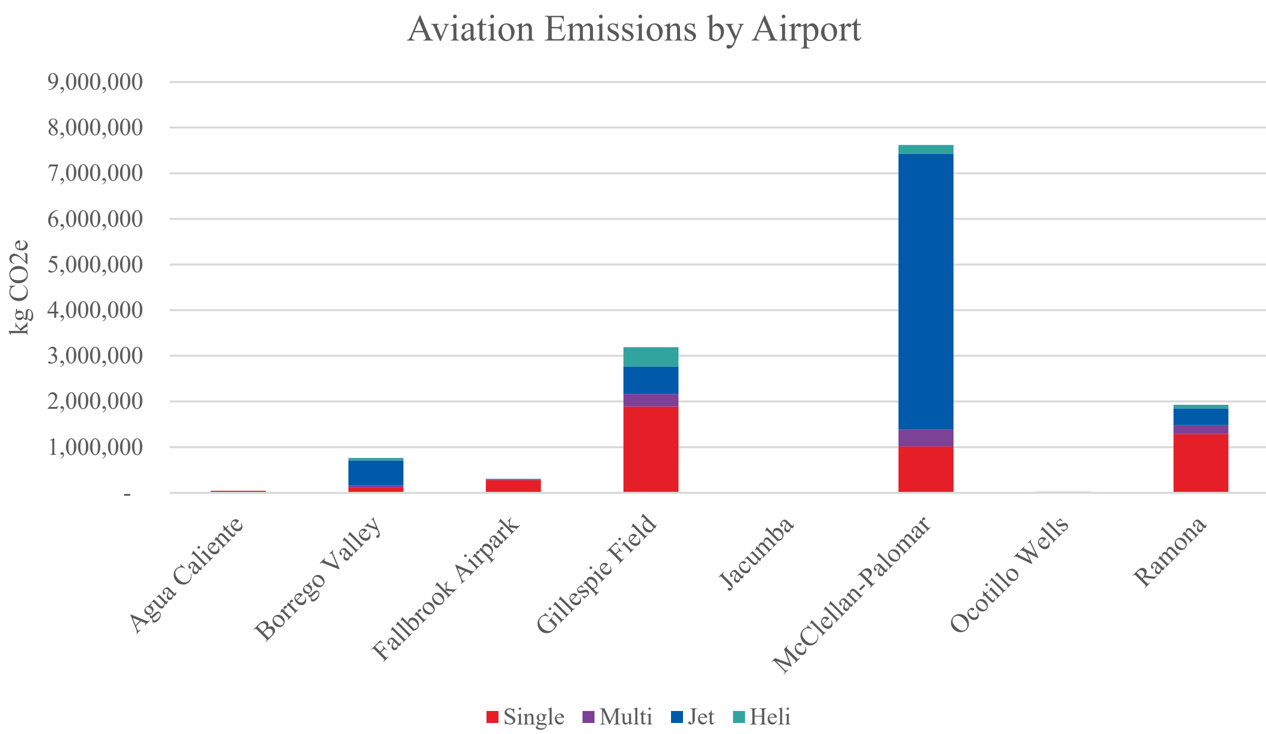
[1] Appendix F Greenhouse Gas Emissions Calculations (sandiegocounty.gov)

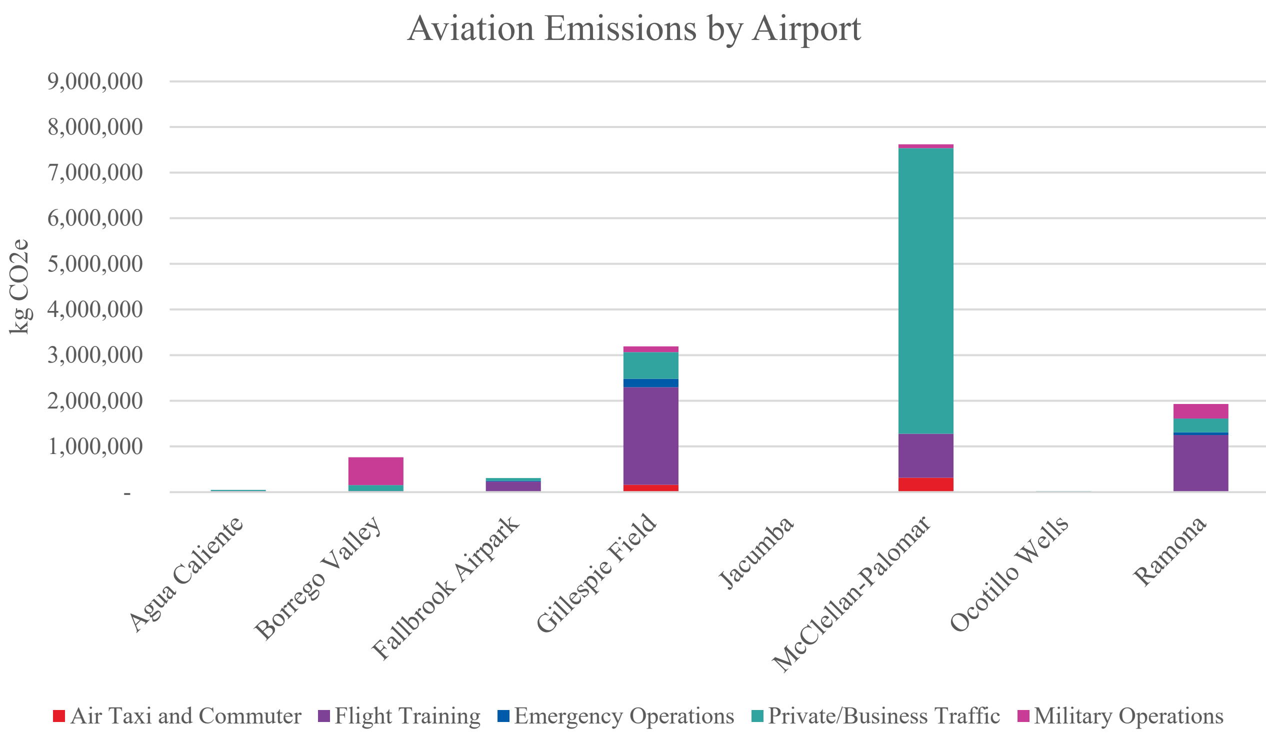
airports in the system. Operations by jet aircraft, which have higher fuel burn rates and increased amounts of total emissions compared to smaller aircraft, are responsible for the largest emissions at McClellan-Palomar. While jet aircraft conducting private or business operations result in the most emissions by aircraft type, the amount of single engine operations across all San Diego County system airports is also a significant source of total emissions, approximately 2/3 of jet emissions, driven by significant flight training operations.

Figure 4 - CO2e Aircraft Emissions Generated During Landing and Takeoff Operations by Aircraft Type



Note: The County is not responsible nor is in charge of the number of aircraft operations at airports because they are within the FAA purview.

Figure 5 - CO2e Aircraft Emissions Generated During Landing and Takeoff Operations by Flight Type



Note: The County is not responsible nor is in charge of the number of aircraft operations at airports because they are within the FAA purview.

Methodology

For the airports in this study, detailed information on flight operations was not available due to the unscheduled nature of most operations at County airports and limited data for general aviation traffic. To calculate aircraft emissions levels, assumptions for operations and emissions information were made using representative aircraft derived from local information and data sources. These data sources include the County of San Diego, Federal Aviation Administration (FAA), International Civil Aviation Organization (ICAO), and Airport Cooperative Research Program (ACRP).

When determining operation levels, the highest annual count between 2019 and 2022 from County operational counts was assumed to attempt to discount impacts from the COVID-19 pandemic. The total operations count was attributed to the following six flight types: commercial, air taxi and commuter, flight training, emergency operations, private or business traffic, and military operations. This distribution was driven by information in the FAA Terminal Area Forecast for each available airport and the evaluation of fuel flowage information provided by the County for each fuel operator. Table 1 shows total assumed operations count for each airport and fight type.

Table 1: Operations by Flight Type

Airport	Agua Caliente		Borrego Valley		Fallbrook Airpark		Gillespie Field	
Operations Count (Highest Annual between 2019-2022)	**4,400**		**18,442**		**29,194**		**227,765**	
	Count	**Percentage**	**Count**	**Percentage**	**Count**	**Percentage**	**Count**	**Percentage**
Commercial (>9 seats)	0	0%	0	0%	0	0%	0	0.0%
Air Taxi and Commuter	0	0%	0	0%	0	0%	1,139	0.5%
Flight Training	2,200	50%	1,844	10%	21,896	75%	193,600	85.0%
Emergency Operations	0	0%	0	0%	1,460	5%	9,111	4.0%
Private/Business Traffic	2,200	50%	11,065	60%	5,839	20%	22,777	10%
Military Operations	0	0%	5,533	30%	0	0%	1,139	0.5%
Airport	**Jacumba**		**McClellan-Palomar**		**Ocotillo Wells**		**Ramona**	
Operations Count (Highest Annual between 2019-2022)	**947**		**148,977**		**2,200**		**144,979**	
	Count	**Percentage**	**Count**	**Percentage**	**Count**	**Percentage**	**Count**	**Percentage**
Commercial (>9 seats)	0	0%	0	0%	0	0%	0	0%
Air Taxi and Commuter	0	0%	2,235	1.5%	0	0%	0	0%
Flight Training	474	50%	81,937	55%	1,100	50%	115,983	80%
Emergency Operations	0	0%	0	0%	0	0%	4,349	3%
Private/Business Traffic	474	50%	64,060	43%	1,100	50%	21,747	15%
Military Operations	0	0%	745	0.5%	0	0%	2,900	2%

Note: The County is not responsible nor is in charge of the number of aircraft operations at airports because they are within the FAA purview.

To determine the aircraft type which was used to operate each flight type, airport-based aircraft counts were applied to operation levels, FAA Traffic Flow Management System Counts (TFMSC), and input from stakeholders.

Table 2: Aviation Operations by Aircraft and Flight Types

		Agua Caliente		Borrego Valley		Fallbrook Airpark		Gillespie Field		Jacumba	
		Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage
Commercial (>9 seats)	Jet	0	0%	0	0%	0	0%	0	0%	0	0%
Air Taxi & Commuter	Multi	0	0%	0	0%	0	0%	763	67%	0	0%
	Jet	0	0%	0	0%	0	0%	376	33%	0	0%
Flight Training	Single	2,200	100%	1,475	80%	20,582	94%	168,984	87%	474	100%
	Multi	0	0%	184	10%	876	4%	13,971	7%	0	0%
	Heli	0	0%	184	10%	438	2%	10,645	5%	0	0%
Emergency Operations	Single	0	0%	0	0%	1,372	94%	0	0%	0	0%
	Multi	0	0%	0	0%	58	4%	0	0%	0	0%
	Jet	0	0%	0	0%	0	0%	0	0%	0	0%
	Heli	0	0%	0	0%	29	2%	9111	100%	0	0%
Private/ Business Traffic	Single	2,200	100%	8,852	80%	5488	94%	19125	84%	474	100%
	Multi	0	0%	1,107	10%	234	4%	1581	7%	0	0%
	Jet	0	0%	0	0%	0	0%	866	4%	0	0%
	Heli	0	0%	1,107	10%	117	2%	1205	5%	0	0%
Military Operations	Single	0	0%	1,383	25%	0	0%	285	25%	0	0%
	Multi	0	0%	1,383	25%	0	0%	285	25%	0	0%
	Jet	0	0%	1,383	25%	0	0%	285	25%	0	0%
	Heli	0	0%	1,383	25%	0	0%	285	25%	0	0%

		McClellan-Palomar		Ocotillo Wells		Ramona	
		Count	Percentage	Count	Percentage	Count	Percentage
Commercial (>9 seats)	Jet	0	0%	0	0%	0	0%
Air Taxi & Commuter	Multi	1,497	67%	0	0%	0	0%
	Jet	737	33%	0	0%	0	0%
Flight Training	Single	62,931	77%	1,100	100%	104,204	90%
	Multi	13,093	16%	0	0%	9,061	8%
	Heli	5,913	7%	0	0%	2,718	2%
Emergency Operations	Single	0	0%	0	0%	3,877	89%
	Multi	0	0%	0	0%	337	8%
	Jet	0	0%	0	0%	34	1%
	Heli	0	0%	0	0%	101	2%
Private/ Business Traffic	Single	38,180	60%	1,100	100%	19,387	89%
	Multi	7,943	12%	0	0%	1,686	8%
	Jet	14,349	22%	0	0%	169	1%
	Heli	3,587	6%	0	0%	506	2%
Military Operations	Single	186	25%	0	0%	725	25%
	Multi	186	25%	0	0%	725	25%
	Jet	186	25%	0	0%	725	25%
	Heli	186	25%	0	0%	725	25%

Note: The County is not responsible nor is in charge of the number of aircraft operations at airports because they are within the FAA purview

Aircraft emissions were assessed using a representative aircraft and engine type for each operation. The emissions total does not include cruise state but does include take-off operations including idle, taxi, take-off, and climb-out as well as approach operations including approach, final approach, taxi, and idle. Time in each mode was determined by ICAO standards and shown in Table 3. Cruise emissions were not included in order to focus on emissions generated at the airports.

Table 3: Time in Each Phase of Flight in Seconds

Condition	Take-Off	Climb-Out	Cruise	Approach	Final Approach	Taxi	Idle
Total Seconds	42	132	0	210	30	660	900

Source: ACRP 164, Exhaust Emissions from In-Use General Aviation Aircraft

For each representative aircraft the emissions of hydrocarbons, carbon monoxide, and nitrous oxide have been included and converted to a CO2e emissions level. Representative aircraft and engine type plus emissions per operation are included in Table 4. Representative aircraft were chosen based on an evaluation of FAA Traffic Flow Management System Counts data available for County airports for each aircraft having a significant level of operations. Lycoming O-320, the representative engine for single engine aircraft, and O-470, the representative engine for multi-engine aircraft, are among the most used in the national fleet for their respective aircraft type. These engine emission totals are from ACRP 164: *Exhaust Emissions from In-Use General Aviation Aircraft*, which builds upon data used in the FAA Aviation Environmental Design Tool (AEDT) with an increased focus on general aviation. Each emission type was converted to CO2e using Global Warming Potential values from the GHG Protocol.

Table 4: Representative Aircraft Engines for Aircraft Type and Emissions Per Operation

Type	Representative Aircraft	Engine	Number of Engines	Engine Type	HC (g/Op)	CO (g/Op)	NOx (g/Op)
Single-Engine	Cessna 172	Lycoming O-320	1	Piston	129	2041.5	16
Multi-Engine	Beechcraft Baron	Continental O-470	2	Piston	391	3441	11
Jet	Challenger 600	CF34-3A1	2	Turbofan	308	3350	1137
Helicopter	Robinson R44	Lycoming O-540	1	Piston	107.5	4235	11.5

Source: ACRP 164, Exhaust Emissions from In-Use General Aviation Aircraft

As a sensitivity test to the data inputs used, expected emissions generated by total fuel flowage at each County airports were examined. A total of four airports, including Gillespie, McClellan-Palomar, Ramona, and Fallbrook had fuel flowage in 2022. Using assumed carbon contents for fuel from ACRP 164, an average 3.16 CO2e emissions per kilogram of fuel were used for jet fuel and 3.118 CO2e emissions per kilogram of fuel were used for Aviation Gasoline 100 octane low lead fuel (100LL). As a general benchmark, industry standards are that 10-20% of emissions occur below 3,000’ during landing and take-off operations, which is reflected at McClellan-Palomar. There are local considerations that result in a larger percentage of emissions within the vicinity of the airport compared to total fuel flowage. This includes Gillespie, which has a significant level of local flight training, as well as Ramona and Fallbrook, which have a limited amount of fuel sales relative to operations.

Table 5: Expected CO2e Aircraft Emissions from On-Airport Fuel Flowage

Airport	Fuel Type	Annual Gallons	Expected CO2e Emissions from Fuel Flowage (kg)	Report Identified CO2e Emissions (kg)	Percent of Fuel Flowage Expected Emissions in LTO
SEE	Jet A	1,160,000	10,996,800		
	100LL	146,000	1,365,684		
	Total	**1,306,000**	**12,362,484**	**3,190,049**	**25.80**
CRQ	Jet A	6,238,000	59,136,240		
	100LL	327,000	3,058,758		
	Total	**6,565,000**	**62,194,998**	**7,619,832**	**12.25**
RNM	Jet A	132,000	1,251,360		
	100LL	66,000	617,364		
	Total	**198,000**	**1,868,724**	**1,928,756**	**103.21**
L18	100LL	**38,000**	**355,452**	**306,303**	**86.17**

Source: County of San Diego, ACRP 164, Exhaust Emissions from In-Use General Aviation Aircraft

Additionally, estimated amounts of lead across all flights, including lead emissions during cruise stage, were calculated using the fuel flowage information. With a maximum lead content of 2.12 grams per gallon, and 592,000 gallons of 100LL sold at San Diego County airports, 1,254 kg (1,255,040 g) of lead may be produced as result of the total 100LL fuel sold.

See Appendix A.2 for key data points for each airport and Appendix A.3 for more detailed graphs and tables for associated emissions by airport.

2.2.3 Ground Vehicles

The primary types of ground vehicles operating at the County of San Diego Airports can be categorized by landside vehicles, airside vehicles, and county vehicles. Landside vehicle operations consist largely of trips getting visitors and employees to and from San Diego County airports. Airside vehicle operations include equipment and vehicles owned and operated by airport tenants to support aircraft such as fuel trucks, tugs, golfcarts, ground power units, and forklifts used as ground support equipment (GSE). County vehicle operations include county-owned and operated vehicles like tractors, firetrucks, forklifts, and passenger vehicles driven by county employees, which often go among multiple airports to do maintenance or other tasks.

Results

Figure 6 shows that landside vehicles account for nearly all GHG emissions associated vehicle travel across all airports. Figure 7 shows that Gillespie Field and McClellan-Palomar Airport total vehicle emissions significantly exceed the total vehicle emissions of the other six county airports.

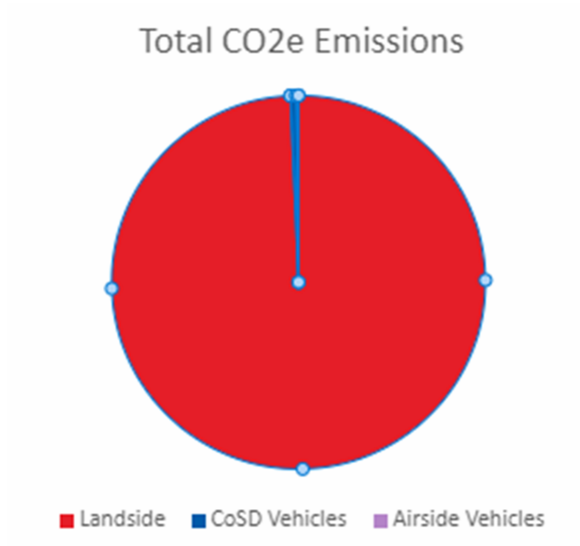


Figure 6 - GHG Emissions by Vehicle Type

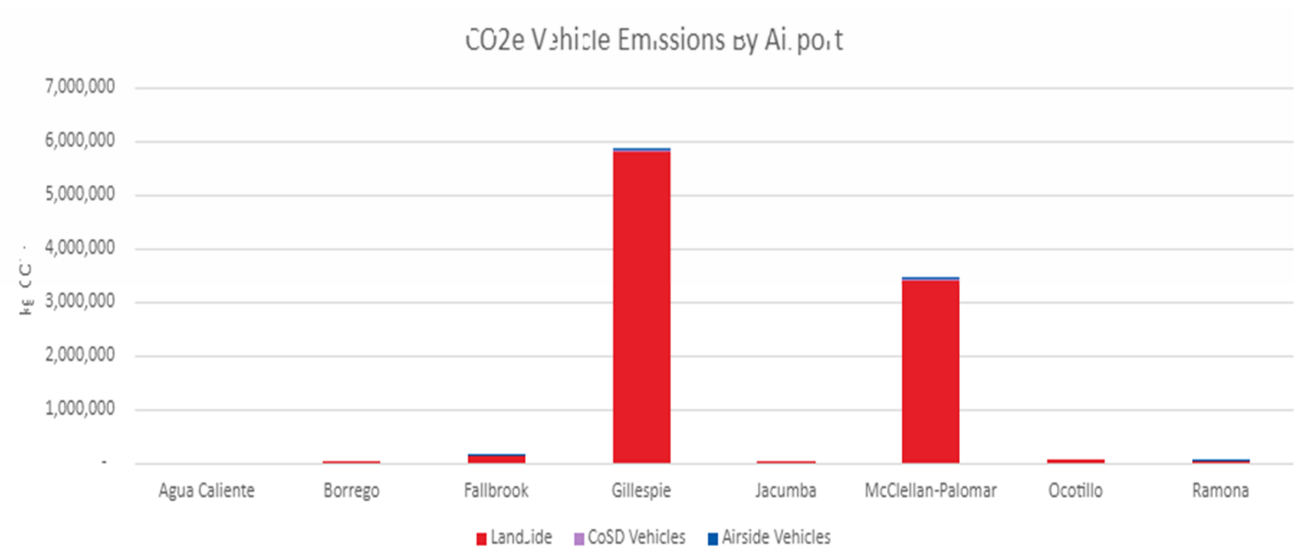


Figure 7 - GHG Emissions by Airport

2.2.3.1 Landside Vehicles

Table 6 shows the estimated Vehicle Miles Traveled (VMT) for each airport and the associated GHG emissions behind Figure 7 - GHG Emissions by AirportFigure 7.

Results

Table 6 - Annual Weighted VMT and CO2e Emissions

Airport	Year	Season	Day	Total Daily VMT	Annual Weighted VMT	Annual CO2e Emissions (kg)
Ramona	2021	Fall	Thursday	298	116,513	53,615
			Saturday	454		
		Spring	Thursday	319		
			Saturday	238		
Fallbrook	2021	Fall	Thursday	201	291,348	134,068
			Saturday	620		
		Spring	Thursday	1198		
			Saturday	1470		
Jacumba	2021	Fall	Thursday	65	32,798	15,092
			Saturday	68		
		Spring	Thursday	133		
			Saturday	66		
McClellan-Palomar	2021	Fall	Thursday	17318	7,444,618	3,425,759
			Saturday	13375		
		Spring	Thursday	24475		
			Saturday	24916		
Gillespie	2021	Fall	Thursday	37004	12,657,470	5,824,535
			Saturday	21364		
		Spring	Thursday	42290		
			Saturday	23147		
Borrego	2021	Fall	Thursday	0	74,825	34,432
			Saturday	0		
		Spring	Thursday	174		
			Saturday	1000		
Ocotillo	2021	Fall	Thursday	0	186,698	85.912
			Saturday	0		
		Spring	Thursday	455		
			Saturday	2443		
Agua Caliente	2021	Fall	Thursday	0	0	0
			Saturday	0		
		Spring	Thursday	0		
			Saturday	0		

Methodology

To estimate the amount of vehicle miles traveled to each airport, the data platform Replica was used. Replica coalesces several databases including de-identified mobile location data; demographic data from public and private sources; land use data; building data; transportation network data; and economic transaction data that reflects time and location of spending to create a synthetic population model reflects the characteristics of all trips within the area it covers (which includes all of San Diego County). In addition to the comprehensive data set Replica's ability to reflect local mobility patterns to the census tract level provided the most complete proxy to actual travel patterns to and from the airport in lieu of exact data. Replica's model includes typical Thursday and Saturday vehicle patterns for Spring and Fall conditions. to give a representative example of weekday and weekend travel patterns. At the time this report was written, Replica did not have characteristic transportation models for any other days of the week nor Summer or Winter seasonality.

Shapefiles of each airport's boundary were uploaded to Replica to generate a model of all trips crossing the airport boundary for each of the eight airports within scope. Mode outputs include demographic and travel related estimates of trip origin, duration, distance, household income, age, race and ethnicity. Figure 8 shows the distribution of trips by distance and Figure 9 shows the density of trips by trip origin for a Saturday in Spring 2021 for Gillespie and Palomar, respectively. These figures illustrate the mode outputs that were used to determine the GHG emissions baseline for vehicles traveling to each airport. Figures associated with airports not represented in Figure 8 and Figure 9 are provided in Section A.4 of the Appendix. For Figure 9, the density of trips per origin is communicated via color-coded regions; dark blue regions correspond to regions with a lower number of trips to the airport while yellow regions correspond to regions with a higher number of trips taken to the airport. The results in Figure 8 Figure 9 change when the scenario is modeled for a Thursday, in the Fall, or a combination of both.

These histograms illustrate what percentage of those traveling to each airport are traveling a given distance and provide insight to the viability of possible VMT reduction strategies that may work better for certain trip distances. All Replica figures provided in this report reflect the estimated travel to each respective airport, and include trips made by county employees, tenants, visitors, and the general public. Replica does not yet have 2022 data integrated into the model.

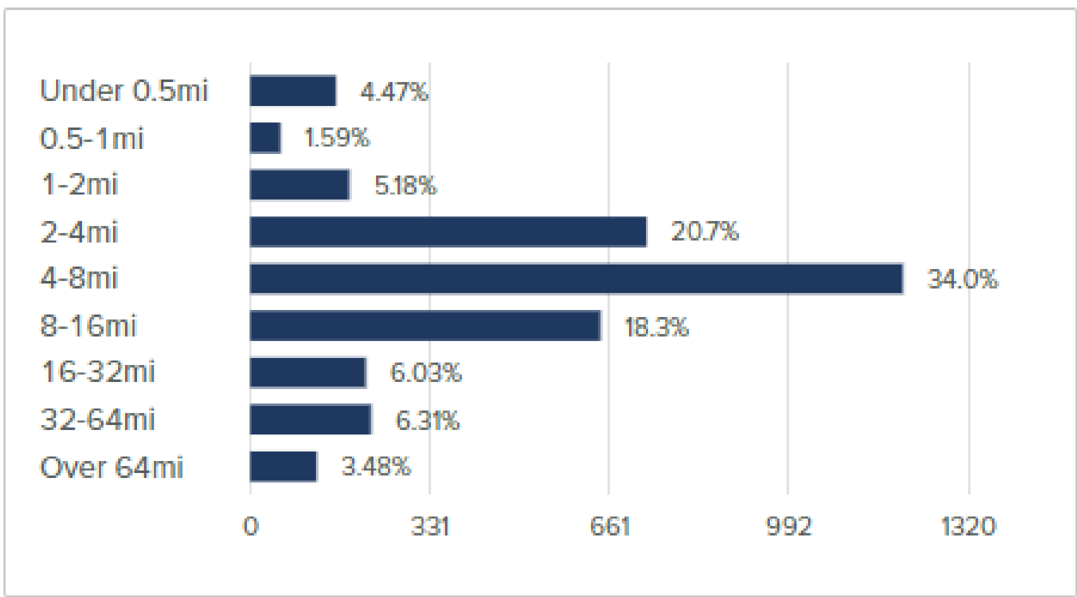


Figure 8 - Replica Trip Distance Histogram for Gillespie Field

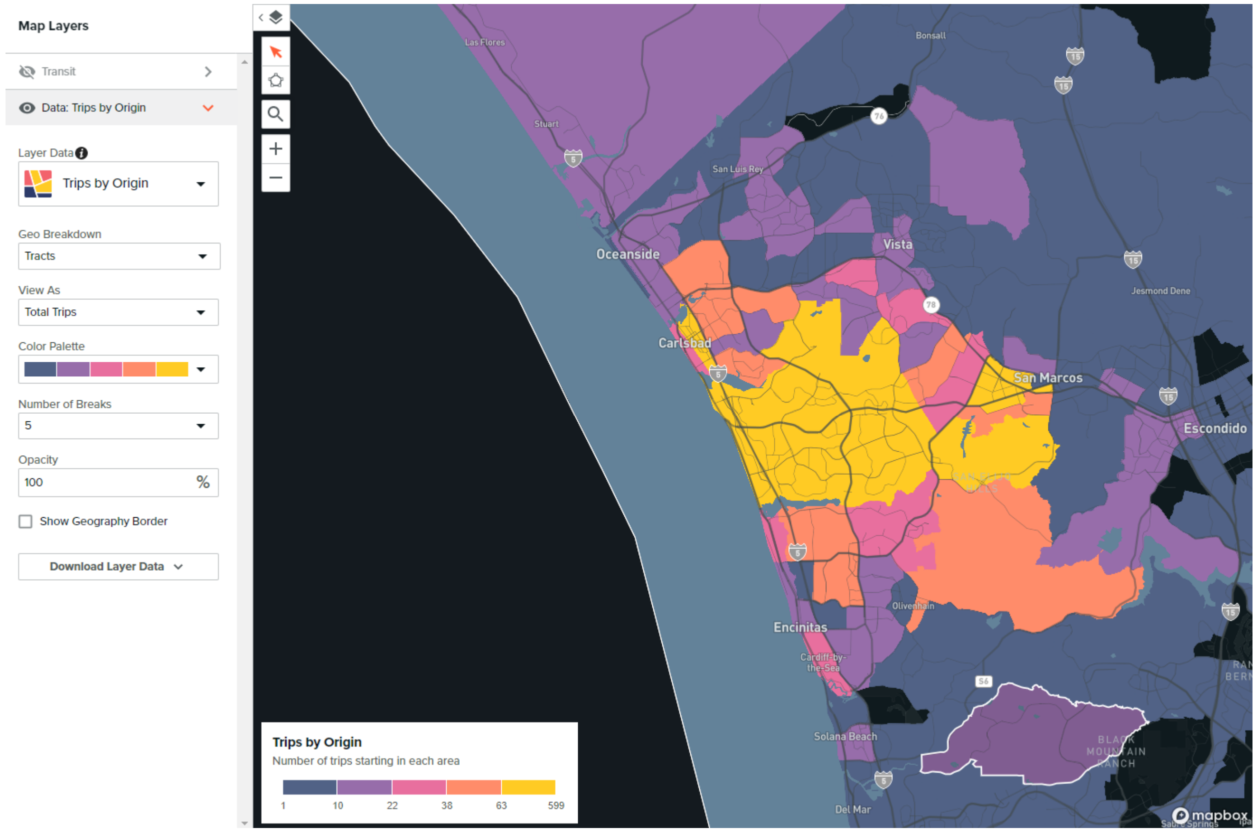


Figure 9 - Replica Trip Origin Heat Map for trips to McClellan-Palomar Airport

To find total emissions, the emission rates on carbon dioxide equivalent (CO2e) per mile for various vehicle types were applied to the VMT from Replica. The CO2e per mile rates include carbon dioxide, methane, and nitrous oxide emission rates resulting from engine startup, idling, and running. The distribution of various vehicle types was found using the California Air Resources Board's (CARB) Emission Factor (EMFAC) model for the year 2022. While the distribution of vehicle types was based off 2022 data, the emission rates from the EMFAC model are based off 2021 data since at the time of this writing the EMFAC model had not been updated to reflect 2022 data. Since the outputs from Replica are specific to a given day and season, this study created a blended VMT to represent the VMT of a complete year. To do this, each Replica study was simulated for a Thursday and Saturday in Spring 2021, and a Thursday and Saturday in Fall 2021. The VMTs for each of these scenarios was weighted appropriately to reflect the 5:2 ratio of weekdays to weekends as well as the seasonal split of 50:50 for Spring and Fall (in lieu of all four season simulations being available). This process was repeated for each airport operated by San Diego County to calculate the annual CO2e emissions shown in To gather a list of aviation sustainability best practices, the project team surveyed a range of both industry-wide sustainability guidance documents and sustainability management plans from similar-sized airports and airport systems. The reference SMPs were identified from the list of SMPs funded by FAA Sustainability Master Plan Pilot Program. Industry-wide references included:

- FAA Sustainability Master Plan Pilot Program
- AAAE American Association of Airport Executives
- NBAA National Business Aviation Association
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2.3 County Sustainability Opportunities and Best Practices

The County of San Diego 2020 Airports Sustainability Guidance Plan describes previous sustainability efforts and outlines proposed measures that will contribute to achieving the County's sustainability goals, including greenhouse gas emissions reductions related to airport operations. Each measure that aligns with the shortlist of aviation-specific best practices relevant to small and general aviation airports in Table 8 are indicated under "County activity."

2.3.1 Previous Sustainability Efforts

County Airports began to deploy sustainability-driven initiatives in 2008 and are summarizes as follows:

- 2008, McClellan-Palomar Airport's terminal building was built to Leadership in Energy and Environmental Design (LEED) Silver standard for energy use
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The proposed measures were vetted not just by Airports but also by the County's Department of General Services (DGS), Planning and Development Services (PDS), and the Land Use and Environmental Group (LUEG) Executive Office, to develop a comprehensive list of short- and long-term measures.

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The "sectors" outlined throughout are summarized [with guidance plan indicators] as follows:

- Integrate "green" terms in leasing agreements on private ground leaseholds [SS-1, LS-1]
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- Implement energy efficiency/conservation and renewable energy production [SS-3, LS-3]
- Divert waste from landfill with monitoring and service-level audits [SS-4, LS-4]
- Implement sustainable water- and wastewater-related measures [SS-5, LS-5]
- Integrate administrative changes to support of sustainable practices at airport facilities [SS-6]

Table 8.

2.3.2.1 Airside Ground Support Equipment (GSE)

While total airside ground vehicle emissions are very small compared to landside emissions, Figure 10 shows that Ground Power Units (GPUs) likely are responsible for the largest share of airside emissions, followed by fuel trucks and aircraft tugs.

Results

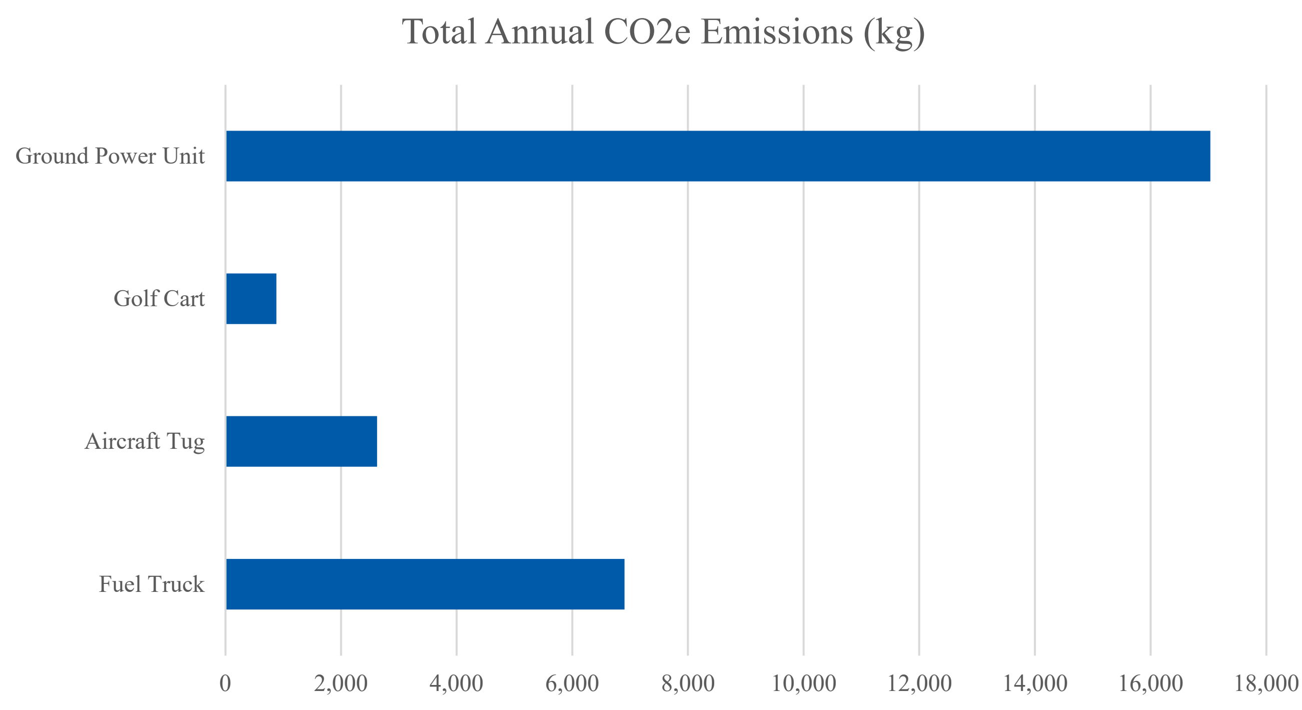

Figure 10 - Annual Airside Vehicle Emissions Per Vehicle Type (Logarithmic)

Methodology

Given that much of the GSE that is used to support airside operations are owned and operated by tenants, little quantitative information was accessible prior to tenant surveying. GSE inventory was provided for McClellan-Palomar Airport and scaled based on 2022 annual fuel flowage data provided for each of the airports to represent GSE inventory at Fallbrook, Ramona, and Gillespie. Ocotillo, Borrego, Jacumba, and Agua Caliente are assumed to have no or negligible GSE emissions. Of the GSE inventory received, there was a combination of electric GSEs, gas GSEs, and diesel GSEs. To calculate the annual GHG emissions, only the gas and diesel GSEs were considered.

For ground power units (GPUs), an estimated hourly fuel consumption and assumed daily hours of use was applied to estimate daily gallons of fuel consumed. Since movement of these units was assumed to performed by tug or by hand, the distance traveled by the GPUs was not calculated. Since the GPU CO2e emissions are from a stationary combustion source rather than a moving vehicle, the EPA's GHG Emission Factors Hub was used to find the emissions from the gas and diesel GPUs. For fuel trucks, distance traveled (i.e., VMT) was calculated by multiplying the estimated round-trip distance to fuel farms and round-trip distance to aircraft by the estimated annual trips to each, respectively, based on annual fuel flowage information provided. Similarly, VMT for tugs was calculated by estimating the roundtrip distance from the facility each tug is located to a midpoint of the associated aircraft parking area and multiplying that distance by the estimated number of annual trips to the aircraft. For the gas-fueled golf cart, VMT was estimated by assuming a certain hourly use per day, as well as an estimation of vehicle speed during use. Forklifts were provided as part of the GSE inventory; however, all forklifts were reported to be electric and therefore not considered in the GHG emissions calculation. The applicable 2021 EMFAC emission rates were applied to the VMT found for the fuel trucks, tug, and golf cart based on fuel type (gas or diesel) to calculate the annual CO2e emissions.

2.3.2.2 County Vehicles

The Airports system owns 19 vehicles that serve McClellan-Palomar Airport and Gillespie Field. Table 7 shows the vehicle inventory and estimated emissions per vehicle.

Results

Table 7 - County-owned vehicle inventory and emissions estimate

Vehicle Category	CoSD Vehicle ID	Fuel Type	Miles	CO2e Rate (g/mile)	McClellan-Palomar Annual CO2e Emissions (g)	Gillespie Annual CO2e Emissions (g)
Light-Duty Automobile	D61031	Plug-in Hybrid	1,596	164	-	276,572
Light-Duty Automobile	D62837	Plug-in Hybrid	2,683	164	-	464,771
Light-Duty Automobile	D62996	Plug-in Hybrid	1,367	164	-	236,829
Light-Duty Trucks (3,751-5,750 lbs. GVWR)	D62977	Gasoline	8,389	402	-	3,559,977
Medium-Duty Trucks (5,751-8,500 lbs. GVWR)	D61032	Gasoline	3,803	488	-	1,959,346
	D62646	Gasoline	5,704	488	2,938,586	-
	D62673	Gasoline	3,186	488	1,641,350	-
	D62785	Gasoline	15,701	488	8,089,484	-
	D62805	Gasoline	8,339	488	4,296,300	-
	D62819	Gasoline	1,638	488	-	843,783
	D62879	Gasoline	10,489	488	-	5,404,290
	D62900	Gasoline	12,920	488	-	6,656,800
	D62951	Gasoline	12,312	488	-	6,343,338
	D62952	Gasoline	6,015	488	-	3,099,022
Medium-Heavy Duty Diesel Instate Truck Class 5	D62523	Diesel	4	1258	5,042	-
	D62525	Diesel	14	1258	-	18,046
Medium-Heavy Duty Diesel instate Truck Class 4	D62833	Diesel	7	1248	-	8,688

Medium-Heavy Duty Diesel instate Truck Class 7	**D62515**	Diesel	1,624	1228	-	2,102,420
Heavy-Heavy Duty Diesel Utility Fleet Truck Class 8	**D62538**	Diesel	882	1861	1,731,646.19	-
Total CO2e Emissions (kg)					**16,971**	**30,233**

Methodology

The County's inventory of Airports system vehicles includes make, model, fuel type, and miles traveled. This information allowed each vehicle type to be assigned a vehicle category from the EMFAC 2021 emissions rate database. The corresponding emission rates for each vehicle type were then multiplied by each vehicles annual mileage to calculate the annual CO_2e emissions.

See Appendix A.4 for Replica trip length histogram and trip origin heat map results and Appendix A.3 for more detailed graphs and tables for associated emissions by airport.

2.4 Energy

Energy consumption is closely related to GHG emissions but is presented separately as utility bills are more related directly to energy use, and so that the split between gas use and electricity can be more clearly seen.

Results

Figure 11 shows estimated tenant energy consumption for each airport, broken down into on-site electricity and natural gas consumption. Across all airports, tenant-operated facilites at Gillespie Field consume the greatest amount of energy. Overall, tenants consumes electricity at higher rates in comparison to natural gas.

Figure 11 shows that agriculture at Fallbrook consumes electricity and natural gas as a greenhouse typology, but the data presented is based on assumption and rough estimates. There is confirmation of energy used on site for portable heaters and lighting, but the extent of use is unknown.

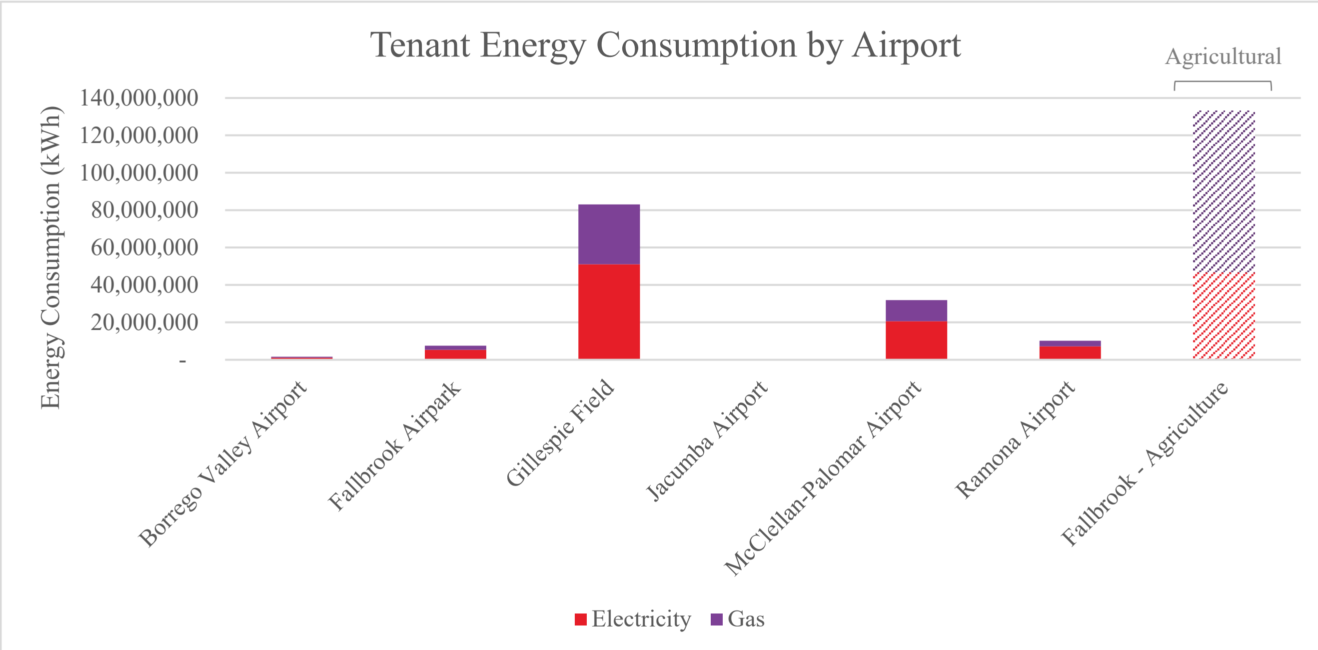

Figure 11 – Estimated Tenant Energy Consumption by Airport

Figure 12 shows County energy consumption for each airport, broken down into on-site electricity and natural gas consumption, based on utility data. Across all airports, County-operated facilites at McClellan-Palomar Airport consume the greatest amount of energy. Overall, the County consumes electricity at higher rates in comparison to natural gas.

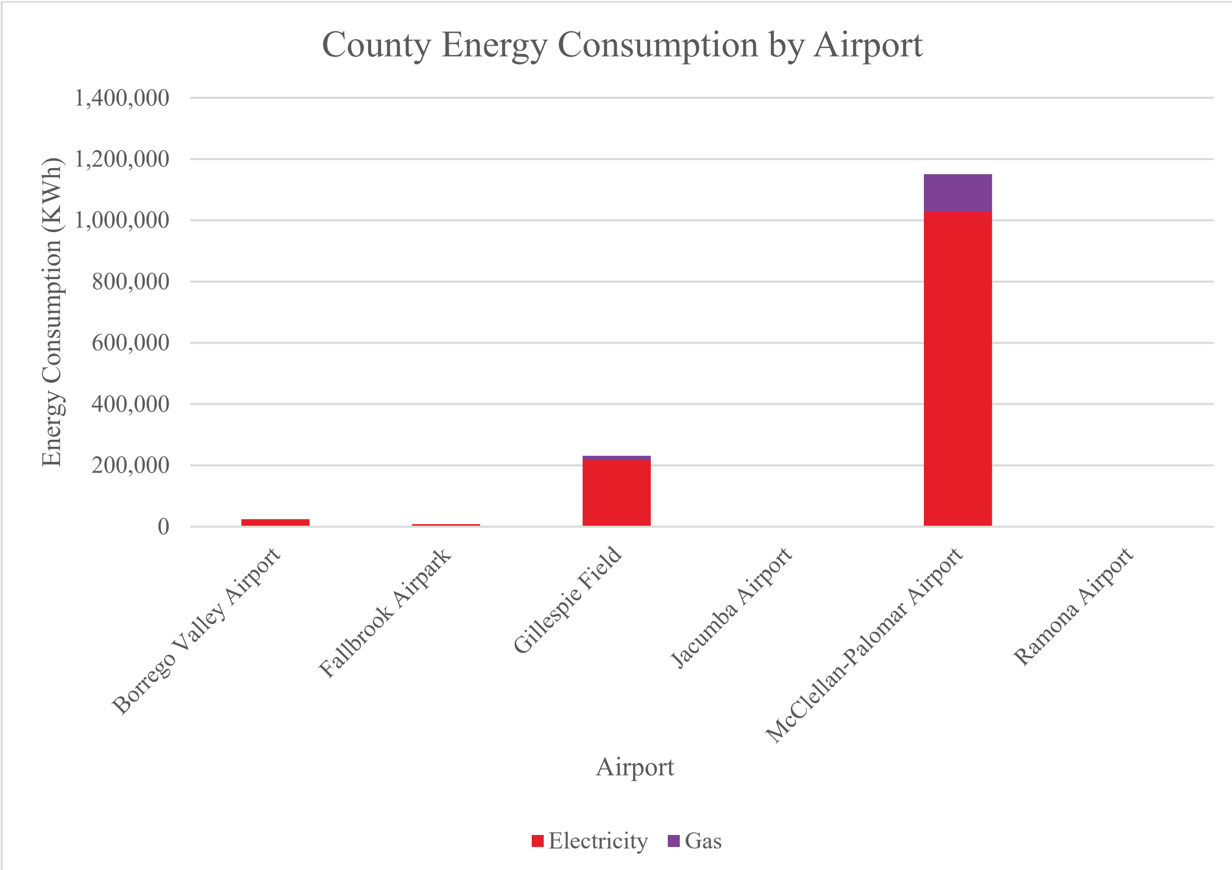

Figure 12 - County Energy Consumption by Airport

Figure 13 shows a breakdown of tenant use typologies by airport. Apart from Fallbrook agricultural energy consumption, hangars and offices are the largest energy consumers across tenant-operated facilities. The office category includes modular offices, modular administration offices, and general offices.

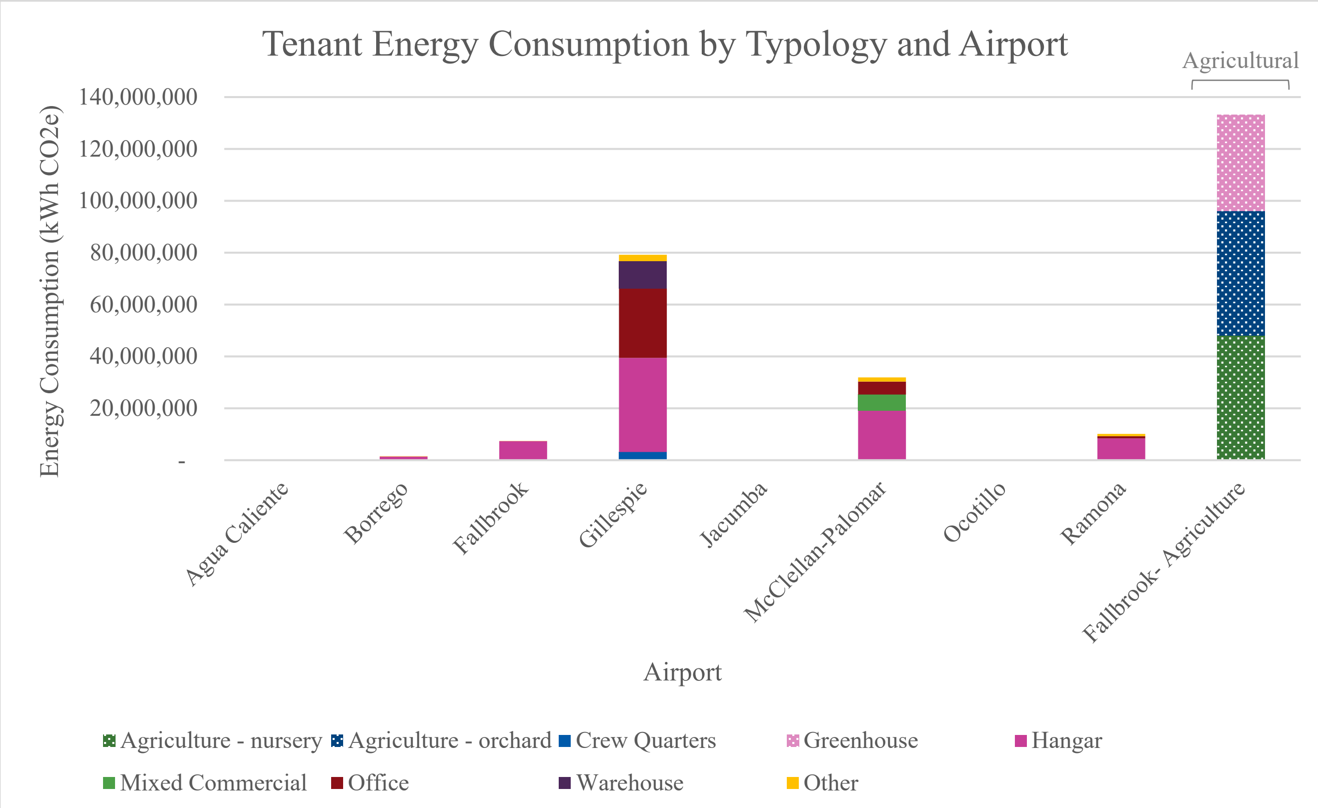

Figure 13 – Estimated Tenant Energy Consumption by Use Typology by Airport

Methodology

County data is pulled from the 2020 Airports Sustainability Guidance Plan, prepared by the Department of Public Works Airports Division. The methodology to estimate tenant electricity and natural gas follows the same methodology laid out in Section 2.3 Emissions Methodology. The typical electricity and natural gas usage is estimated based on the EIA's building-level EUI based on Use Typology multiplied by building square footage. The resulting usage is reported in kWh for electricity and therms for natural gas consumption, converted to a common unit of measure (kWh), per building per airport.

Fallbrook Airpark has agricultural-use land separated from all other land uses due to the significant area and assumptions made about the agriculture. Using the EIA building-level intensities multiplied by square footage methodology described above, the agricultural areas show significantly higher usages compared to the airport buildings. Due to the significant differences between buildings and agricultural spaces, any energy or water reduction measures suggested will differ considerably between the two.

2.5 Water

Results

Figure 14 shows a stacked comparison of County vs tenant general water use. County general water use based on utility data and tenant general water use is based on estimates. General water use excludes any water allocated for irrigation purposes. The figures demonstrate that Gillespie tenants use the greatest amount of general water. There is no water provided for the County-leased administration trailer at Fallbrook Airpark. To give an idea of percent breakdown - Gillespie uses the greatest percentage of water in a year, at 57 percent. Borrego Airport only consumes 1 percent across the portfolio, as the airport is estimated to use less than 800,000 gallons per year. Jacumba Airport represents <1 percent due to very minor water use, sourced from an on-site well. There is no record of water use for either Ocotillo or Agua Caliente, thus they are not shown in Figure 14.

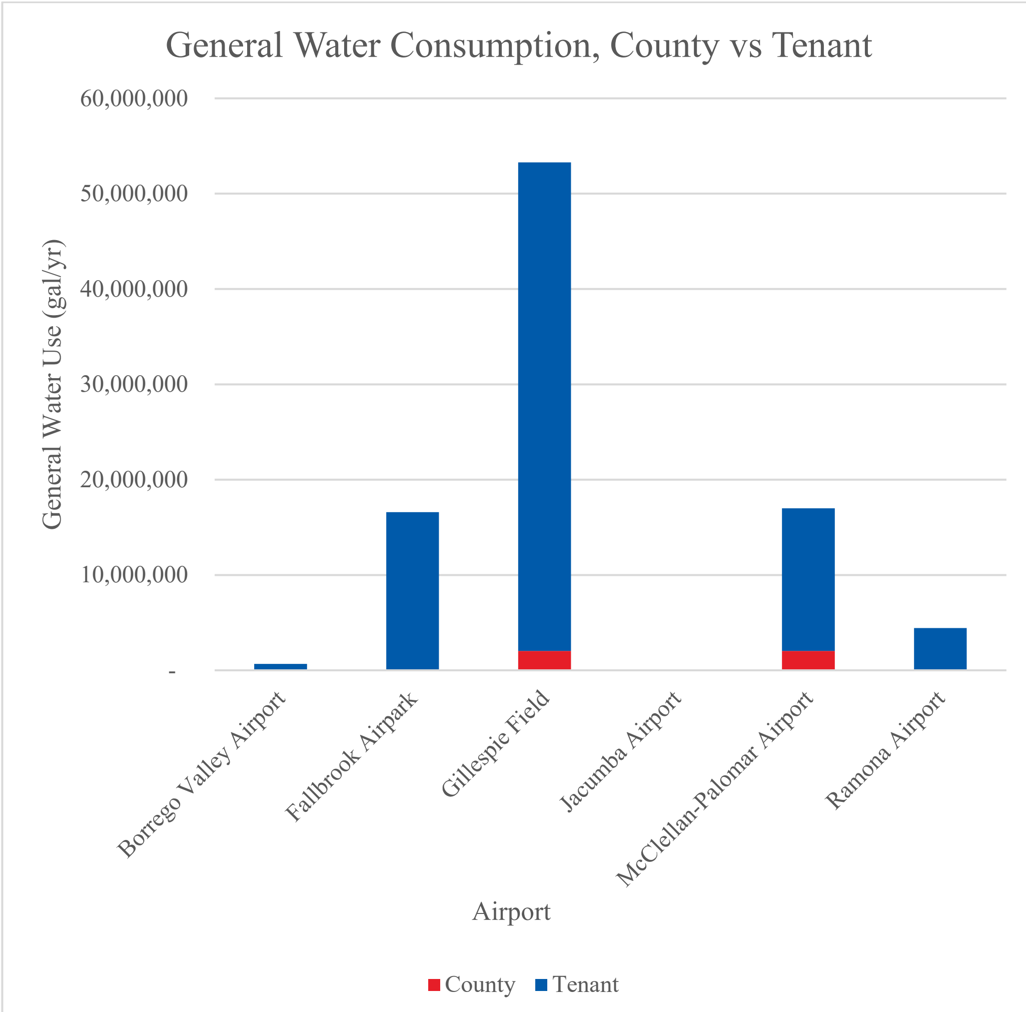

Figure 14 – General Water Consumption, County vs Tenant by Airport

Figure 15 shows estimated tenant irrigation water use - for landscaping and agricultural needs. Figure 16 shows County irrigation water use. Figure 17 shows a stacked comparison of County vs tenant irrigation water use.

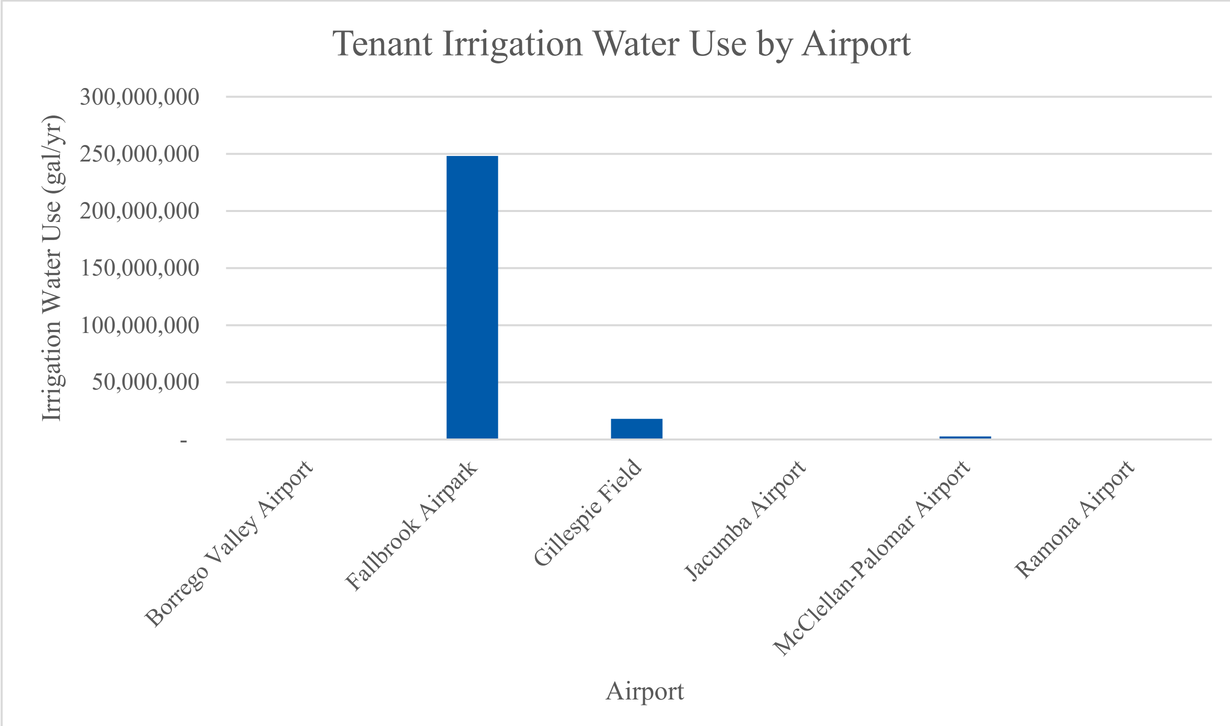

Figure 15 – Estimated Tenant Irrigation Water Use by Airport

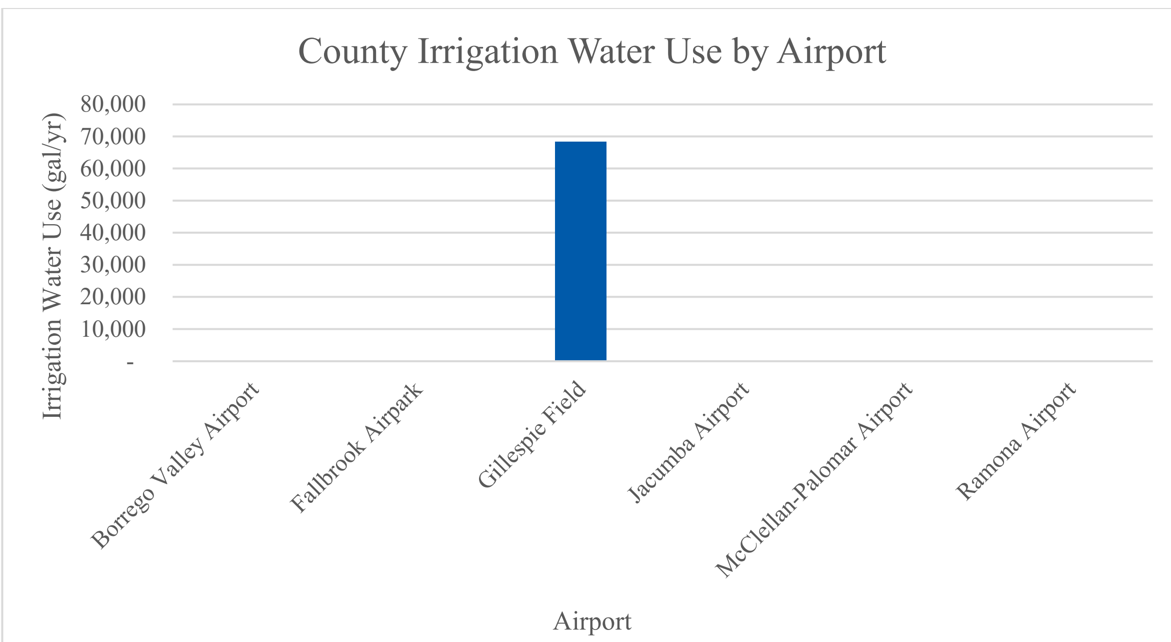

Figure 16 - County Irrigation Water Use by Airport

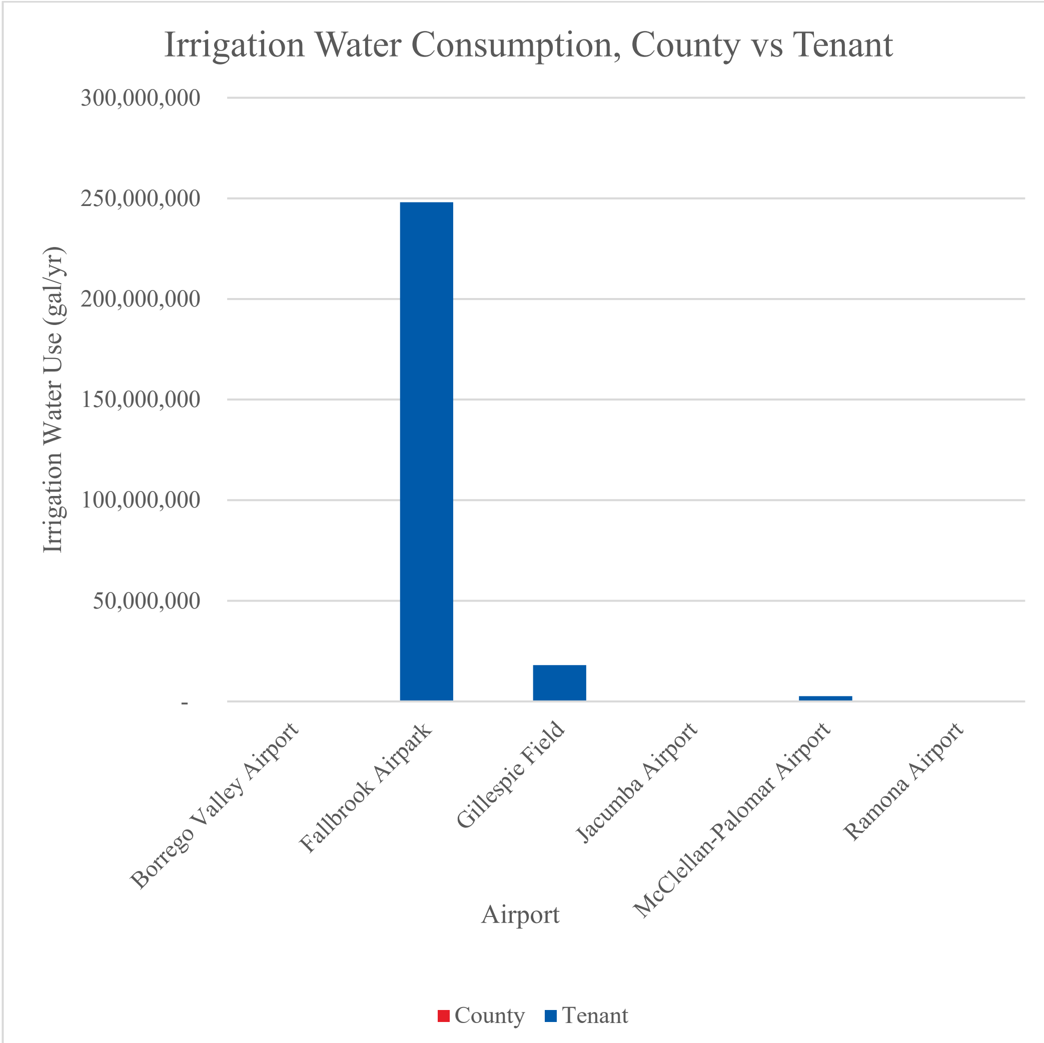

Figure 17 - Irrigation Water Consumption, County vs Tenant

Figure 18 shows estimated tenant water consumption broken down by typology at each airport. As already noted, Fallbrook Airpark's greatest water use is for agricultural purposes, which is further broken down into three types: nursery, orchard, and greenhouse. Agricultural data presented is based on assumption and rough estimates. At Gillespie Field, office spaces and hangars consume the highest volume of water, each at around 17,000,000 gallons of water per year. At McClellan-Palomar Airport, hangars are responsible for an estimated 8,500,000 gallons per year, qualifying them as the highest use-type.

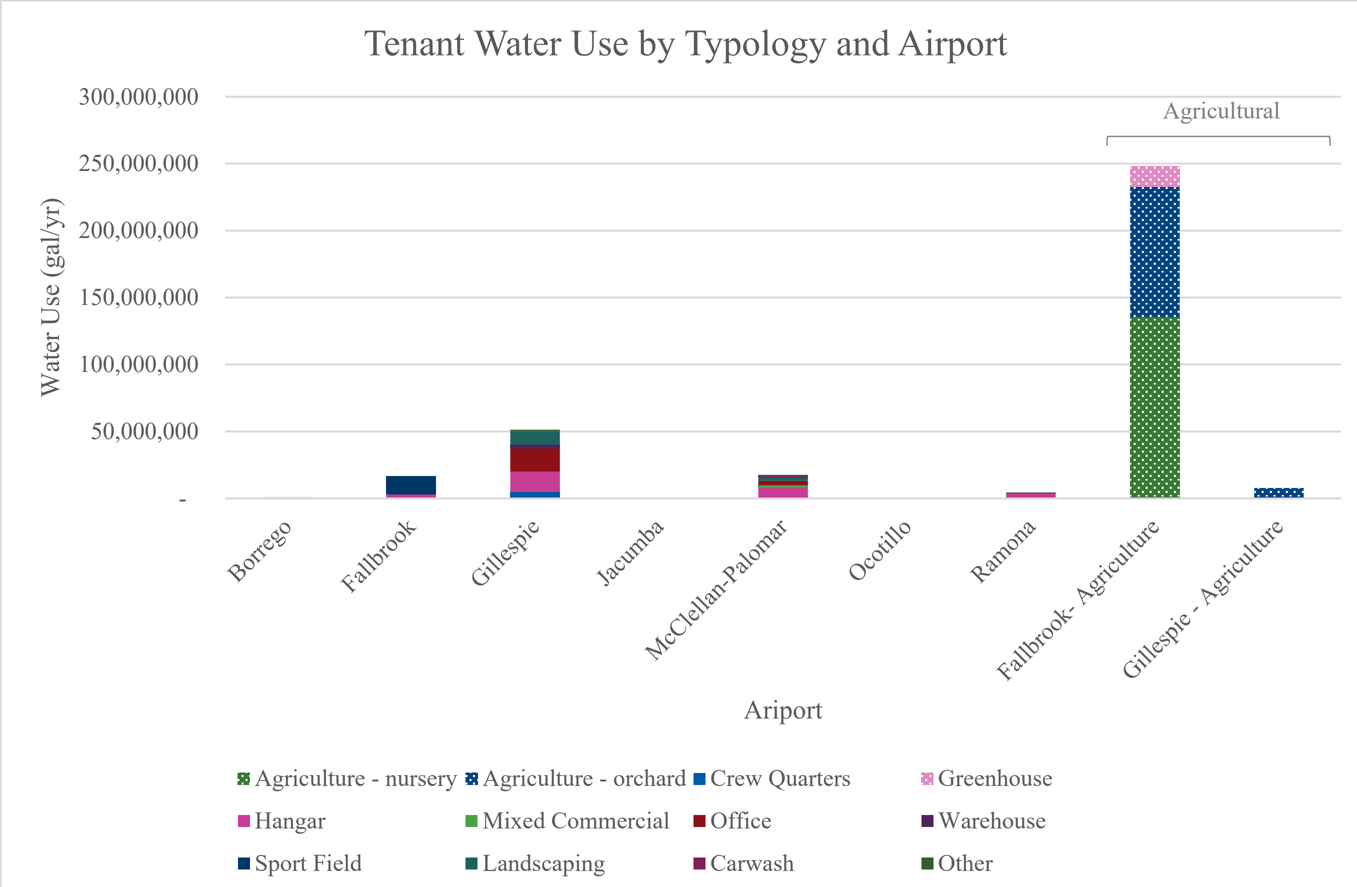

Figure 18 – Estimated Tenant Water Consumption by Typology

Methodology

County data is pulled from the 2020 Airports Sustainability Guidance Plan, prepared by the Department of Public Works Airports Division. To calculate tenant baseline water data, this study uses data on typical water use by Use Typology from two primary sources: 1) The U.S. Energy Information Administration (EIA) 2012 Commercial Buildings Energy Consumption Survey (CBECS) Water Consumption in Large Buildings, and 2) DOE's EnergyStar 2012 Water Use Tracking Data Trends report. The two sources give water use per square foot for the variety of Use Typologies in the Airports system.

Estimates for agricultural water use come from an Irrigation Demand calculation based on the Water Use Classification of Landscape Species (WUCOLS) method. This framework accounts for bioregion and classifies water use into four categories from 'high' to 'very low'. The calculation multiplies plant factor (the rate of water use of different species types), monthly average evapotranspiration (ETo) rate, and irrigation efficiency (e.g., drip, spray) to estimate water use on a per square foot basis.

Water use per square foot calculation is then multiplied by total square footage for each Use Typology. To properly understand the breakdown of Fallbrook Airpark's building resource-use, we separated out the irrigated water use. Water reduction measures suggested for agriculture and irrigation will differ significantly from measures for buildings.

See Appendix A.3 for more detailed graphs and tables for water consumption by airport.

2.6 Waste

Results

Figure 19 shows the amount of estimated solid waste tenants produce annually at each airport and Figure 20 shows a percent breakdown. Gillespie Field is the largest producer of solid waste for tenants across the airports, while neither Ocotillo Airport or Agua Caliente Airport have buildings on-site, and thus do not produce any solid waste and are not shown.

Figure 19 – Estimated Tenant Solid Waste by Airport

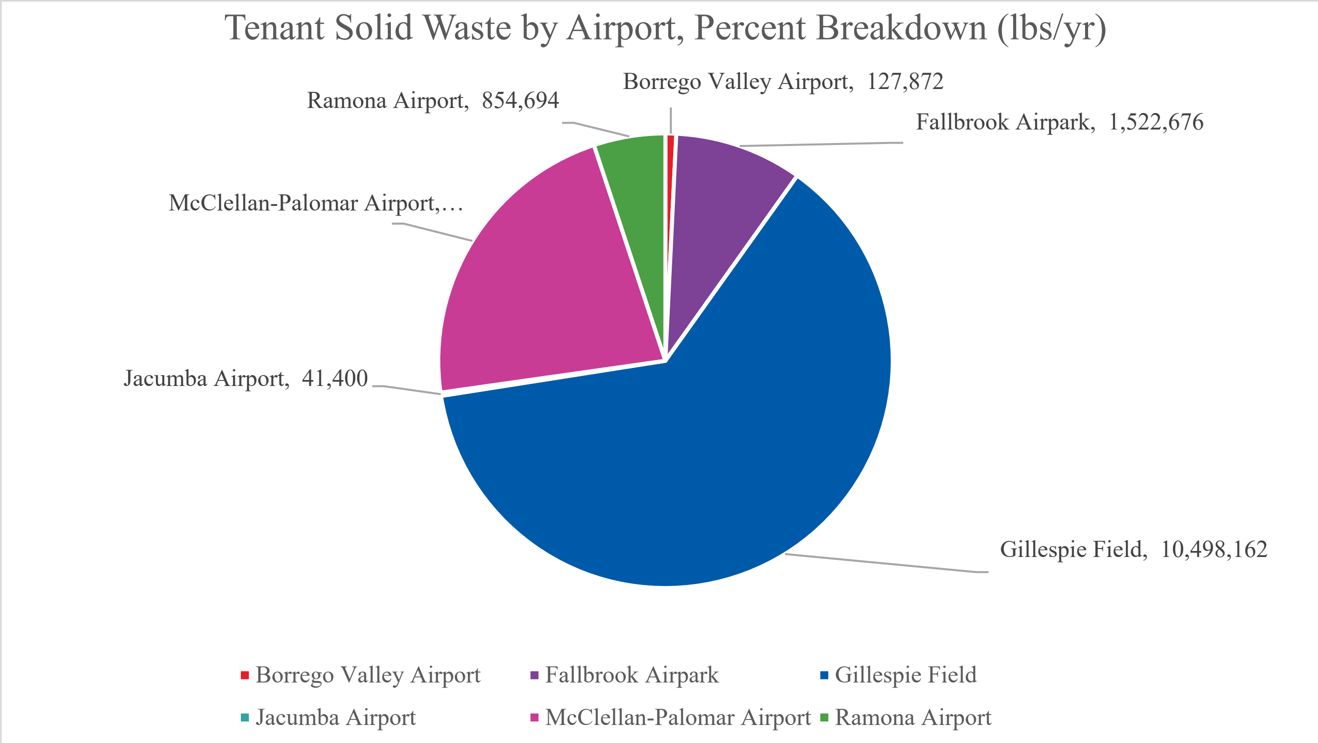

Figure 20 – Estimated Tenant Solid Waste by Airport, Percent Breakdown

Figure 21 shows the breakdown of estimated tenant solid waste by airport and use typology. Gillespie Field's largest producer of waste is its hangars, with office and warehouse space following closely behind, nearly on par with each other. At McClellan-Palomar Airport, hangars also produce the greatest amount of waste, followed by mixed commercial space. Agricultural land use data is based on assumption and rough estimates.

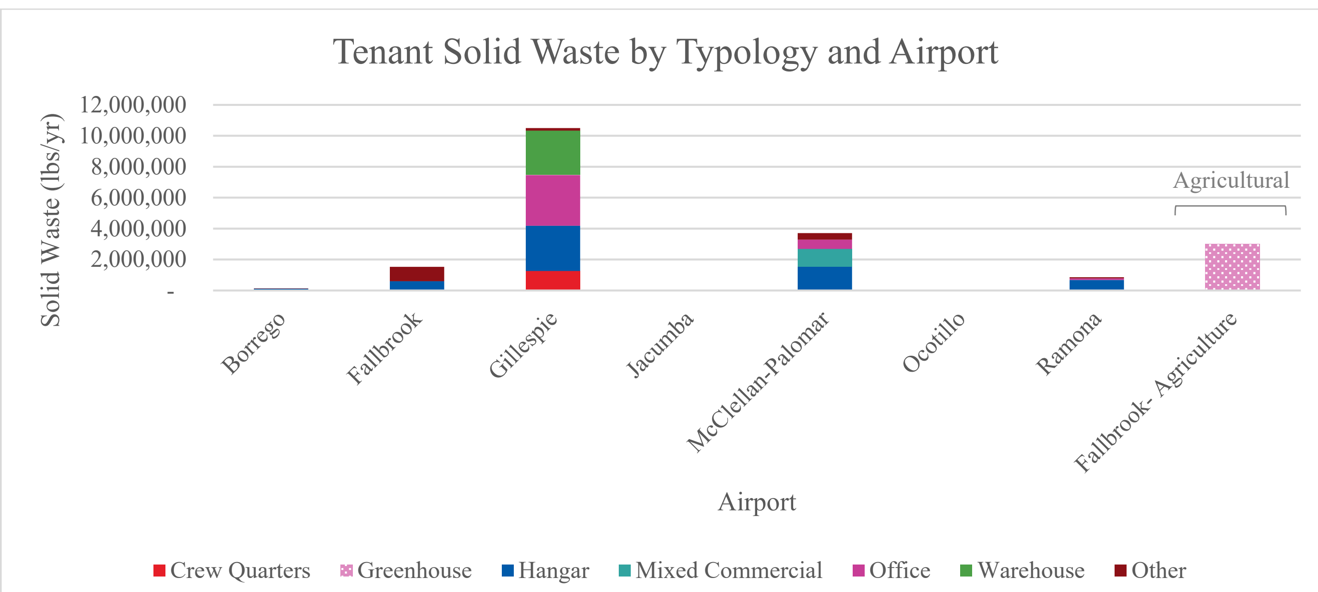

Figure 21 – Estimated Tenant Solid Waste by Typology and Airport

Figure 22 shows the amount of solid waste County facilities produce annually at each airport and Figure 23 shows a percent breakdown. McClellan-Palomar Airport is the largest producer of solid waste for County facilities across the airports.

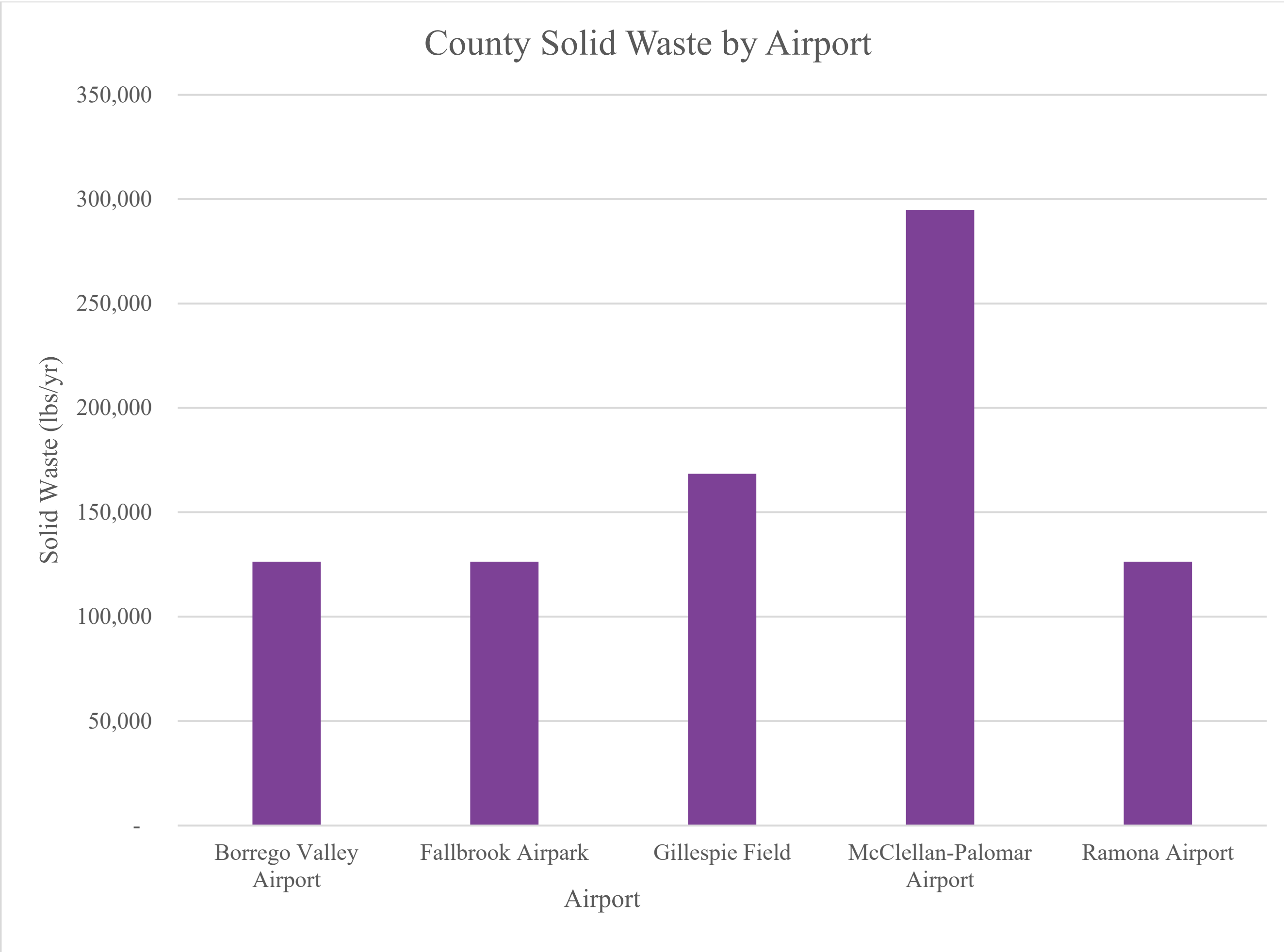

Figure 22 - County Solid Waste by Airport

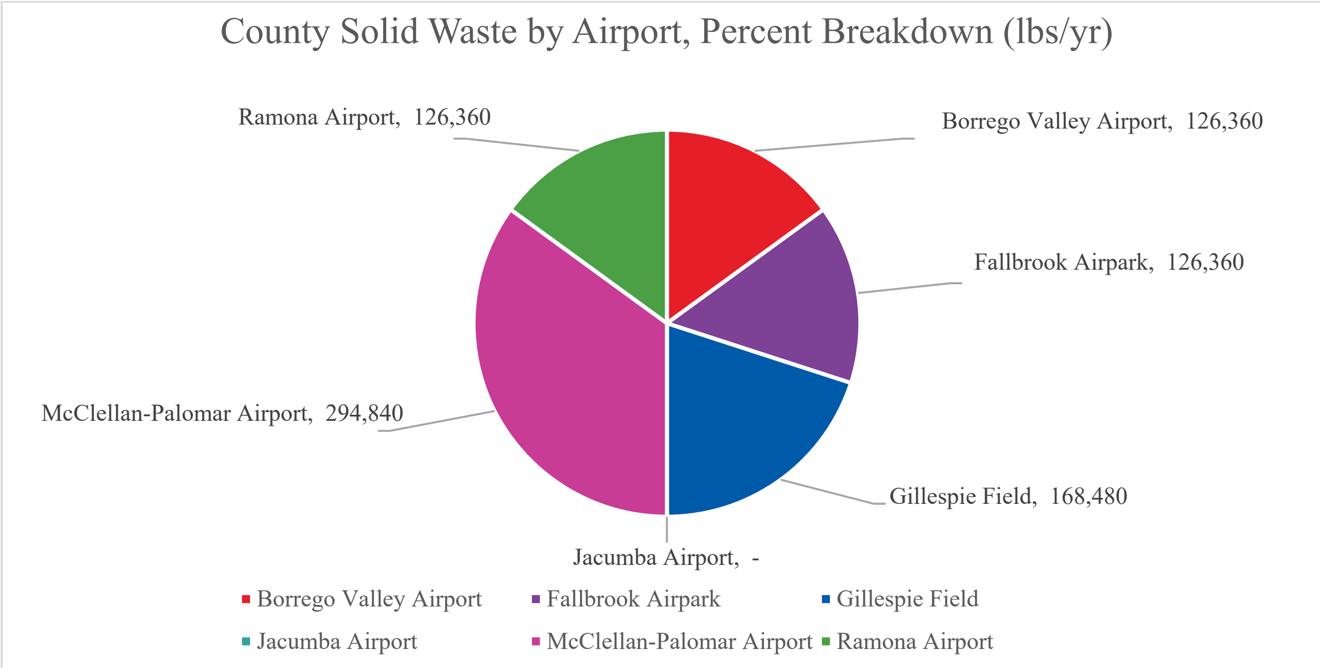

Figure 23 – County Solid Waste by Airport, Percent Breakdown

Figure 24 shows a stacked comparison of County vs tenant solid waste across the airports.

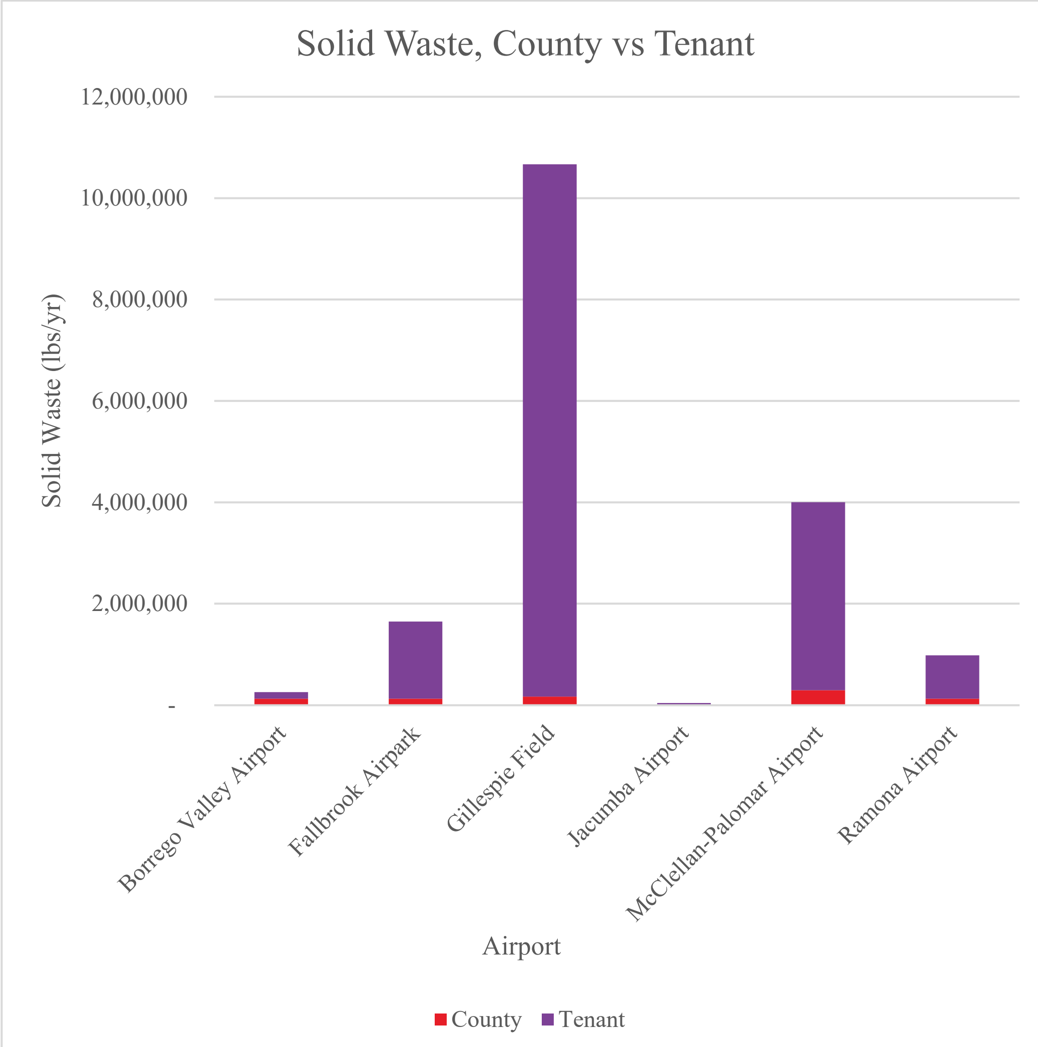

Figure 24 - Solid Waste by Airport, County vs Tenant

Methodology

County baseline data is pulled from the 2020 Airports Sustainability Guidance Plan, prepared by the Department of Public Works Airports Division. To find tenant baseline waste data, typical solid waste quantities produced per square foot by Use Typology from both CalRecycle and WasteCare were used. We multiplied the square footage of each Use Typology by its typical solid waste production rate. Applicable and current proxy data is scarce, thus some data is sourced from as far back as the 1990s.

Recycling proxy data from reliable sources was not available, so recyclable waste was excluded for now.

See Appendix A.3 for more detailed graphs and tables for waste generation by airport.

2.7 Wastewater

Results

Figure 25 shows tenant general wastewater by airport. Tenant-operated facilities produce the largest amount of wastewater Gillespie Field. Figure 26**Error! Reference source not found.** shows tenant wastewater by use typology and airport. Figure 27 shows County general wastewater by airport. County-operated facilities produce the largest amount of wastewater McClellan-Palomar Airport.

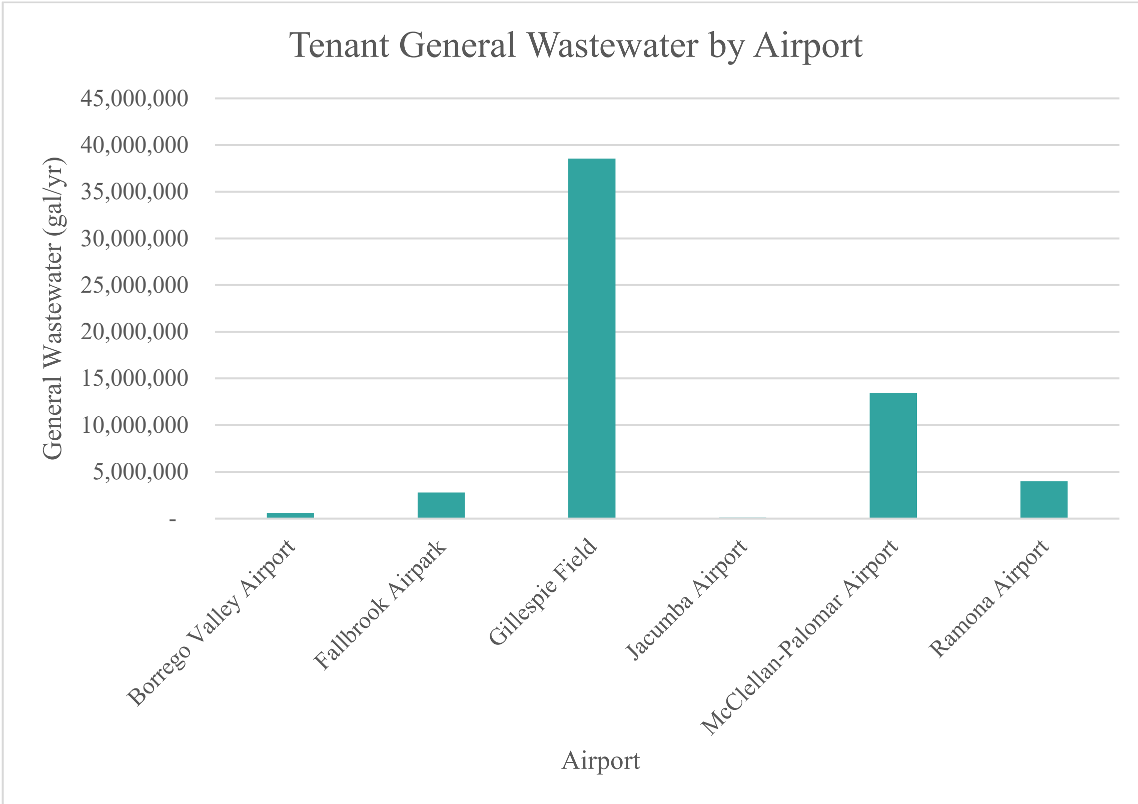

Figure 25 – Tenant General Wastewater by Airport

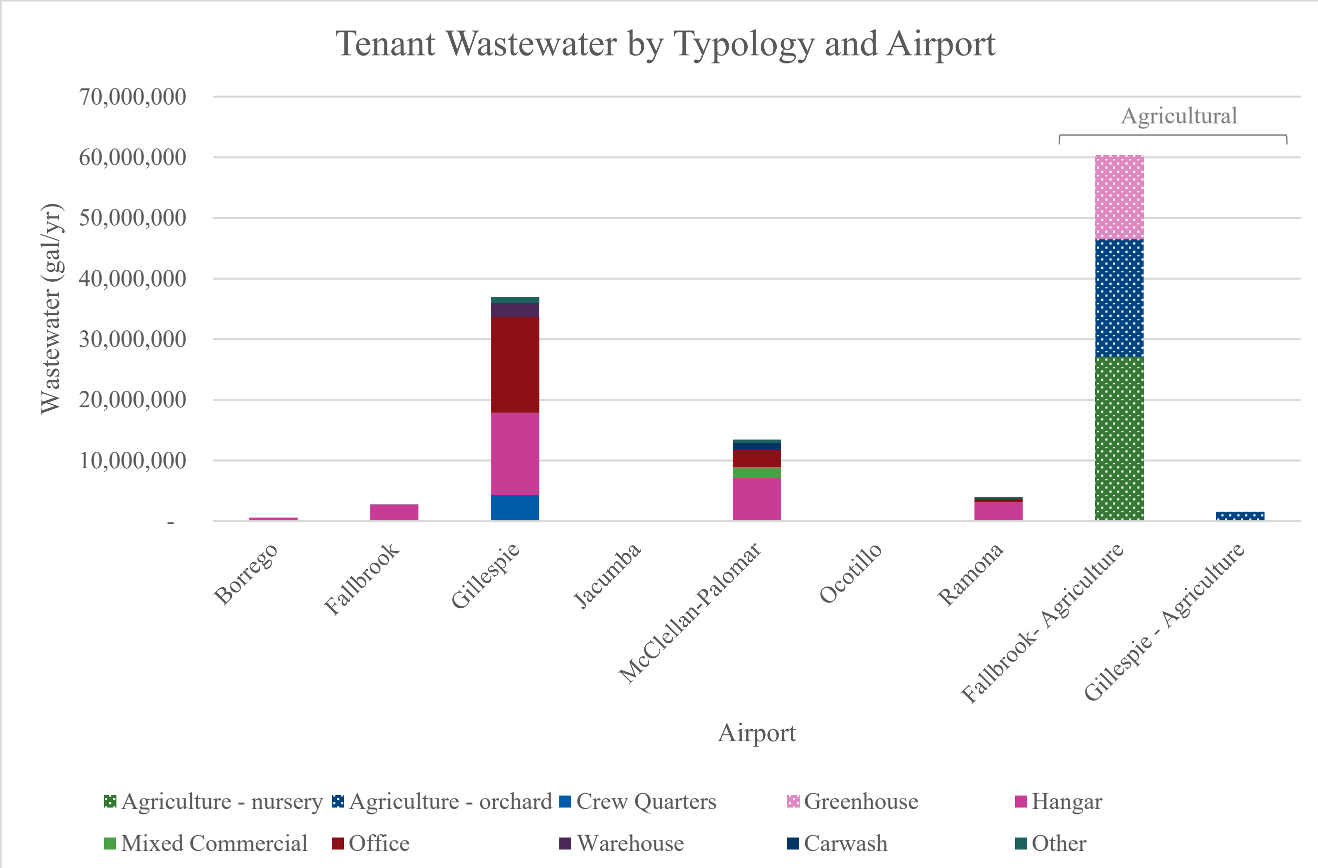

Figure 26 - Tenant Wastewater by Typology and Airport

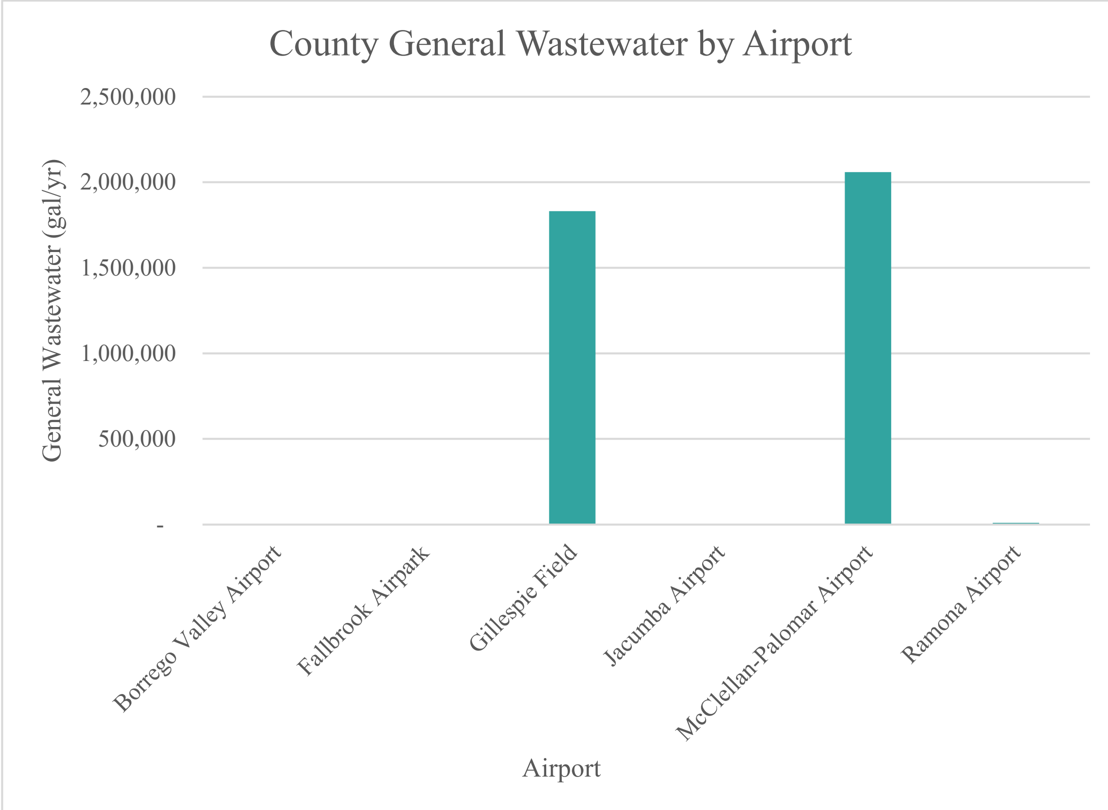

Figure 27 - County General Wastewater by Airport

Figure 28 shows a stacked comparison of County vs tenant general wastewater by airport. The greatest amount of wastewater is generated from tenants of Gillespie Field.

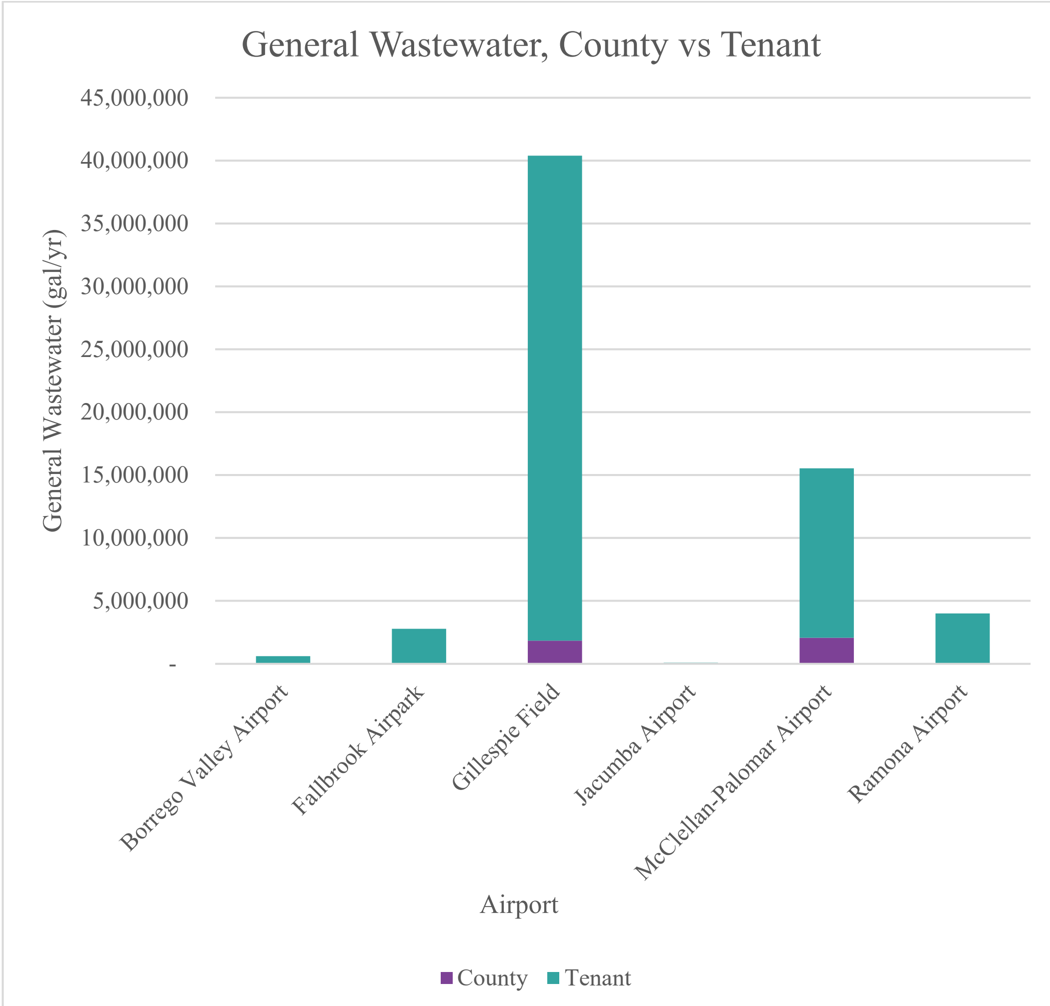

Figure 28 - General Wastewater, County vs Tenant

Methodology

County baseline data is pulled from the 2020 Airports Sustainability Guidance Plan, prepared by the Department of Public Works Airports Division, then multiplied by a factor of .9. It is common practice for wastewater generation to be based directly on water consumption data using a factor of 0.9 units of wastewater produced for every 1.0 units of water consumed. This is a standard industry assumption to account for losses that occur during water consumption such as drinking, leaks, and storage overflows. By using this factor, wastewater generation can be estimated based on water consumption data, which is more accessible than direct wastewater measurements. Irrigation water use was separated and excluded from these figures since it is assumed that most water used for agriculture or landscaping is absorbed back into the ground instead of entering a wastewater collection system.

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3. Summary of General Aviation Sustainability Best Practices

To gather a list of aviation sustainability best practices, the project team surveyed a range of both industry-wide sustainability guidance documents and sustainability management plans from similar-sized airports and airport systems. The reference SMPs were identified from the list of SMPs funded by FAA Sustainability Master Plan Pilot Program. Industry-wide references included:

- FAA Sustainability Master Plan Pilot Program
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- Integrate administrative changes to support of sustainable practices at airport facilities [SS-6]

Table 8 - Aviation Best Practices

Focus Area	Best Practice	Source	County Activity
Commissioning	Establish and follow systems commission requirements for runway lighting and illuminated signage, runway navigational aids, runway site lighting systems, traffic signals, pump stations, and oil/water	SAGA	
Community Engagement	Annual reports and presentations to the town council and general public detailing the airport's accomplishments, goals, and impact	Leesburg Executive Airport (JYO), VA	
Community Engagement	Aviation Summit, like a State of the Airport address to the business community around the Airport	Roanoke Regional Airport (ROA), VA	
Contracts	Integrate sustainability language and requirements into airport contracts	SAGA	[SS-1, LS-1]
Emissions	Design airfield geometry (or reposition runway and taxiway hold lines) such that aircraft idling in the departure queue and ground run-up areas are directed away from surrounding sensitive areas	SAGA	
Emissions	Encourage aircraft to taxi at idle power or a specified minimum power threshold.	SAGA	
Emissions	Encourage aircraft to taxi with less than all engines operating, where appropriate.	SAGA	
Emissions	Install automatic engine start/stop technology that reduces idling but maintains engine oil temperature	SAGA	
Emissions	Install high-speed or rapid exit taxiways to reduce aircraft taxi distances	SAGA	
Emissions	Install low emission engines into old equipment chassis	SAGA	
Emissions	Post no-idling signs	SAGA	

Emissions	Purchase and install vehicle air fresheners, placards, stickers, and/or decals (non-toxic) that promote and remind vehicle operators of a "no-idling" or "engines off" campaign	SAGA	
Emissions	Purchase, operate and maintain alternatively-fueled, electric, and hybrid vehicles	SAGA	
Emissions	Develop a reduced vehicle idling plan	SAGA	
Emissions	Install automatic engine start/stop technology that reduces idling but maintains engine oil temperature	SAGA	
Emissions	Install idling reduction technologies	SAGA	
Energy	Geothermal for terminal heating/cooling	Lunenburg County Airport (W31), VA	
Energy	Install tenant energy sub-metering systems	SAGA	
Energy	Investigate energy tax credits, rebates, and grants by local utilities or federal, state, or local agencies	SAGA	
Framework	Adopt the Global Reporting Initiative's Sustainability Reporting Framework, following their Airport Operations Sector Supplement	SAGA	
Fuel	Install biodiesel and ethanol fuel refueling stations	SAGA	
Fuel	Install compressed natural gas (CNG) refueling stations	SAGA	
Fuel	Install electric vehicle charging stations	SAGA	[SS-2, LS-2]
Fuel	Provide general aviation tenants with sump fuel disposal containers	SAGA	
Fuel	Replace conventional gasoline-based equipment with alternative-fuel based equipment, including biodiesel, compressed natural gas (CNG), hybrid electric, fuel cell, hydrogen, or liquid petroleum gas	SAGA	[SS-2, LS-2]
Fuel	Utilize biofuels in facilities and appropriate vehicles	SAGA	
Fuel	Enforce procurement of motorized vehicles with fuel economies higher than existing values	SAGA	
Funding	Apply for Federal Aviation Administration (FAA) Voluntary Airport Low Emissions Program (VALE) funding for intermodal connections, underground fuel hydrants, alternatively fueled vehicles, etc.	SAGA	
Lighting	Enable pilot controlled lighting for aircraft landing during off-peak hours so that airfield lighting can be turned off at night. (*all CoSD may be compliant already*)	SAGA	
Lighting	Establish airside lighting controls and procedures to turn off or reduce the intensity of airside lighting (runway, taxiway and apron lights and navigational aids) when not being used	SAGA	
Lighting	Install LED (light-emitting diode) lighting and signals	SAGA	
Lighting	LED lighting for airfield	Centennial Airport Sustainability Plan, CO	2008, Borrego
Lighting	LED windsock	Mecklenburg Brunswick Regional Airport (AVC), VA	
Mobility / Incentives	Develop preferred parking and/or lot locations for rental fleets that offer alternatively-fueled rental vehicles	SAGA	
Noise	Noise mitigation (work with FAA and the CACNR)	Centennial Airport Sustainability Plan, CO	
Noise	Noise Exposure Maps	Centennial Airport Sustainability Plan, CO	
Noise	FAA’s voluntary noise program, Part 150	Roanoke Regional Airport (ROA), VA	
Noise	FAA’s voluntary noise program, Part 150	Manassas Regional Airport (HEF), VA	
Noise	"Fly Friendly" noise program	Manassas Regional Airport (HEF), VA	

Standards	Include sustainable practices in the airport's Minimum Operating Standards	SAGA	
Urban Heat Island	Use advanced satellite imagery to create a map that identifies hot spots at the airport where urban heat island reduction strategies will have the greatest impact	SAGA	
Waste	Provide waste oil containers to pilots (particularly general aviation pilots) for the collection of waste engine oil	SAGA	
Waste	Recycle aircraft tires, turbine oil, hydraulic fluid, engine oil, carpet, glass and metal from light bulbs, and batteries	SAGA	
Waste	Recycle all used oil cans as scrap metal	SAGA	
Waste	Recycle gas filters, waste gasoline, motor oil, anti-freeze, scrap metal, tires, electrical wiring, electronics, grease and sludge, hazardous materials and spent solvents, pallets, and wood	SAGA	
Waste	Recycle hot-drained or crushed non-terne plated used oil filters	SAGA	
Waste	Reuse existing runway pavement	SAGA	
Waste	Spill prevention control and countermeasure (SPCC) plan; governs materials such as fuels, fluids, and materials from fixed-base operators and maintenance hangars	SAGA	
Wildlife	Install bird deterrent wires or other mechanisms to prevent wildlife interference	SAGA	

Appendices

A.1 Buildings floor area by Use Typology

Table 9 - Building Floor Area by Typology Across Airports

Typology	Area (sqft)
Aeronautical Manufacturing	5,175
Agriculture - nursery	5,077,212
Agriculture - orchard	5,485,500
Airfield	3,914,416
Animal Shelter	26,355
ATC Tower	1,705
Bank	6,218
Carwash	9,041
Classroom	5,746
Covered Parking	87,154
Crew Quarters	113,393
Flight School	18,168
Greenhouse	906,449
Gun Range	2,120
Hangar	1,948,310
Hardscape	32,645,872
Heavy Manufacturing	293,377
Landscaping	665,223
Maintenance Facility	20,221
Maintenance Hangar	15,879
Manufacturing	30,460
Mixed Commercial	168,124
Museum	22,750
Non Aircraft Storage Unit	4,656
Office	1,491,674
Pilot Shop - Retail	5,018
Restaurant	12,827
Restroom	1,177
Self-Fueling Station	630
Sheriff Office	3,291
Snack Bar	1,658
Sport Field	505,867
Storage Room	-
Tennis Pro Shop	2,710
Terminal	22,831
Warehouse	776,092
Waste Transfer Station	-

A.2 Aircraft Operation Counts & Based Aircraft Counts

This appendix provides a summary of key data points for each airport and is intended as a reference understand the key characteristics of each airport and identify what sets them apart from one another. This can help to inform decision-making and facilitate further analysis or investigation as needed.

A.3 Airport Based Detailed Graphs – Buildings and Landscapes

A.3.1 Emissions

The following figures show the tenant emissions broken down by Use Typology.

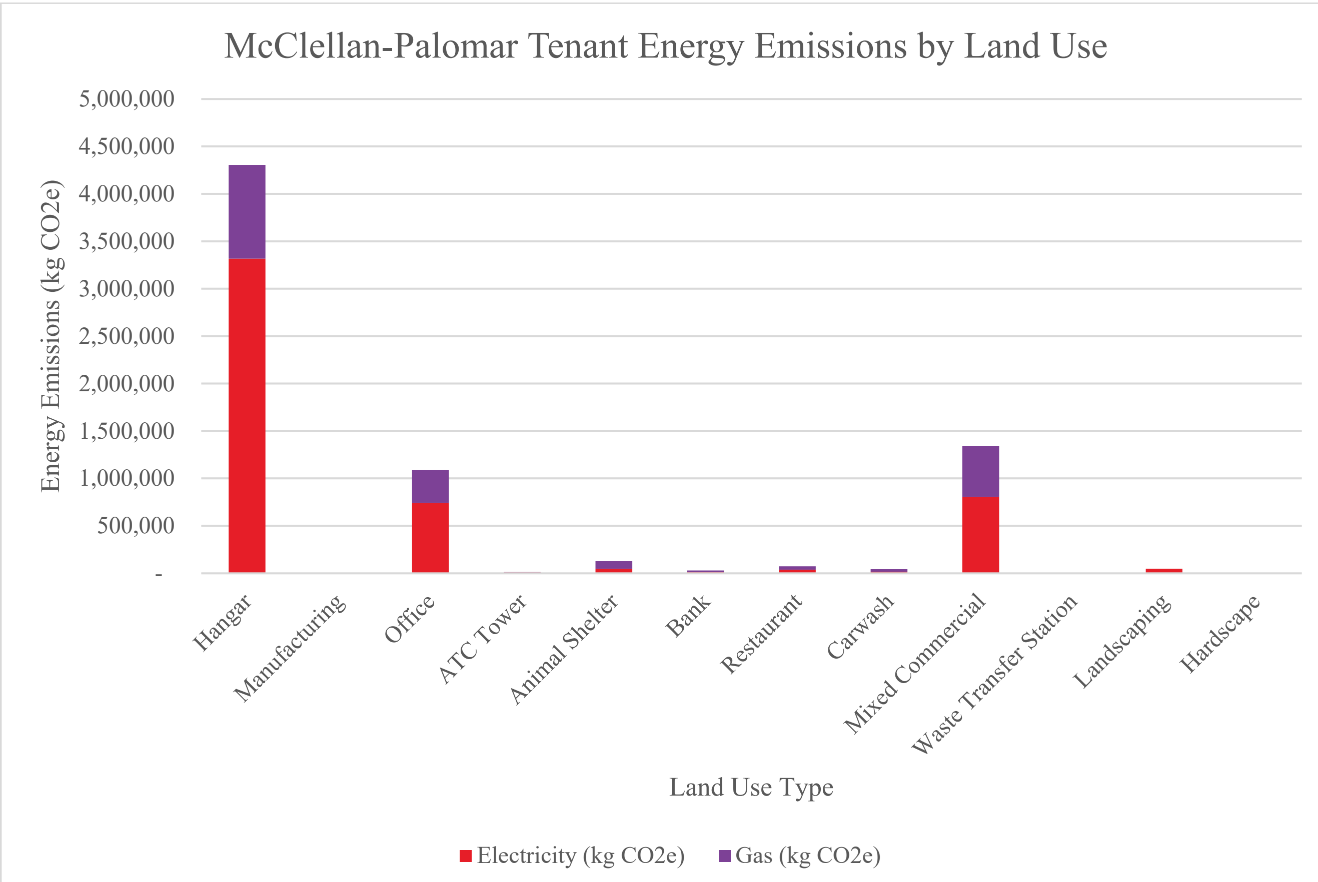

Figure 29 - McClellan-Palomar Tenant Energy Emissions by Use Typology

Table 10 - McClellan-Palomar Tenant Energy Emissions by Use Typology

Use Typology	Electricity (kg CO2e)	Gas (kg CO2e)
Hangar	3,316,869	988,424
Manufacturing	-	-
Office	741,233	344,763
ATC Tower	8,992	2,680
Animal Shelter	46,318	80,049
Bank	10,928	18,886
Restaurant	36,970	36,999
Carwash	15,889	27,460
Mixed Commercial	804,336	536,240
Waste Transfer Station	-	-
Landscaping	47,235	-
Hardscape	97	-

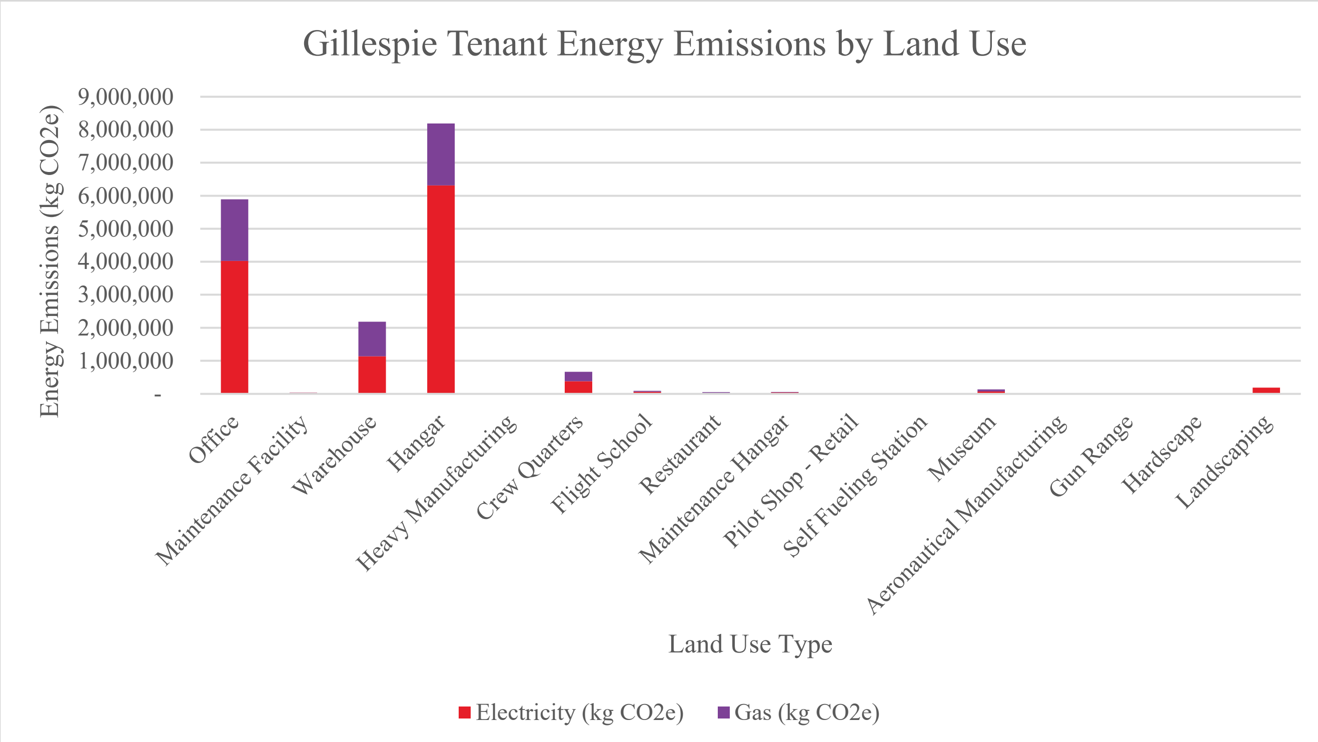

Figure 30 - Gillespie Tenant Energy Emissions by Use Typology

Table 11 - Gillespie Tenant Energy Emissions by Use Typology

Use Typology	Electricity (kg CO2e)	Gas (kg CO2e)
Office	4,022,237	1,870,827
Maintenance Facility	27,290	8,132
Warehouse	1,136,622	1,046,412
Hangar	6,310,878	1,880,636
Heavy Manufacturing	-	-
Crew Quarters	377,304	287,909
Flight School	60,312	28,052
Restaurant	25,119	25,138
Maintenance Hangar	41,446	12,351
Pilot Shop - Retail	-	-
Self Fueling Station	4,475	1,334
Museum	67,747	65,636
Aeronautical Manufacturing	-	-
Gun Range	3,105	-
Hardscape	348	-
Landscaping	185,580	-

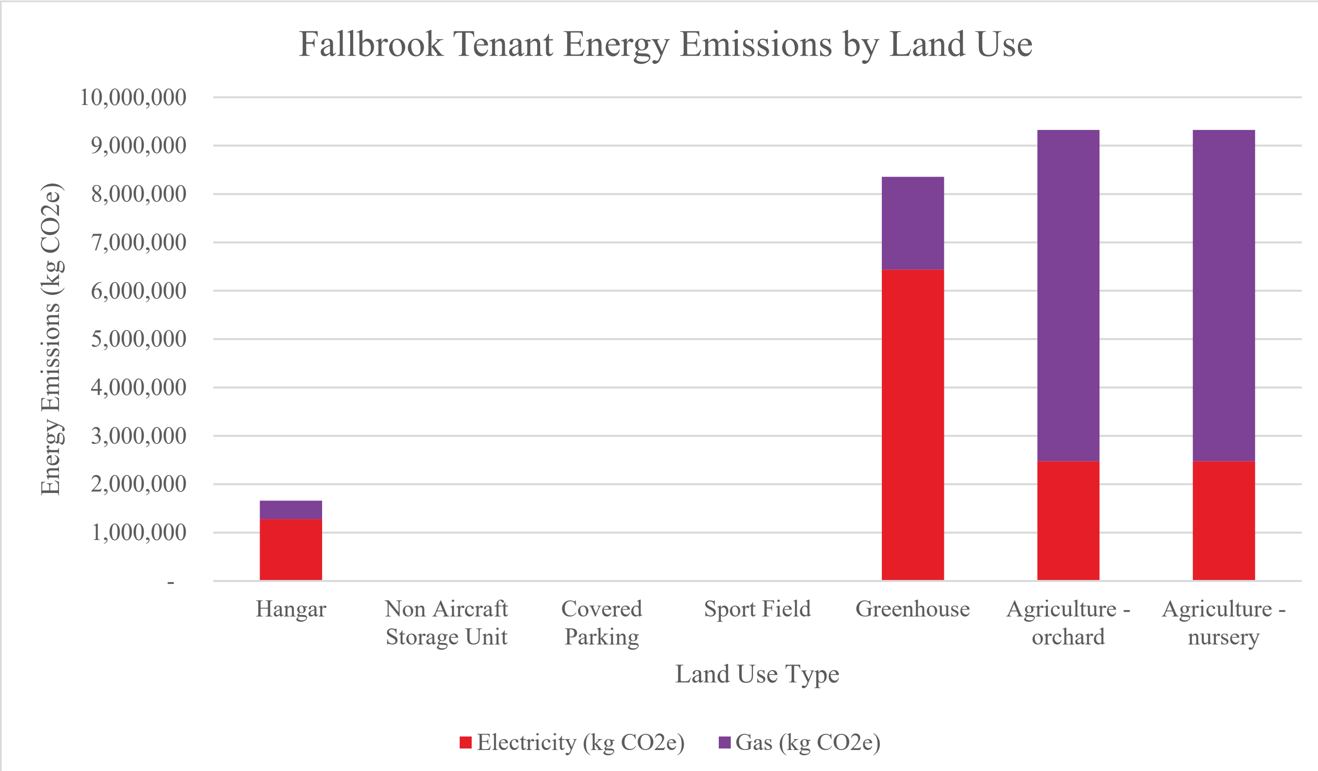

Figure 31 - Fallbrook Tenant Energy Emissions by Use Typology

Table 12 - Fallbrook Tenant Energy Emissions by Use Typology

Use Typology	Electricity (kg CO2e)	Gas (kg CO2e)
Hangar	1,280,459	381,576
Non Aircraft Storage Unit	6,819	6,278
Covered Parking	6	-
Sport Field	37	-
Greenhouse	6,438,548	1,918,682
Agriculture - orchard	2,478,603	6,845,655
Agriculture - nursery	2,478,603	6,845,655

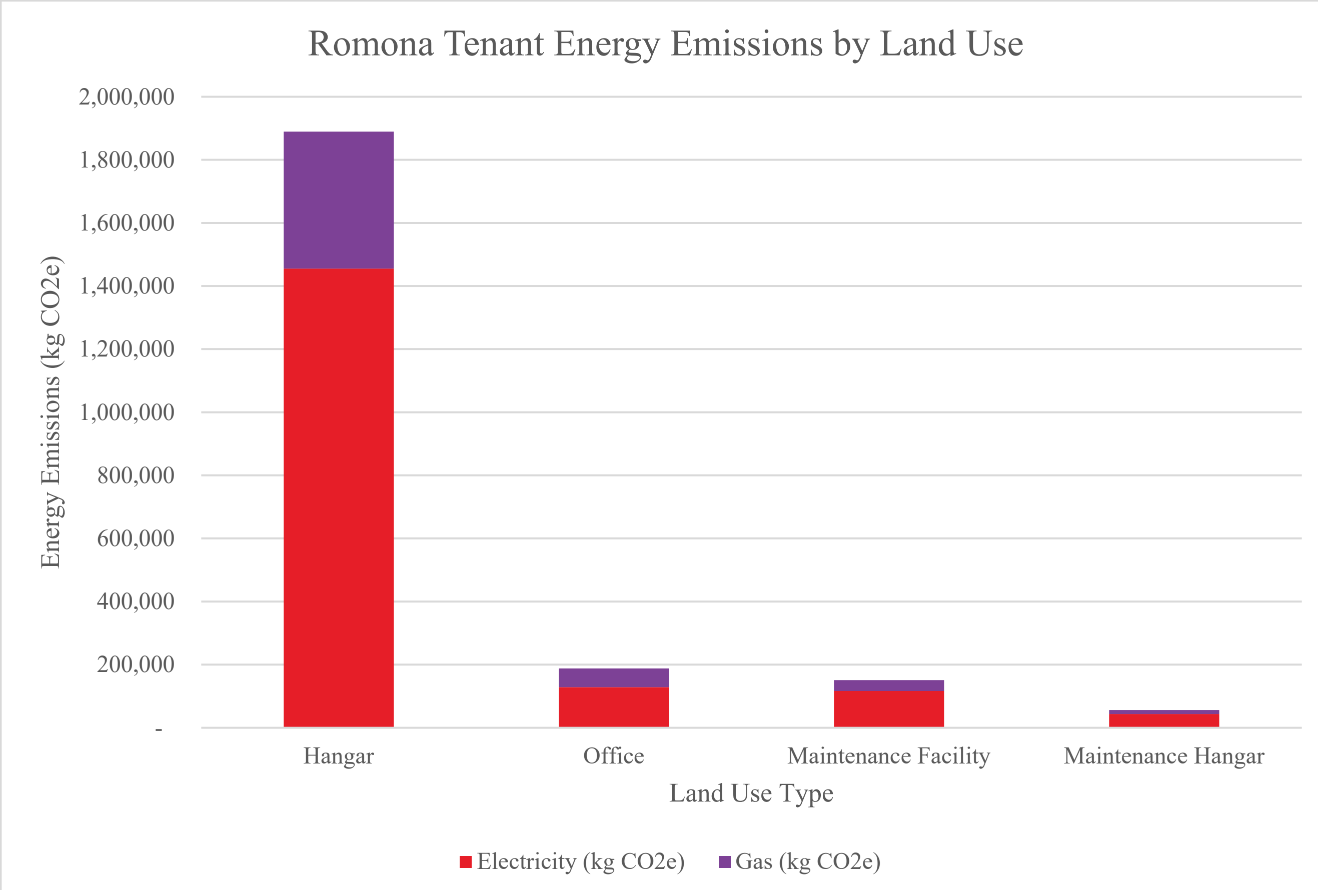

Figure 32 - Ramona Tenant Energy Emissions by Use Typology

Table 13 - Ramona Tenant Energy Emissions by Use Typology

Use Typology	Electricity (kg CO2e)	Gas (kg CO2e)
Hangar	1,455,481	433,732
Office	128,352	59,699
Maintenance Facility	116,341	34,669
Maintenance Hangar	43,151	12,859

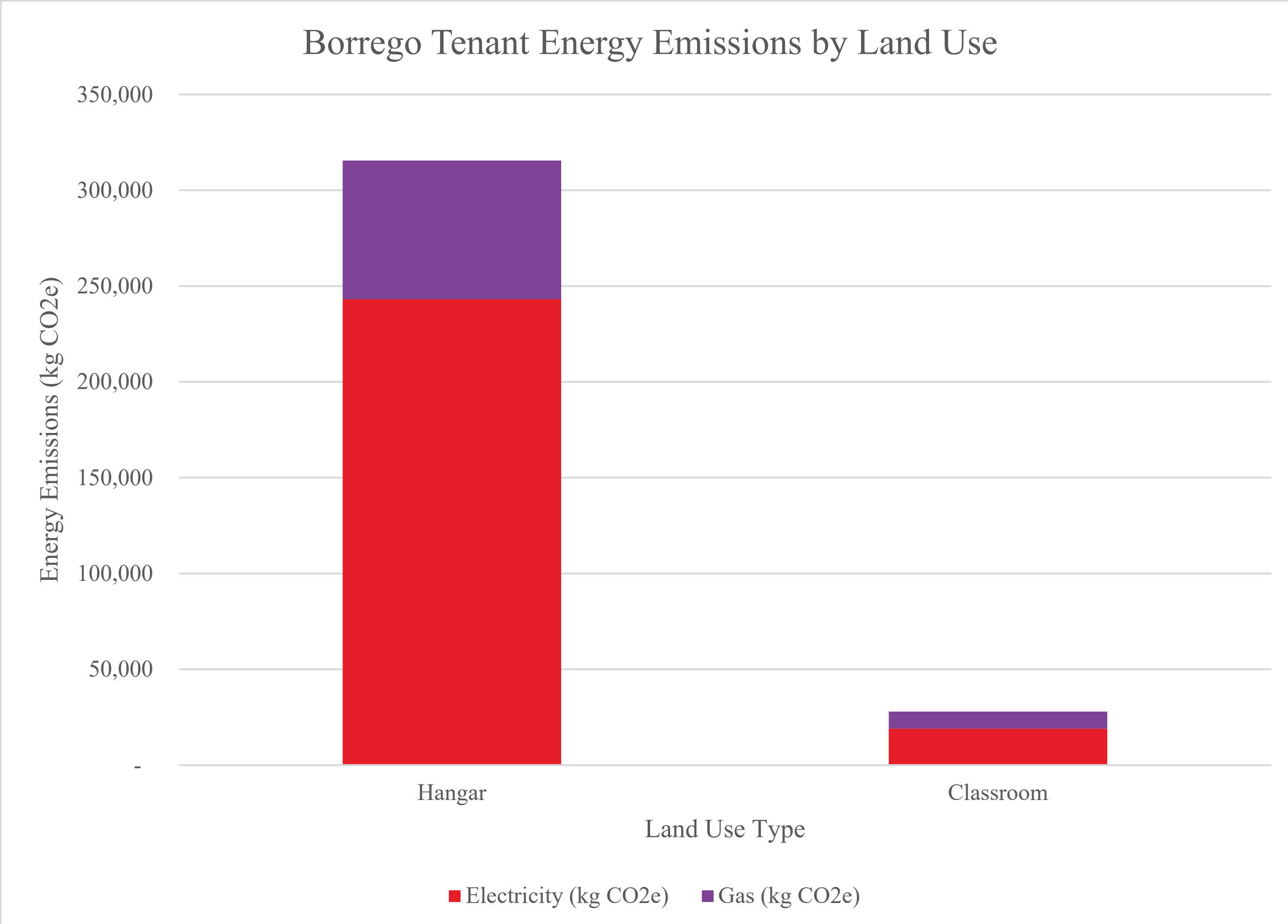

Figure 33 - Borrego Tenant Energy Emissions by Use Typology

Table 14 - Borrego Tenant Energy Emissions by Use Typology

Use Typology	Electricity (kg CO2e)	Gas (kg CO2e)
Hangar	243,080	72,438
Classroom	19,075	8,872

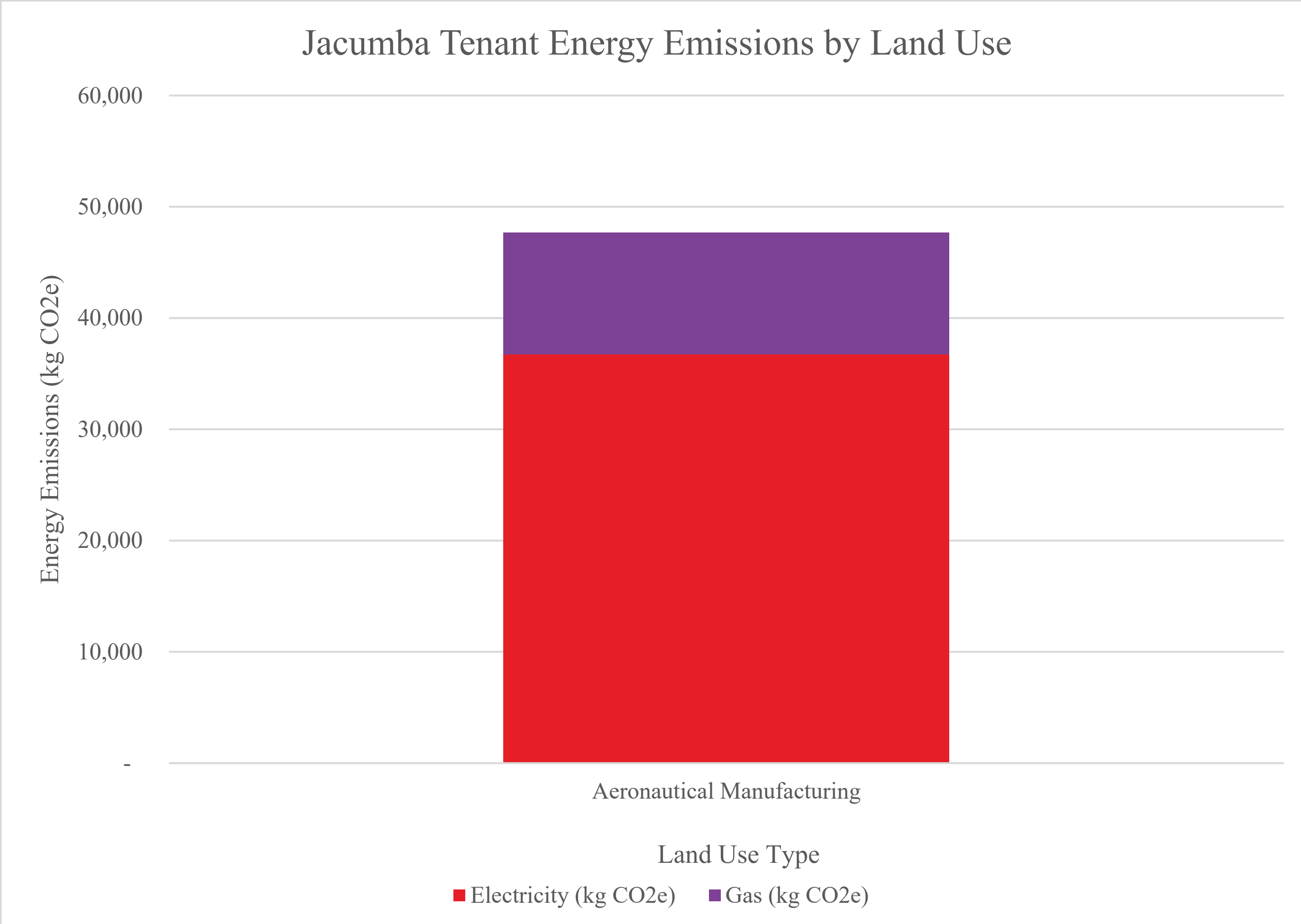

Figure 34 - Jacumba Tenant Energy Emissions by Use Typology

Table 15 - Jacumba Tenant Energy Emissions by Use Typology

Use Typology	Electricity (kg CO2e)	Gas (kg CO2e)
Aeronautical Manufacturing	36,758	10,954

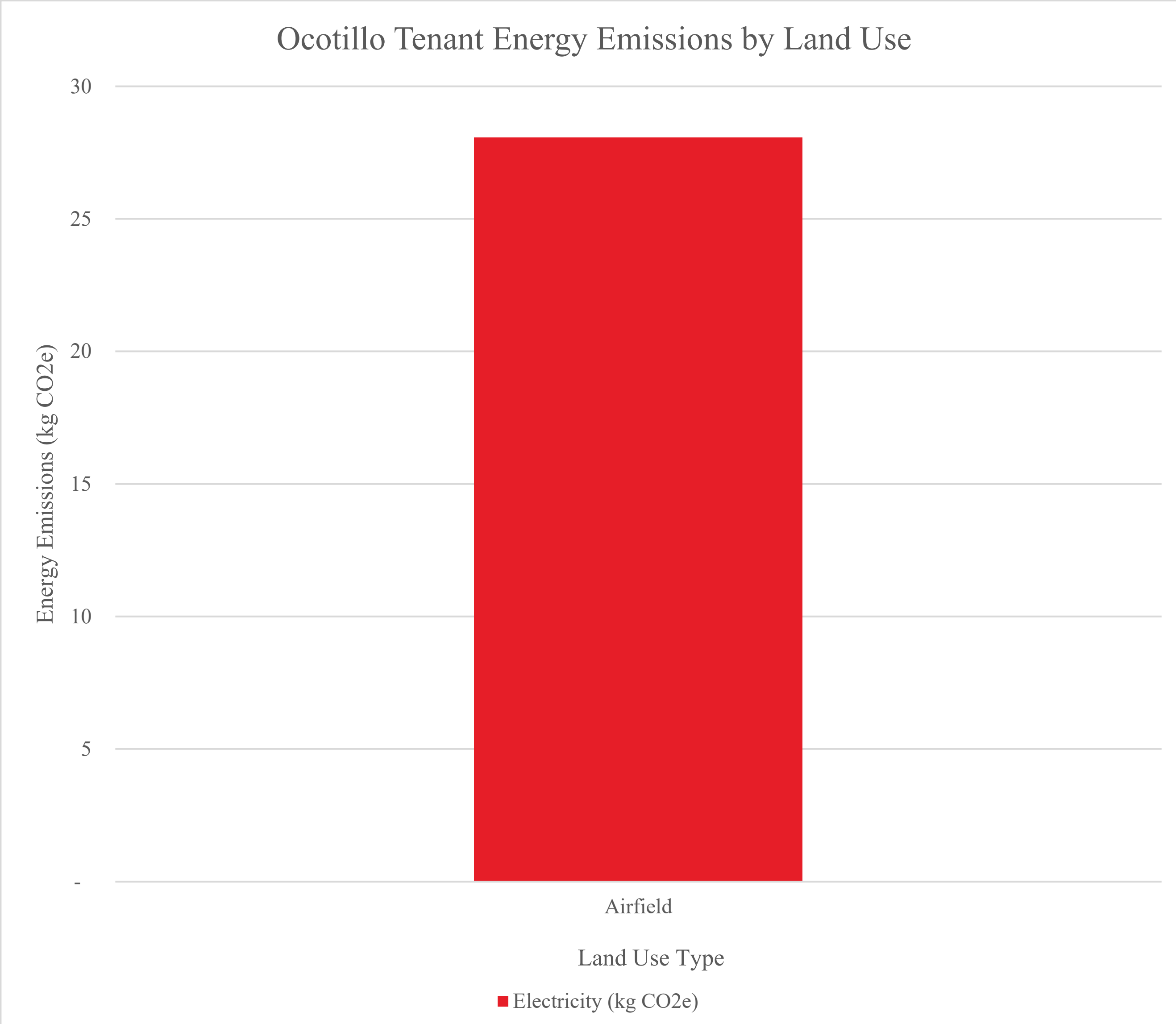

Figure 35 - Ocotillo Tenant Energy Emissions by Use Typology

Table 16 - Ocotillo Tenant Energy Emissions by Use Typology

Use Typology	Electricity (kg CO2e)
Airfield	28

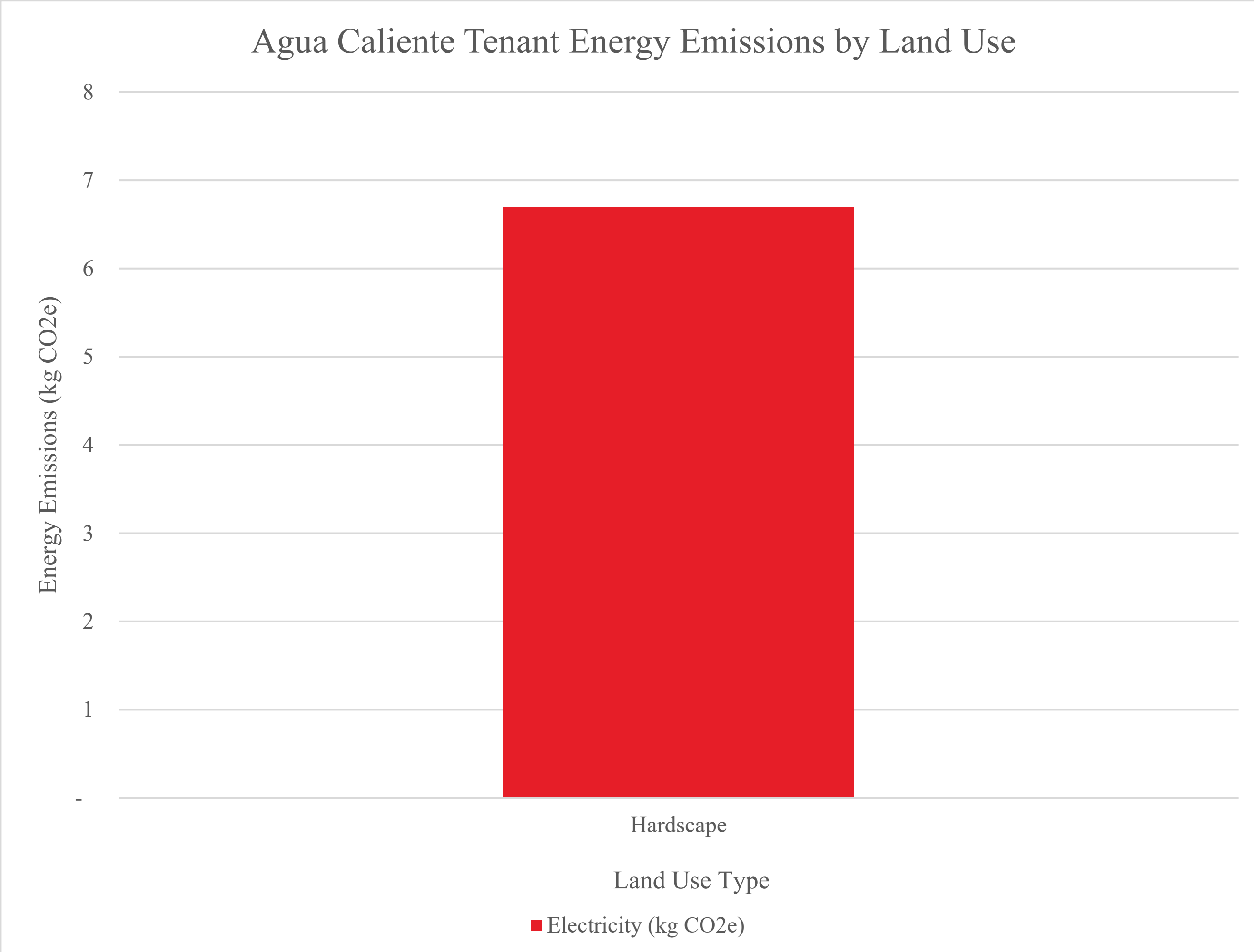

Figure 36 - Aqua Caliente Tenant Energy Emissions by Use Typology

Table 17 - Aqua Caliente Tenant Energy Emissions by Use Typology

Use Typology	Electricity (kg CO2e)
Hardscape	7

A.3.2 Water

The following figures show overall tenant water use broken down by Use Typology, for each airport.

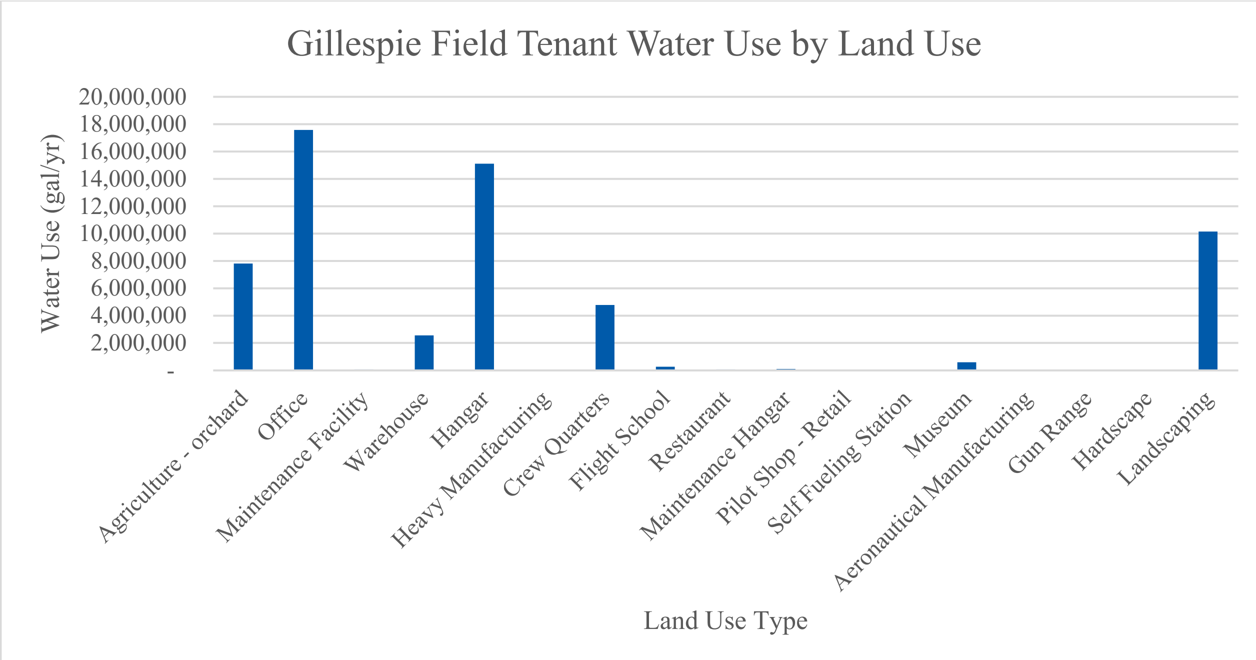

Figure 37 - Gillespie Tenant Water Use by Use Typology

Table 18 - Gillespie Tenant Water Use by Use Typology

Use Typology	Water Use (gal/yr)
Agriculture - orchard	7,810,549
Office	17,568,925
Maintenance Facility	65,314
Warehouse	2,561,103
Hangar	15,104,074
Heavy Manufacturing	-
Crew Quarters	4,776,801
Flight School	263,438
Restaurant	59,912
Maintenance Hangar	99,195
Pilot Shop - Retail	-
Self Fueling Station	10,710
Museum	596,050
Aeronautical Manufacturing	-
Gun Range	-
Hardscape	-
Landscaping	10,149,854

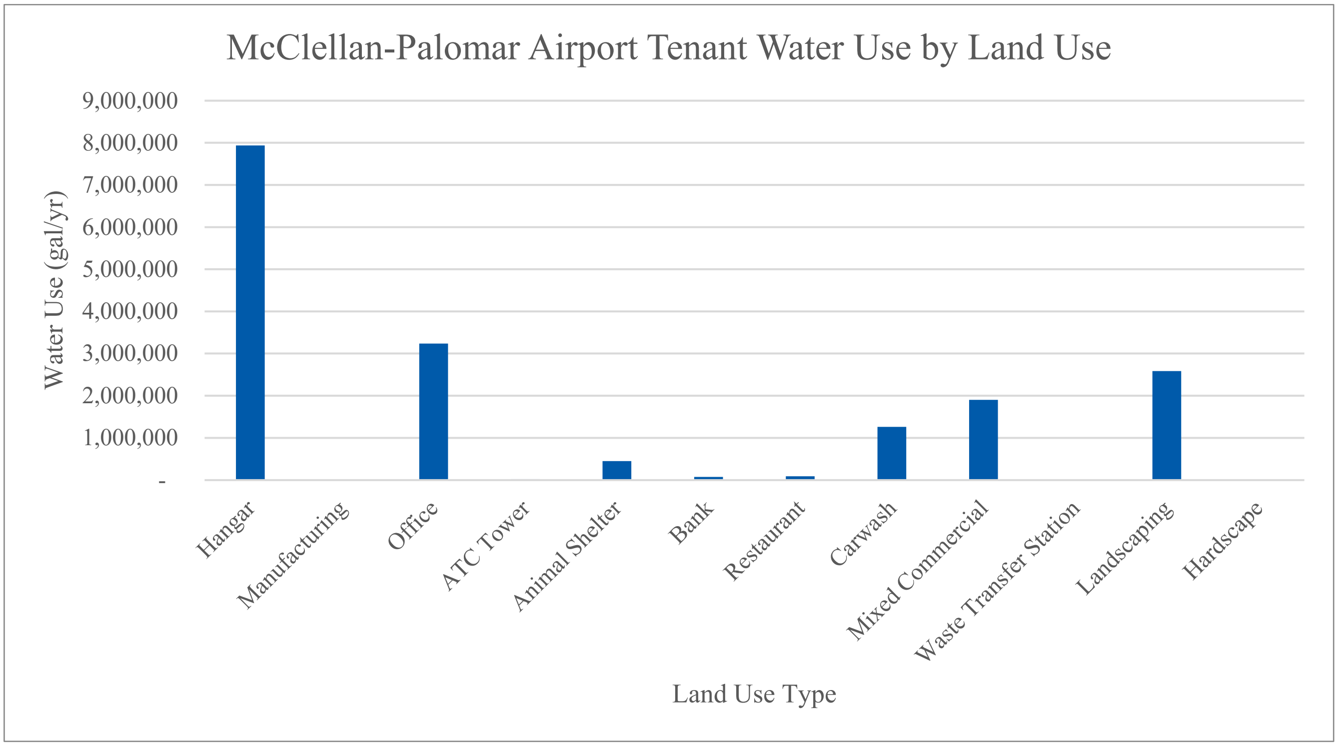

Figure 38 - McClellan-Palomar Tenant Water Use by Use Typology

Table 19 - McClellan-Palomar Tenant Water Use by Use Typology

Use Typology	Water Use (gal/yr)
Hangar	7,938,393
Manufacturing	-
Office	3,237,667
ATC Tower	21,522
Animal Shelter	448,035
Bank	74,616
Restaurant	88,179
Carwash	1,260,000
Mixed Commercial	1,899,801
Waste Transfer Station	-
Landscaping	2,583,439
Hardscape	-

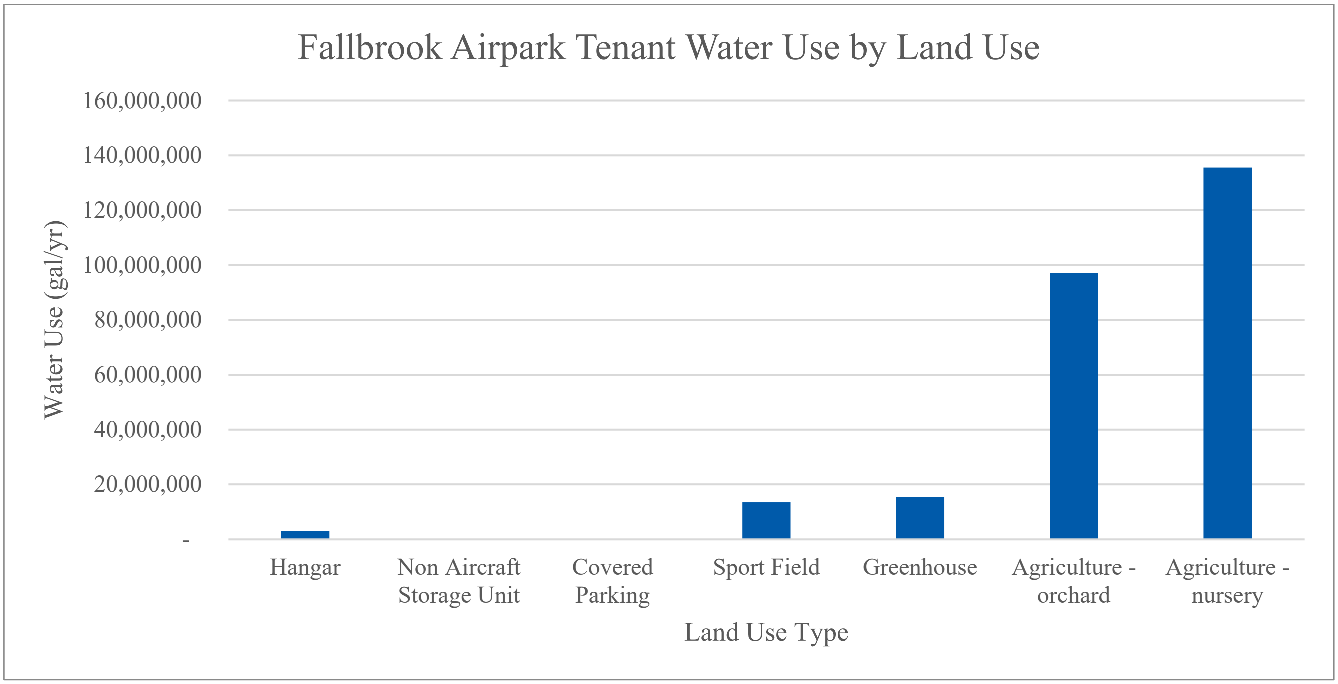

Figure 39 – Fallbrook Tenant Water Use by Use Typology

Table 20 - Fallbrook Tenant Water Use by Use Typology

Use Typology	Water Use (gal/yr)
Hangar	3,064,573
Non Aircraft Storage Unit	15,365
Covered Parking	-
Sport Field	13,506,649
Greenhouse	15,409,633
Agriculture - orchard	97,127,066
Agriculture - nursery	135,561,560

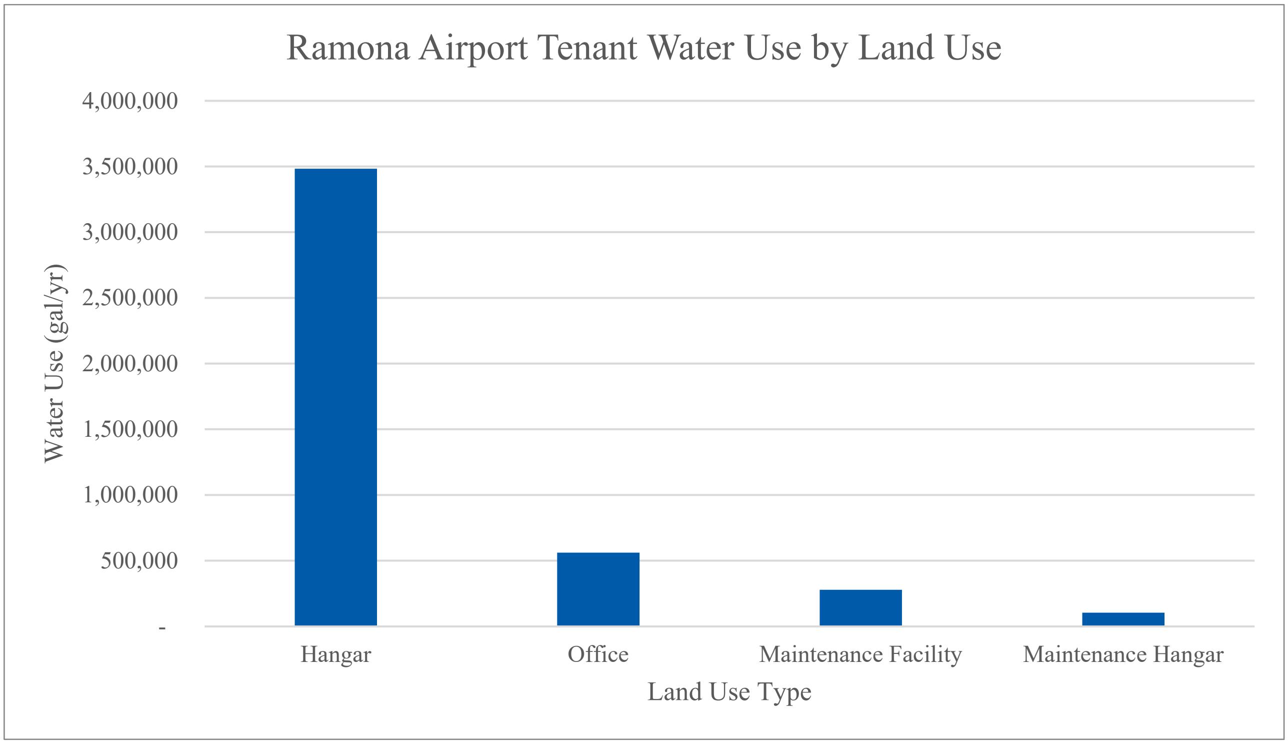

Figure 40 - Ramona Tenant Water Use by Use Typology

Table 21 - Ramona Tenant Water Use by Use Typology

Use Typology	Water Use (gal/yr)
Hangar	3,483,462
Office	560,635
Maintenance Facility	278,443
Maintenance Hangar	103,275

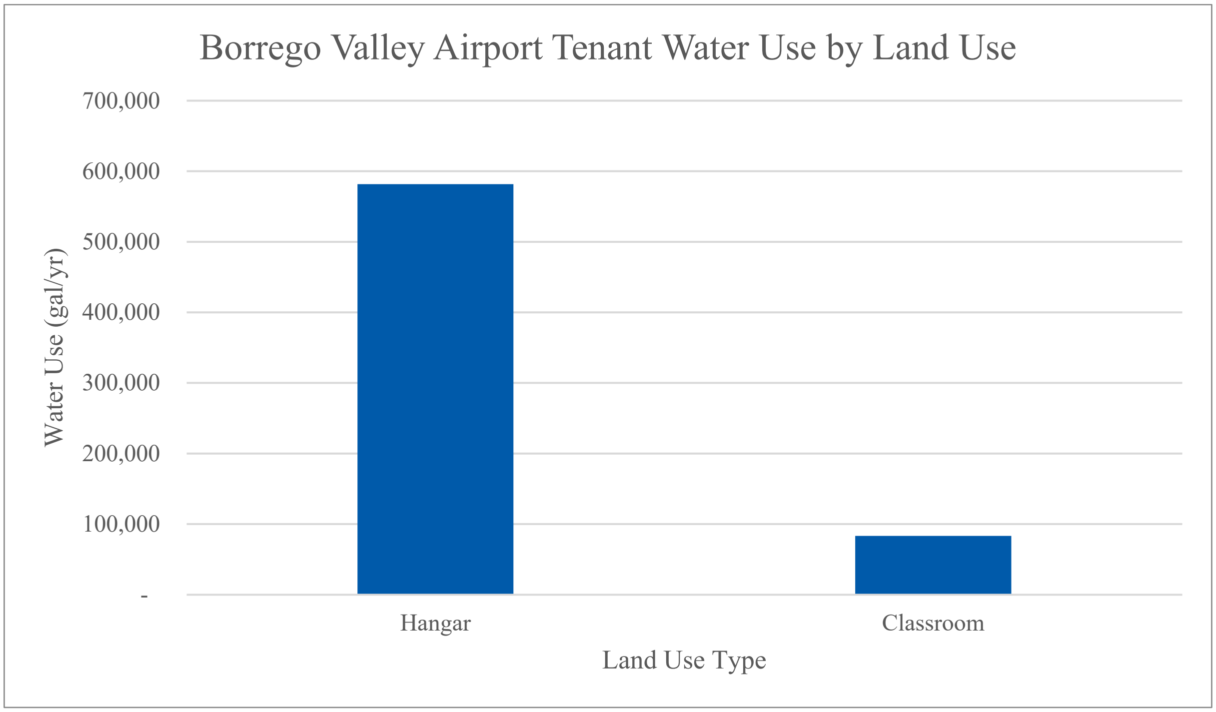

Figure 41 – Borrego Tenant Water Use by Use Typology

Table 22 - Borrego Tenant Water Use by Use Typology

Use Typology	Water Use (gal/yr)
Hangar	581,774
Classroom	83,317

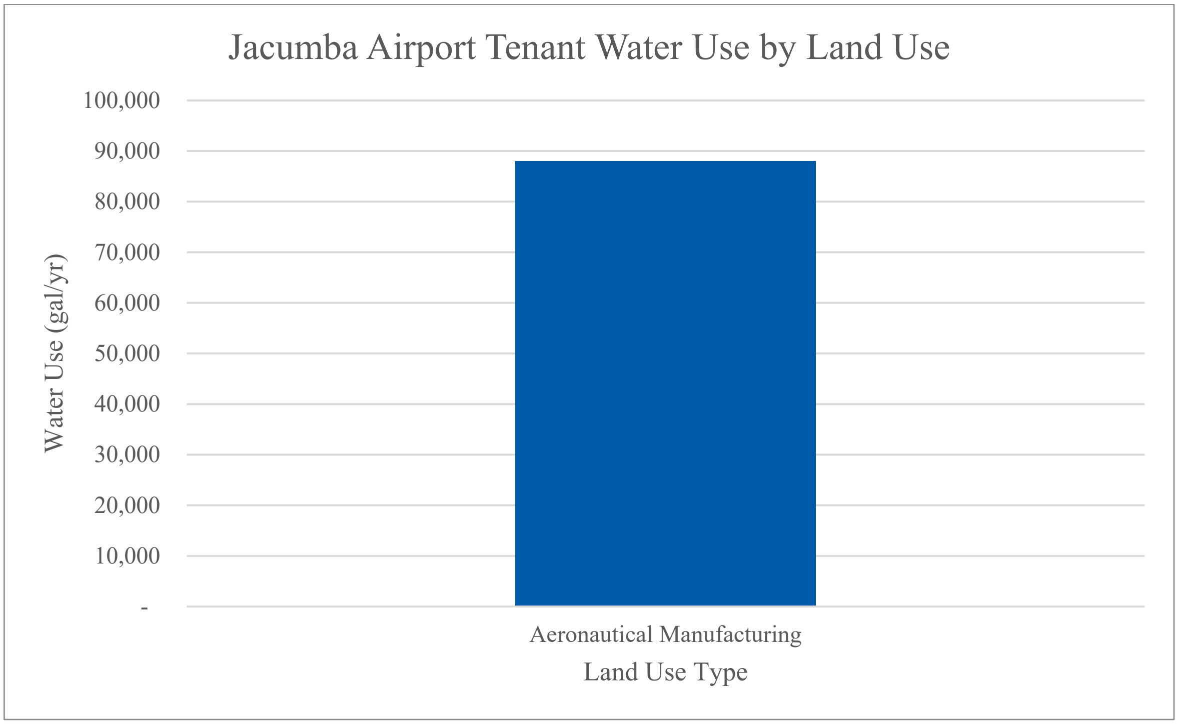

Figure 42 - Jacumba Tenant Water Use by Use Typology

Table 23 - Jacumba Tenant Water Use by Use Typology

Use Typology	Water Use (gal/yr)
Aeronautical Manufacturing	87,975

A.3.3 Solid Waste

The following figures show the tenant water use broken down by Use Typology.

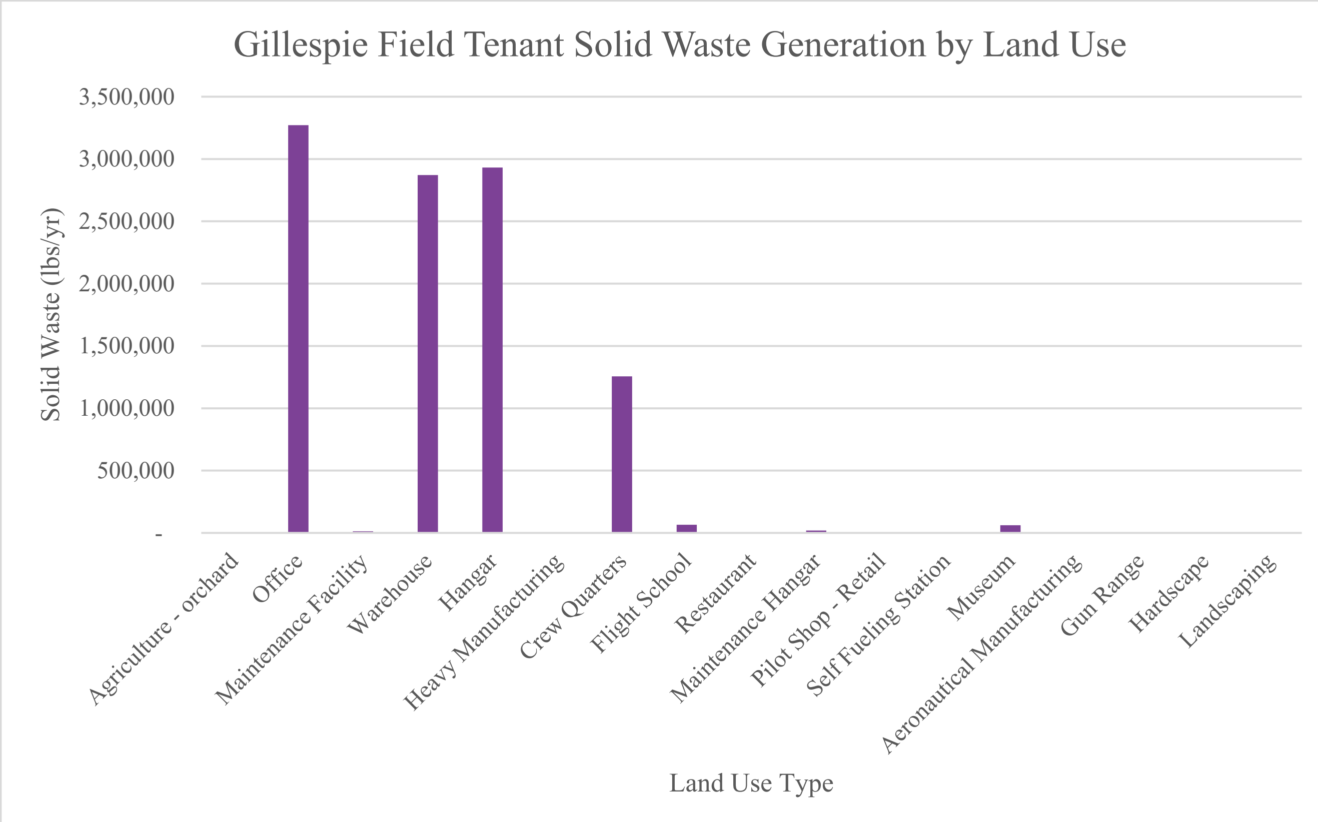

Figure 43 - Gillespie Tenant Solid Waste Generation by Use Typology

Table 24 - Gillespie Tenant Solid Waste Generation by Use Typology

Use Typology	Solid Waste (lbs/yr)
Agriculture - orchard	-
Office	3,271,455
Maintenance Facility	12,679
Warehouse	2,871,539
Hangar	2,931,967
Heavy Manufacturing	-
Crew Quarters	1,255,923
Flight School	65,405
Restaurant	4,229
Maintenance Hangar	19,256
Pilot Shop - Retail	-
Self Fueling Station	4,284
Museum	61,425
Aeronautical Manufacturing	-
Gun Range	-
Hardscape	-
Landscaping	-

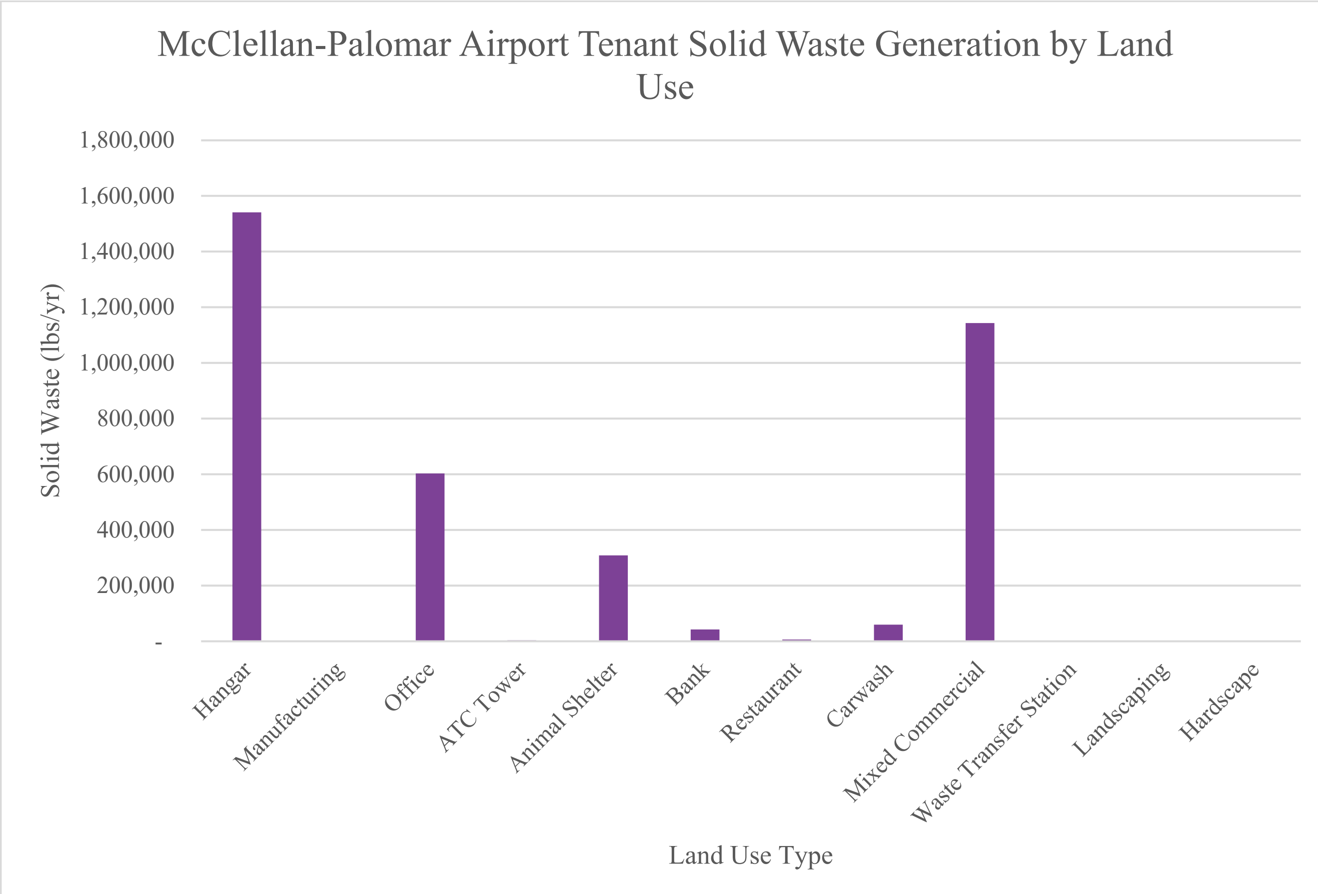

Figure 44 - McClellan-Palomar Tenant Solid Waste Generation by Use Typology

Table 25 - McClellan-Palomar Tenant Solid Waste Generation by Use Typology

Use Typology	Solid Waste (lbs/yr)
Hangar	1,540,982
Manufacturing	-
Office	602,876
ATC Tower	3,418
Animal Shelter	308,354
Bank	42,282
Restaurant	6,224
Carwash	59,671
Mixed Commercial	1,143,243
Waste Transfer Station	-
Landscaping	-
Hardscape	-

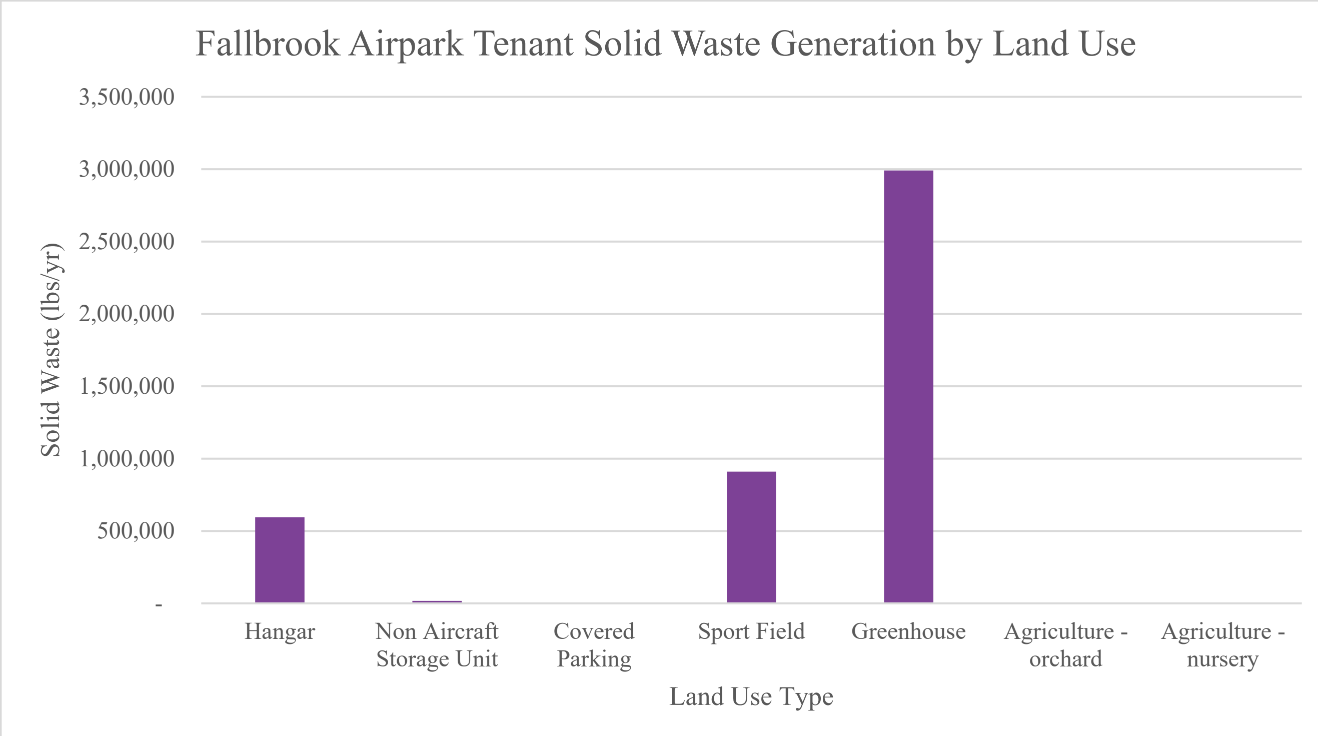

Figure 45 - Fallbrook Tenant Solid Waste Generation by Use Typology

Table 26 - Fallbrook Solid Waste Generation by Use Typology

Use Typology	Solid Waste (lbs/yr)
Hangar	594,888
Non Aircraft Storage Unit	17,227
Covered Parking	-
Sport Field	910,561
Greenhouse	2,991,282
Agriculture - orchard	-
Agriculture - nursery	-

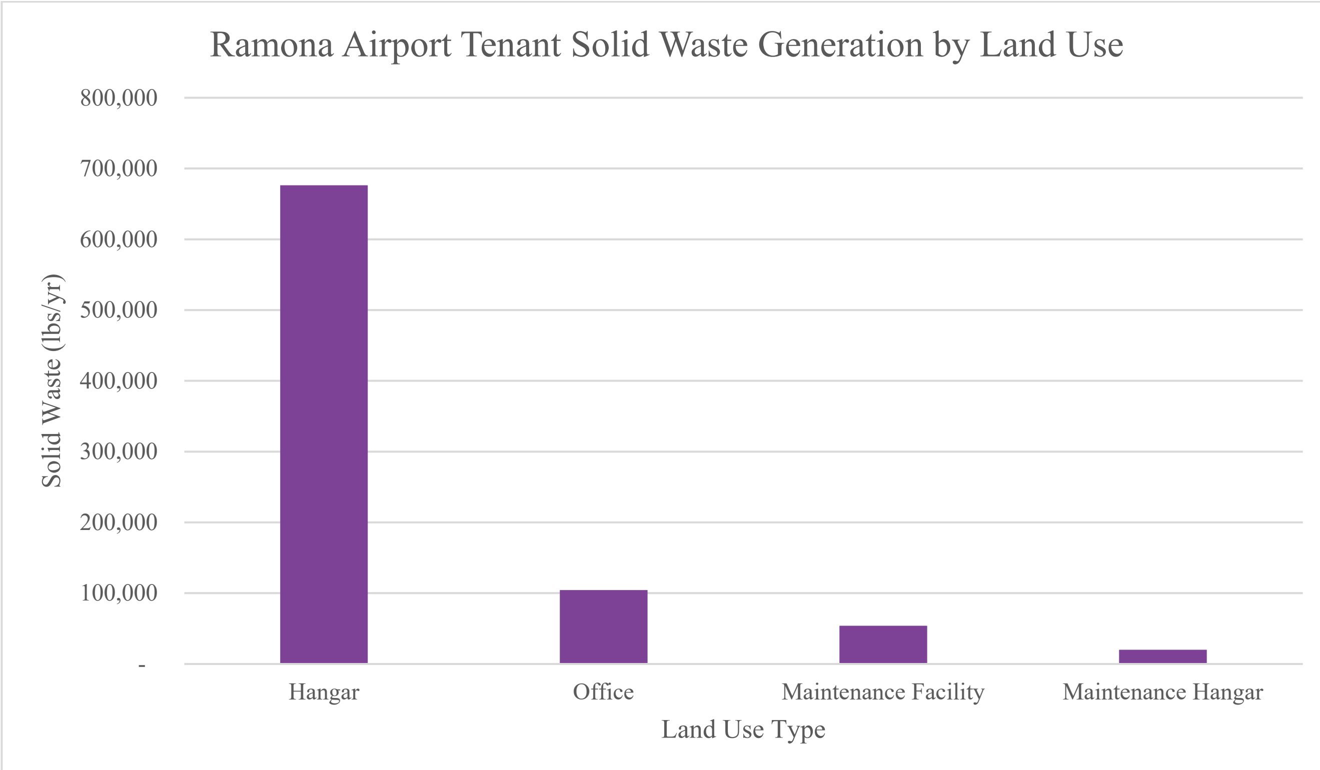

Figure 46 - Ramona Tenant Solid Waste Generation by Use Typology

Table 27 - Ramona Tenant Solid Waste Generation by Use Typology

Use Typology	Solid Waste (lbs/yr)
Hangar	676,201
Office	104,394
Maintenance Facility	54,051
Maintenance Hangar	20,048

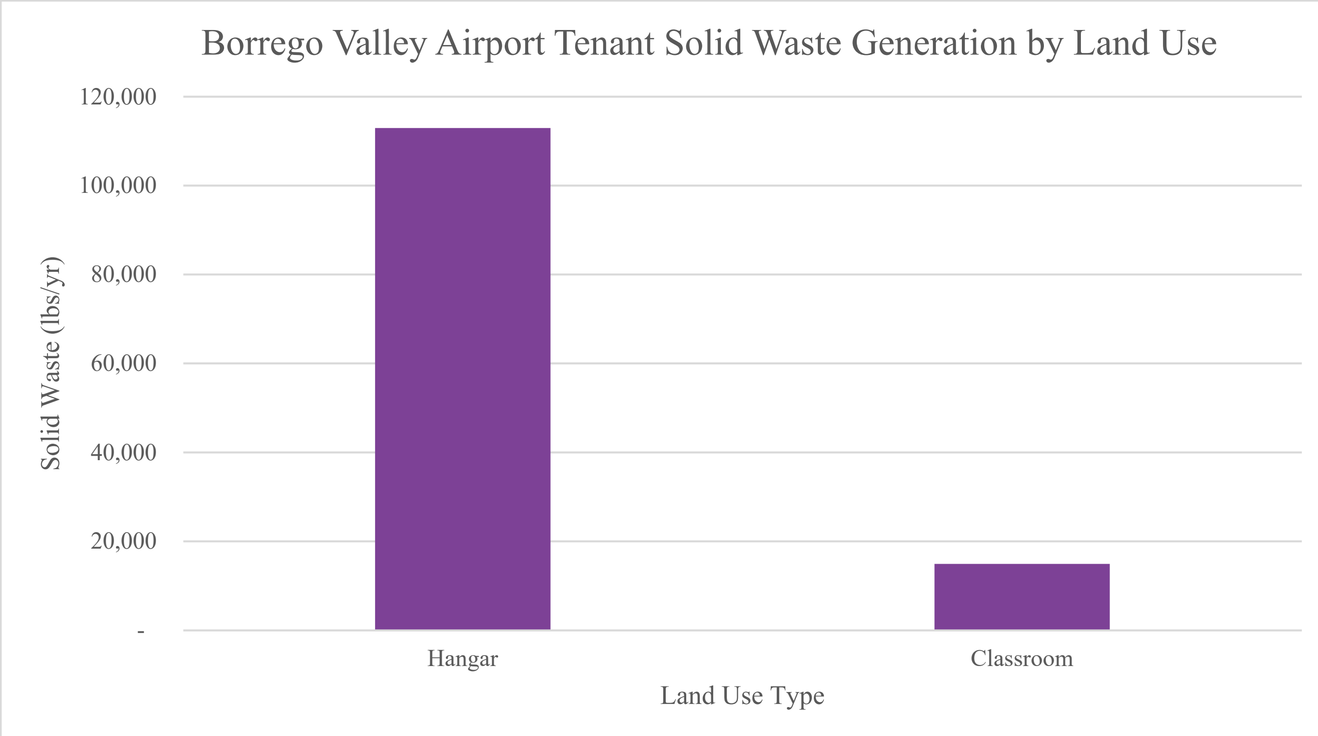

Figure 47 - Borrego Tenant Solid Waste Generation by Use Typology

Table 28 - Borrego Tenant Solid Waste Generation by Use Typology

Use Typology	Solid Waste (lbs/yr)
Hangar	112,933
Classroom	14,940

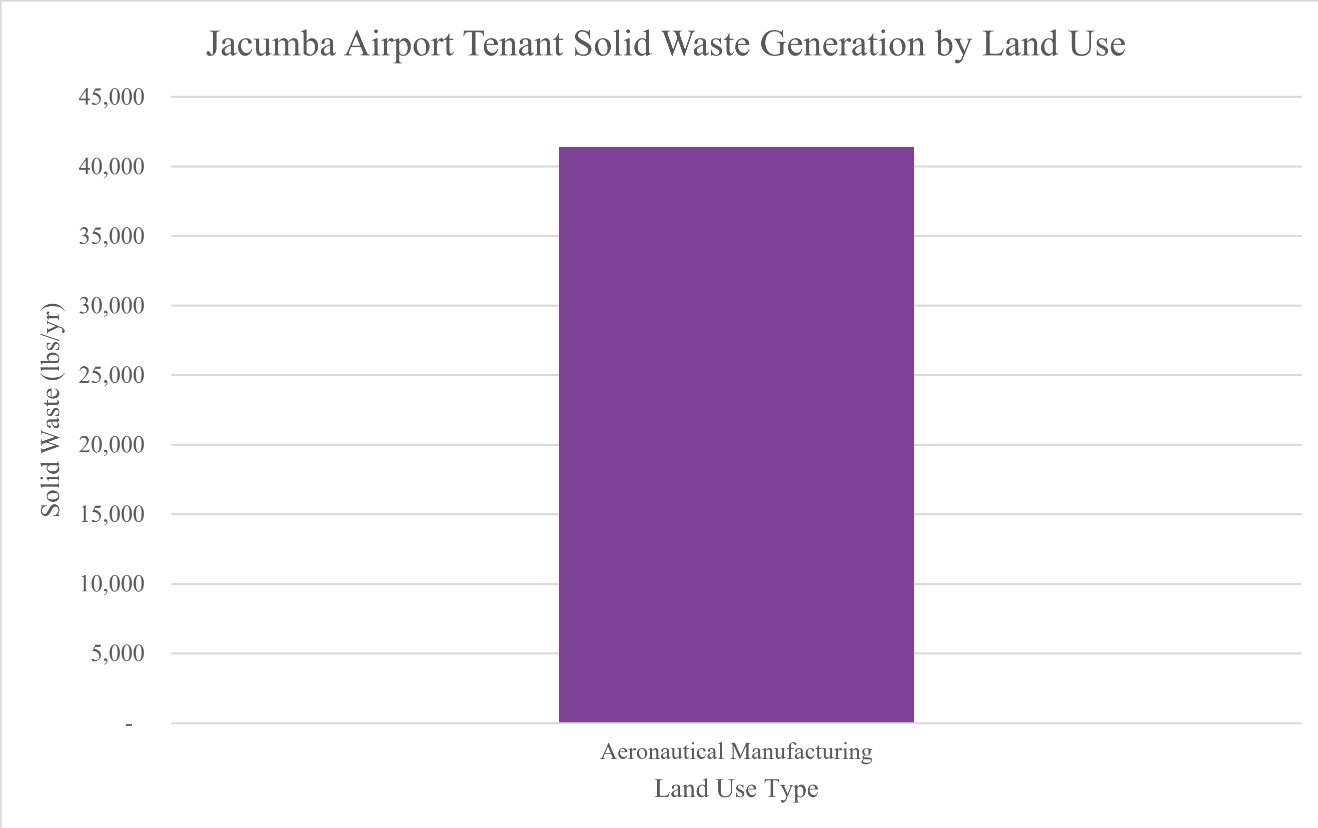

Figure 48 - Jacumba Tenant Wastewater by Use Typology

Table 29 - Jacumba Tenant Solid Waste Generation by Use Typology

Use Typology	Solid Waste (lbs/yr)
Aeronautical Manufacturing	41,400

A.3.4 Wastewater

The following figures show the tenant wastewater broken down by Use Typology.

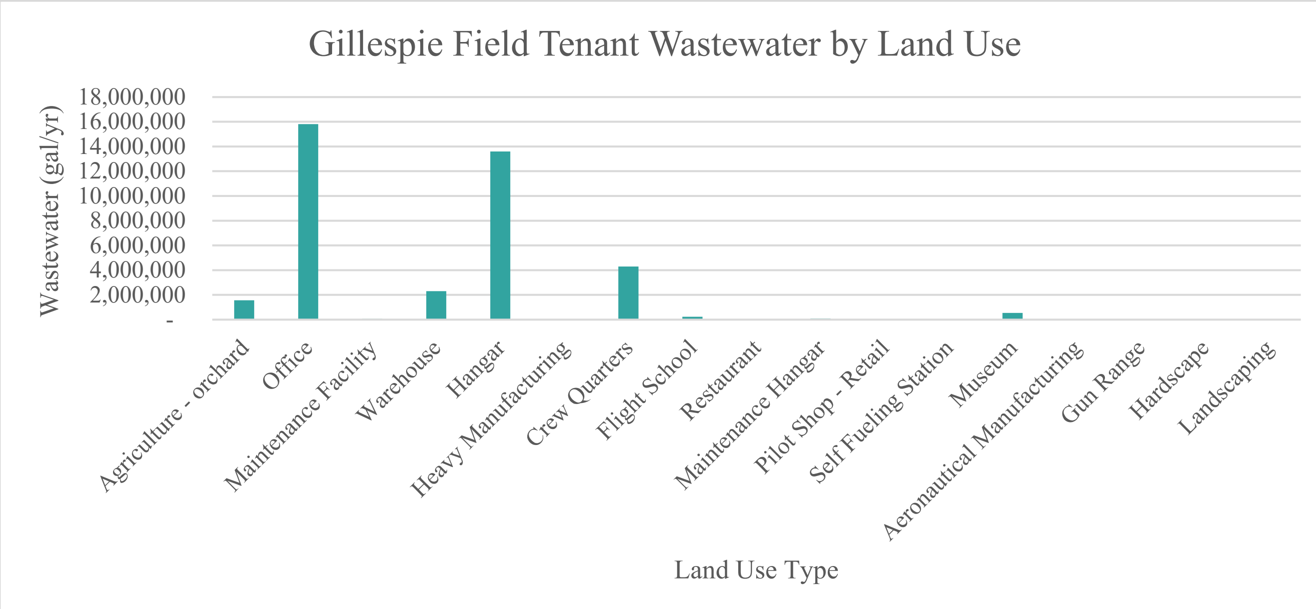

Figure 49 - Gillespie Tenant Wastewater by Use Typology

Table 30 - Gillespie Tenant Wastewater by Use Typology

Use Typology	Wastewater (gal/yr)
Agriculture - orchard	1,562,110
Office	15,812,032
Maintenance Facility	58,783
Warehouse	2,304,992
Hangar	13,593,667
Heavy Manufacturing	-
Crew Quarters	4,299,121
Flight School	237,095
Restaurant	53,921
Maintenance Hangar	89,276
Pilot Shop - Retail	-
Self Fueling Station	9,639
Museum	536,445
Aeronautical Manufacturing	-
Gun Range	-
Hardscape	-
Landscaping	-

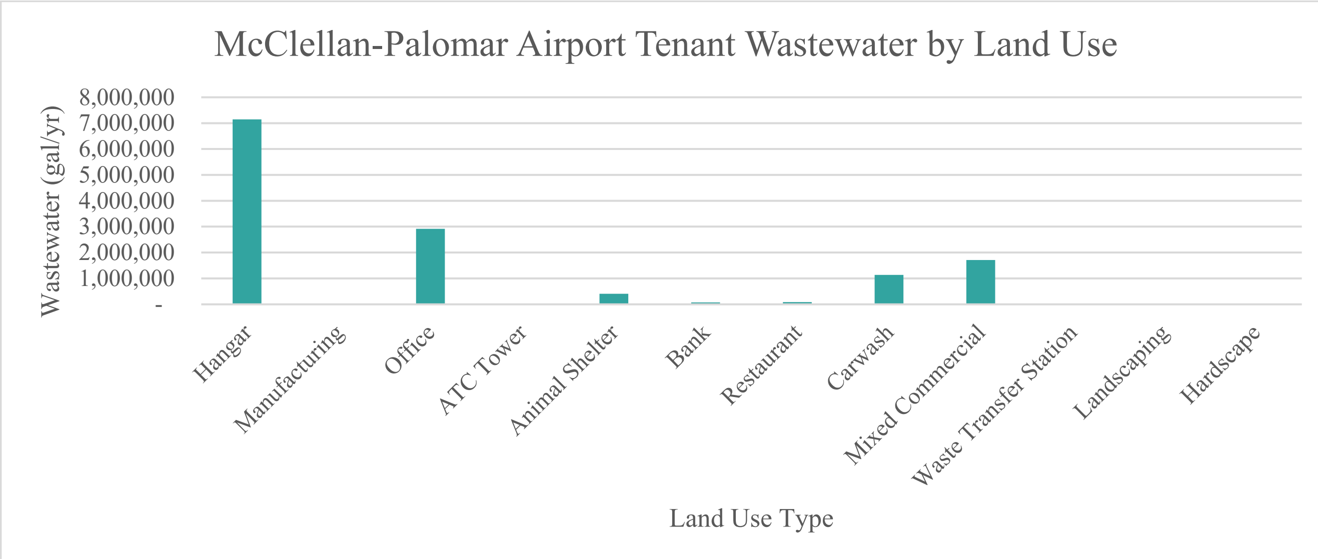

Figure 50 - McClellan-Palomar Tenant Wastewater by Use Typology

Table 31 - McClellan-Palomar Tenant Wastewater by Use Typology

Use Typology	Wastewater (gal/yr)
Hangar	7,144,554
Manufacturing	-
Office	2,913,901
ATC Tower	19,370
Animal Shelter	403,232
Bank	67,154
Restaurant	79,361
Carwash	1,134,000
Mixed Commercial	1,709,821
Waste Transfer Station	-
Landscaping	-
Hardscape	-

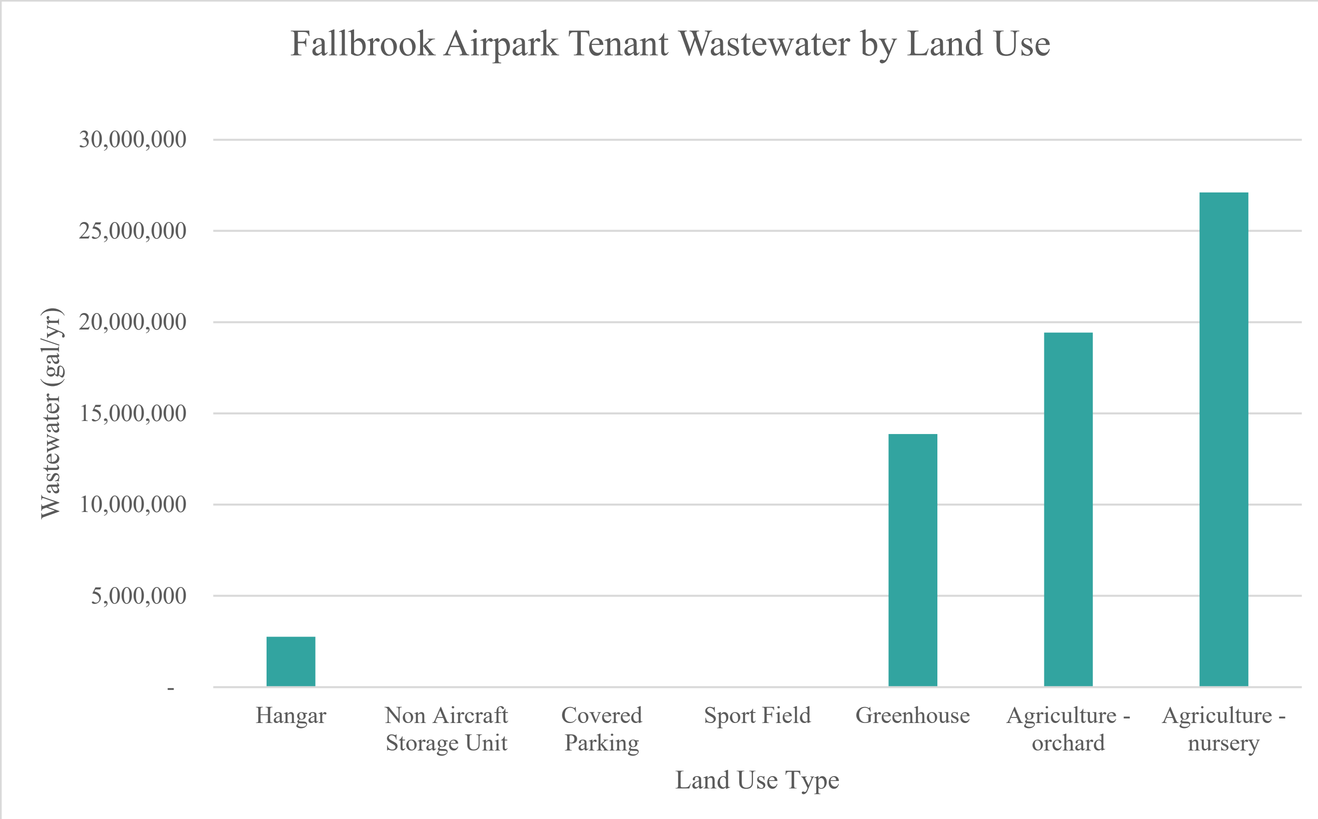

Figure 51 - Fallbrook Tenant Wastewater by Use Typology

Table 32 - Fallbrook Tenant Wastewater by Use Typology

Use Typology	Wastewater (gal/yr)
Hangar	2,758,116
Non Aircraft Storage Unit	13,828
Covered Parking	-
Sport Field	-
Greenhouse	13,868,670
Agriculture - orchard	19,425,413
Agriculture - nursery	27,112,312

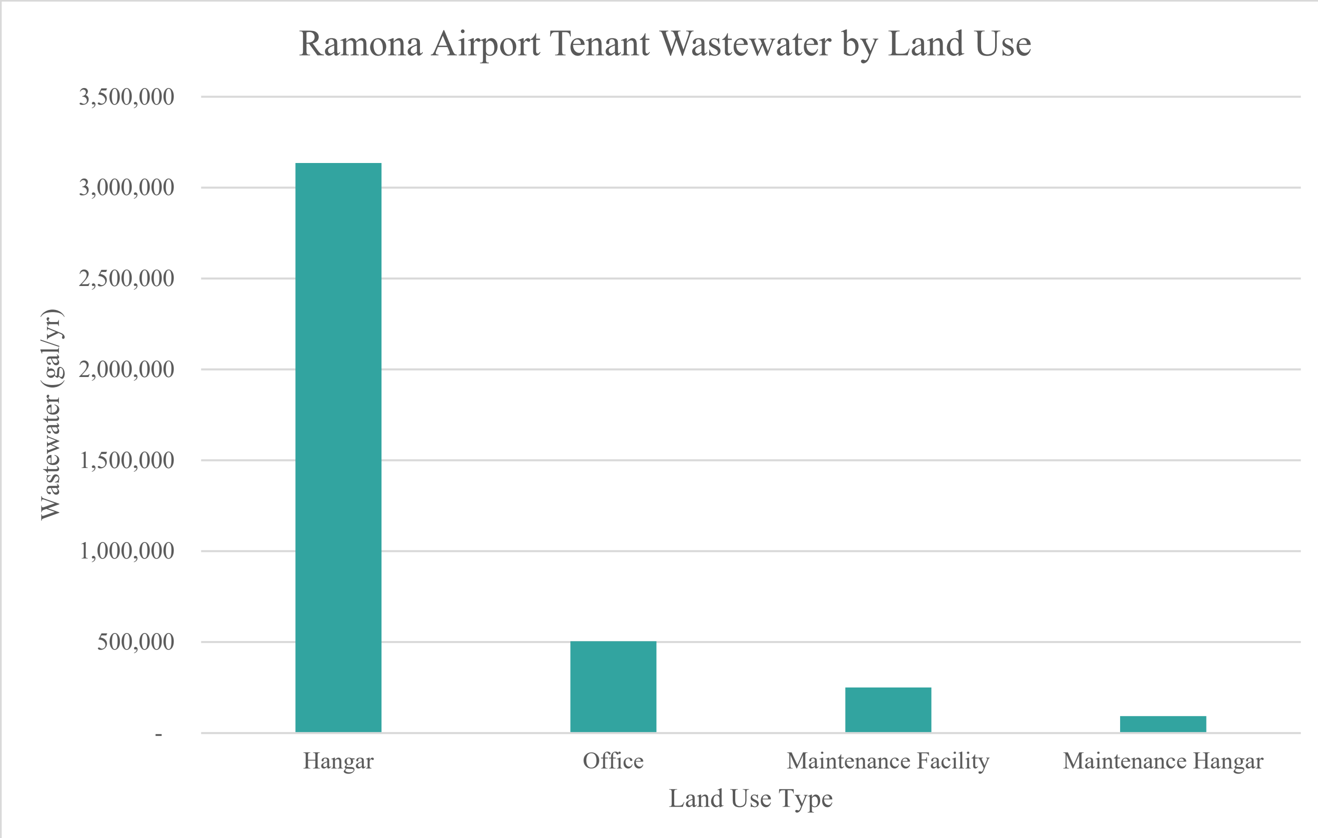

Figure 52 - Ramona Tenant Wastewater by Use Typology

Table 33 - Ramona Tenant Wastewater by Use Typology

Use Typology	Wastewater (gal/yr)
Hangar	3,135,115
Office	504,572
Maintenance Facility	250,599
Maintenance Hangar	92,948

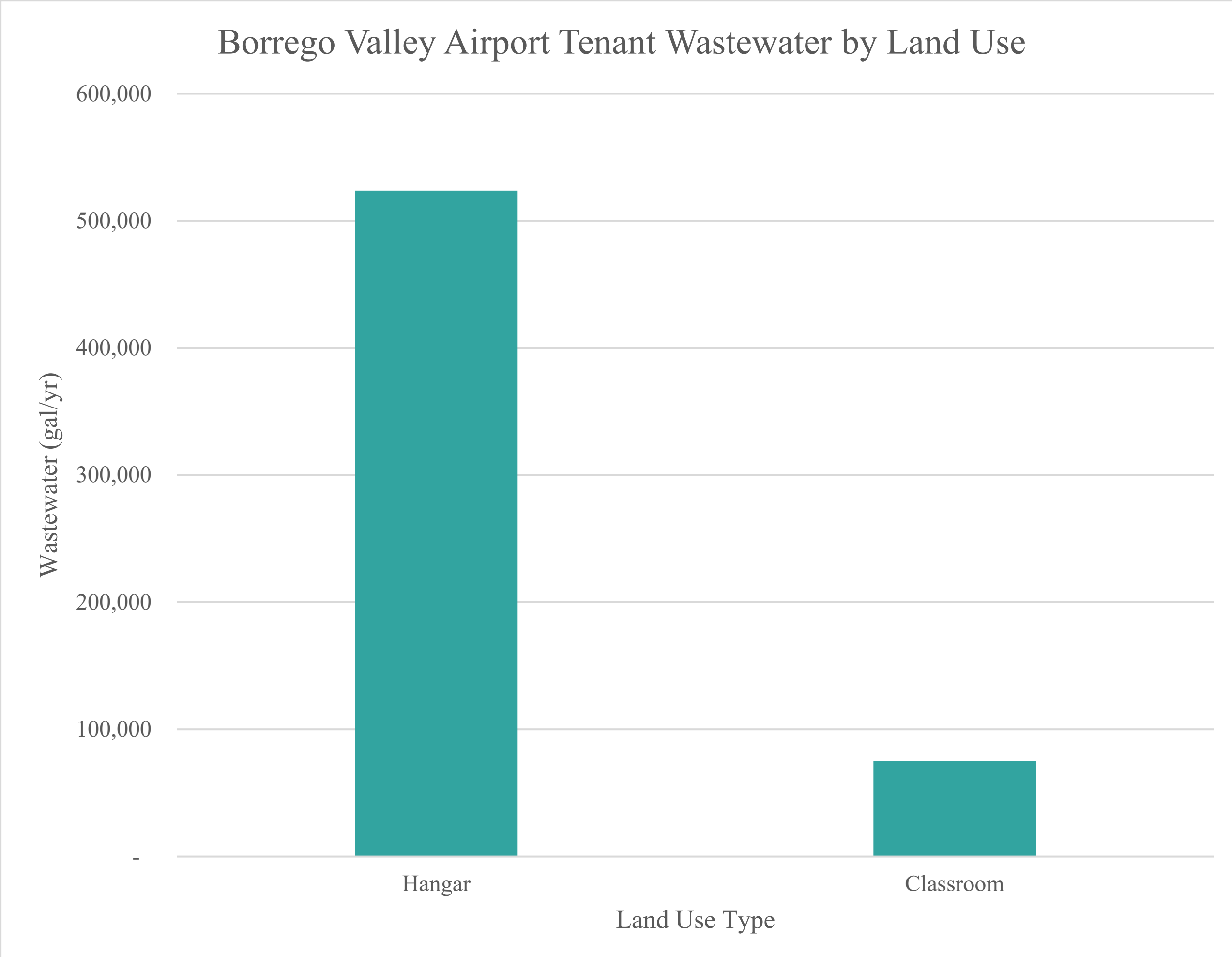

Figure 53 - Borrego Tenant Wastewater by Use Typology

Table 34 - Borrego Tenant Wastewater by Use Typology

Use Typology	Wastewater (gal/yr)
Hangar	523,597
Classroom	74,985

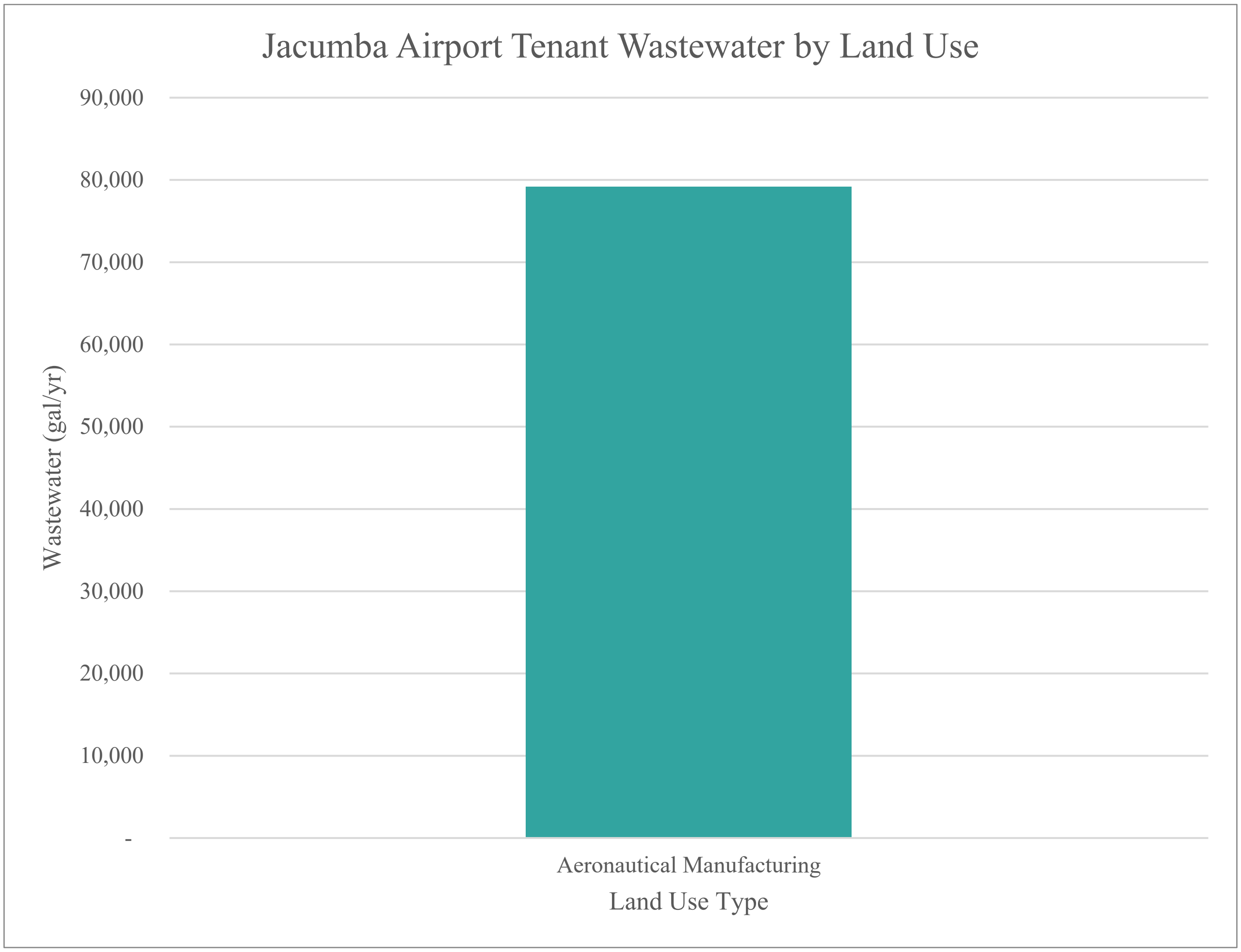

Figure 54 - Jacumba Tenant Wastewater by Use Typology

Table 35 - Jacumba Tenant Wastewater by Use Typology

Use Typology	Wastewater (gal/yr)
Aeronautical Manufacturing	79,178

A.4 Replica Trip Length Histogram and Trip Origin Heat Map Results

Ramona

Thursday, Spring 2021

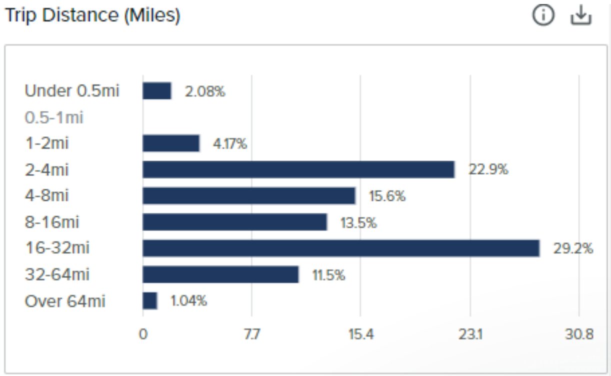

Figure 55 - Replica Trip Distance Histogram for Ramona Airport, Thursday, Spring 2021

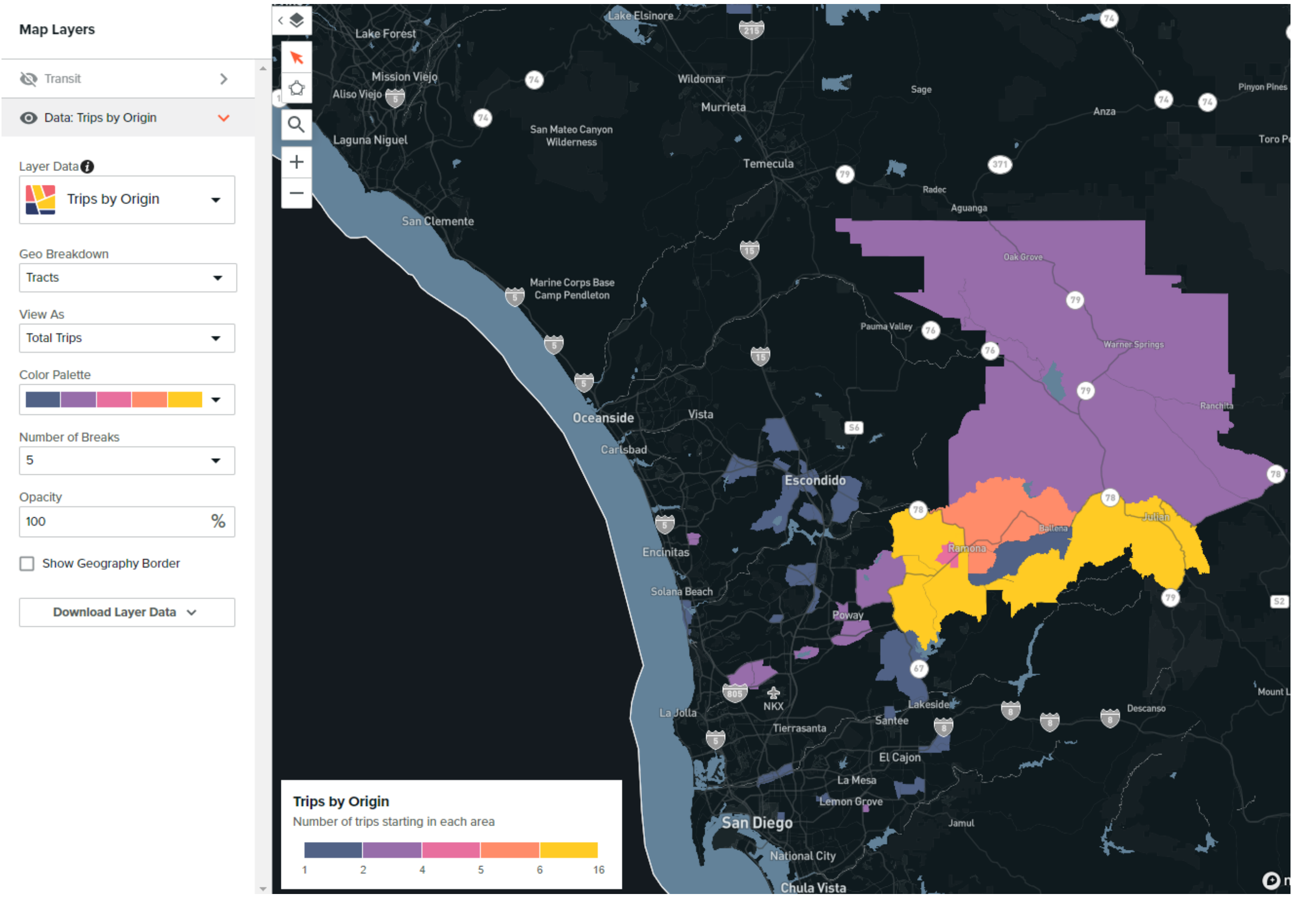

Figure 56 - Replica Trip Origin Heat Map for Ramona Airport, Thursday, Spring 2021

Saturday, Spring 2021

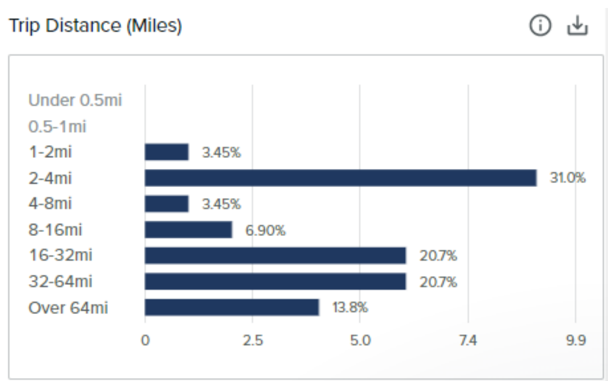

Figure 57 - Replica Trip Distance Histogram for Ramona Airport, Saturday, Spring 2021

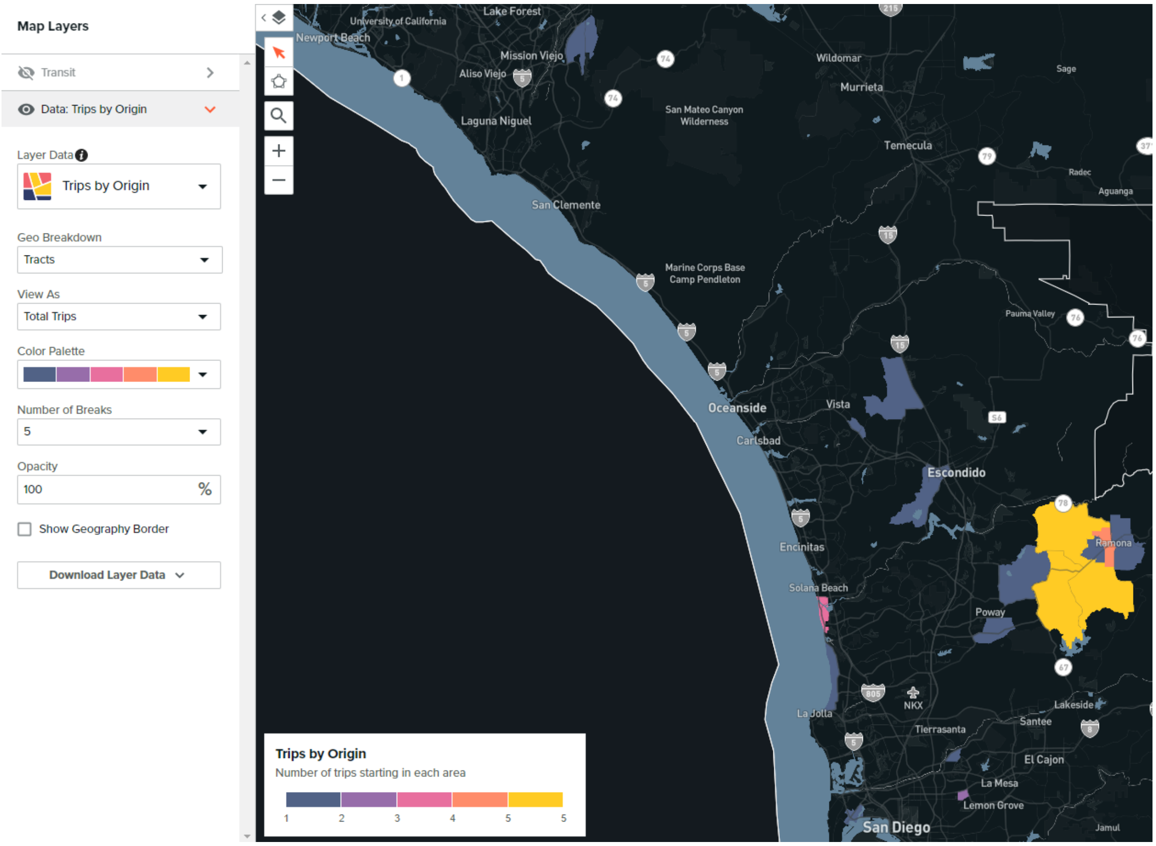

Figure 58 - Replica Trip Origin Heat Map for Ramona Airport, Saturday, Spring 2021

Thursday, Fall 2021

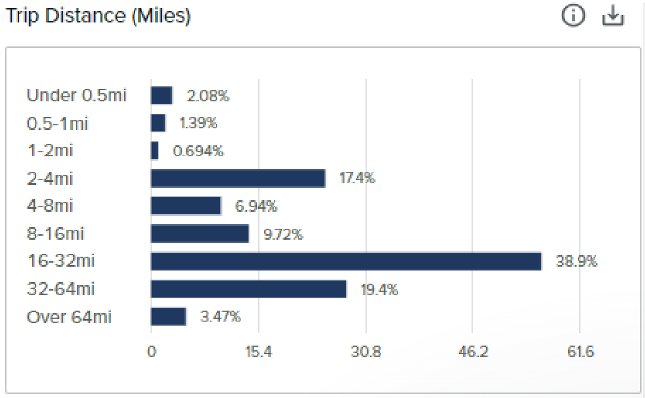

Figure 59 - Replica Trip Distance Histogram for Ramona Airport, Thursday, Fall 2021

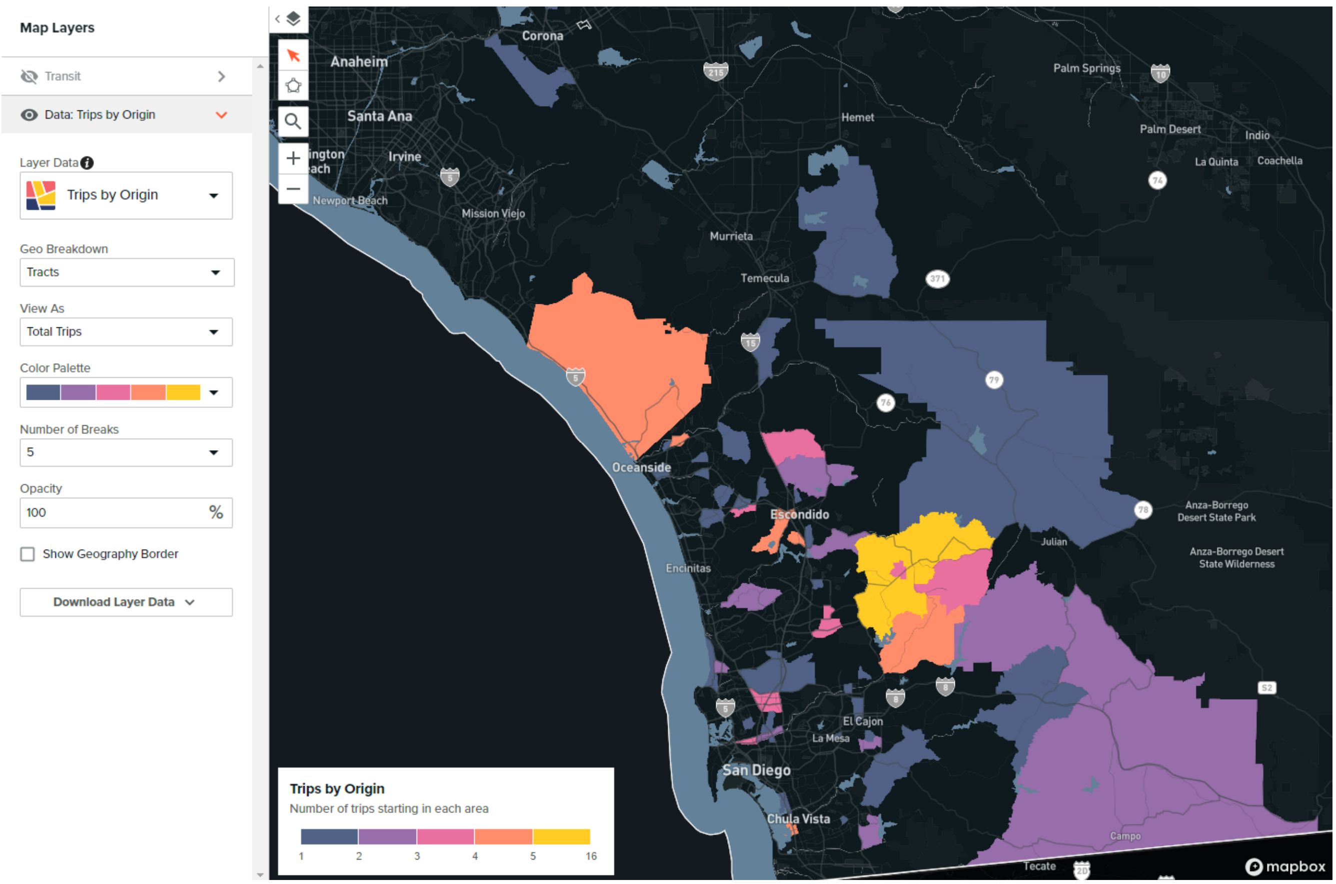

Figure 60 - Replica Trip Origin Heat Map for Ramona Airport, Thursday, Fall 2021

Saturday, Fall 2021

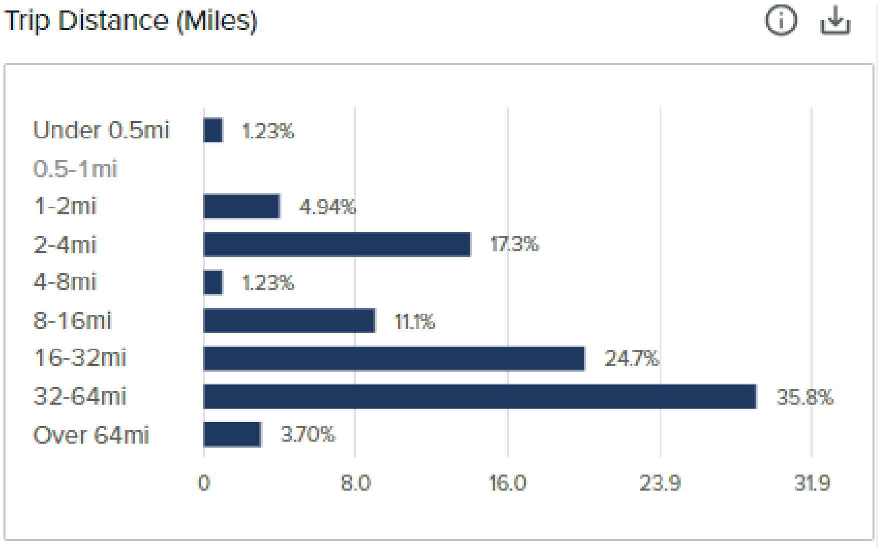

Figure 61 - Replica Trip Distance Histogram for Ramona Airport, Saturday, Fall 2021

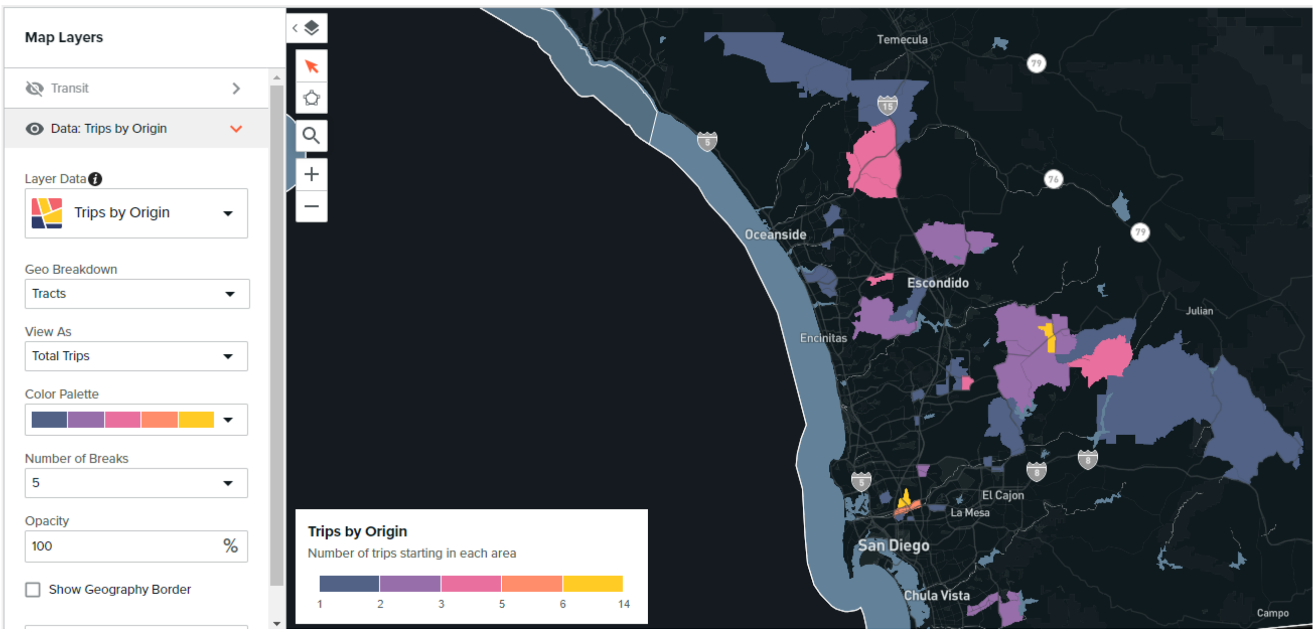

Figure 62 - Replica Trip Origin Heat Map for Ramona Airport, Saturday, Fall 2021

Fallbrook

Thursday, Spring 2021

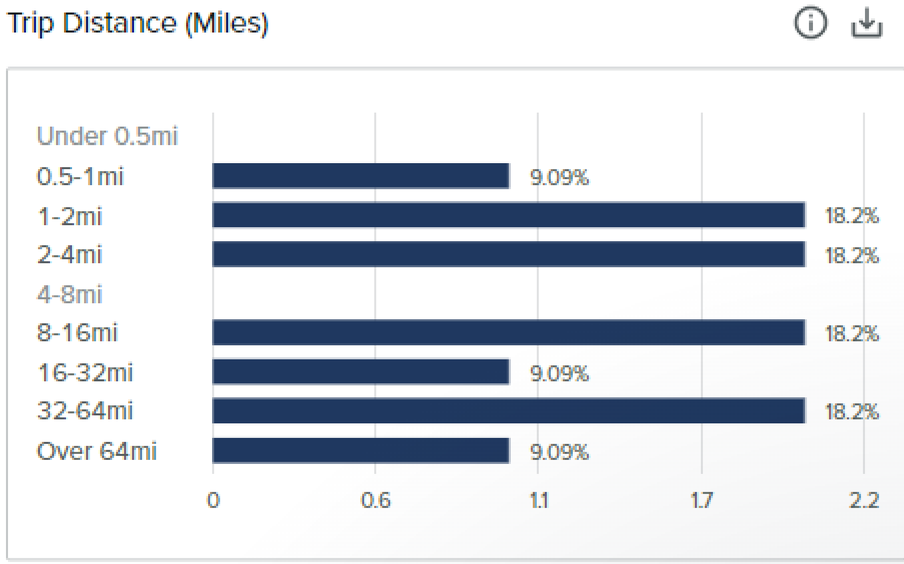

Figure 63 - Replica Trip Distance Histogram for Fallbrook Airpark, Thursday, Spring 2021

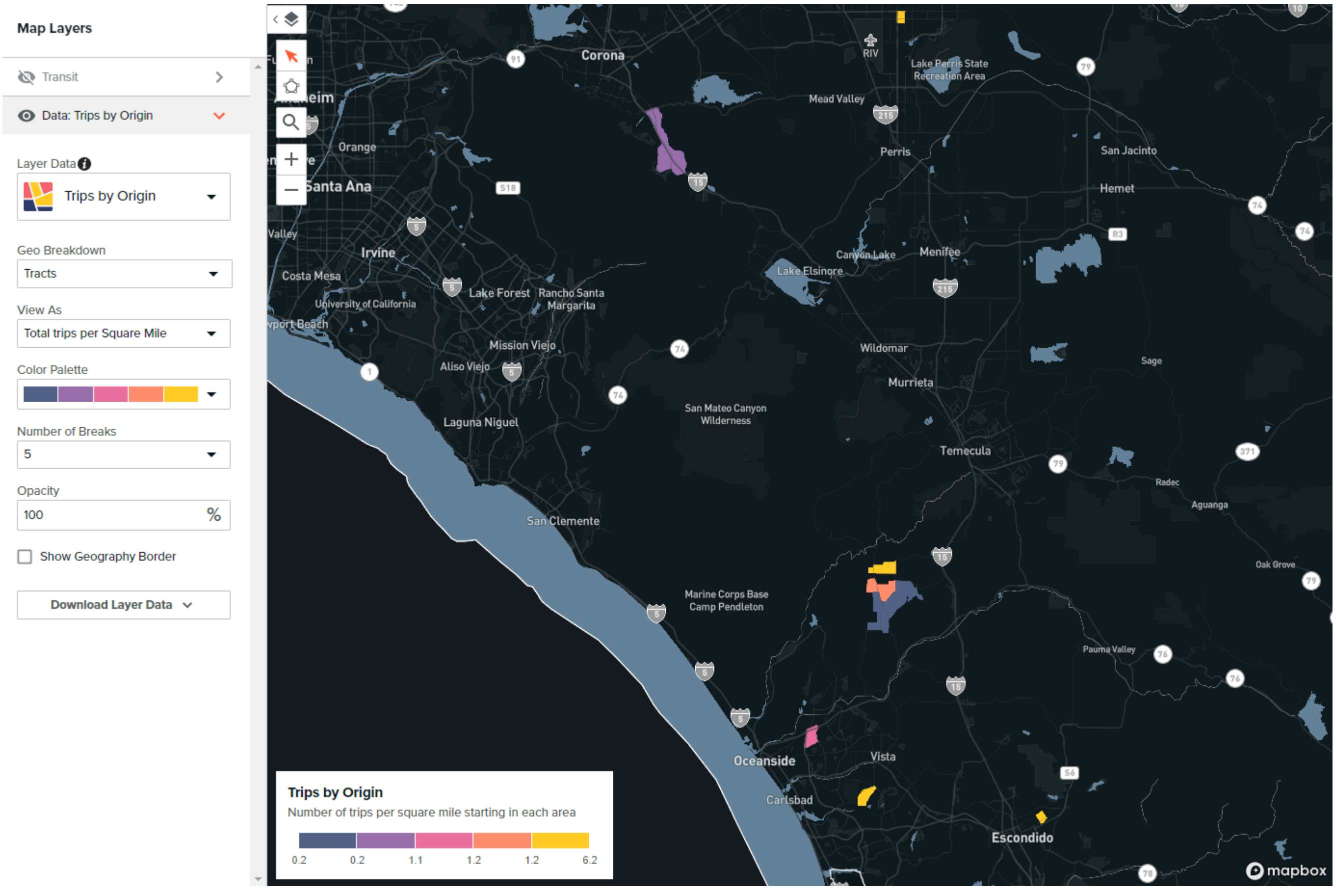

Figure 64 - Replica Trip Origin Heat Map for Fallbrook Airpark, Thursday, Spring 2021

Saturday, Spring 2021

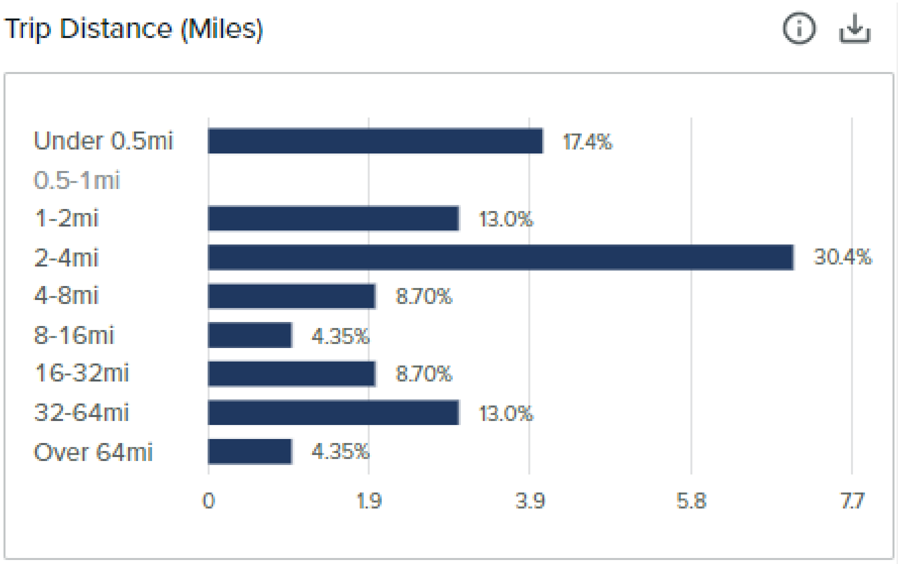

Figure 65 - Replica Trip Distance Histogram for Fallbrook Airpark, Saturday, Spring 2021

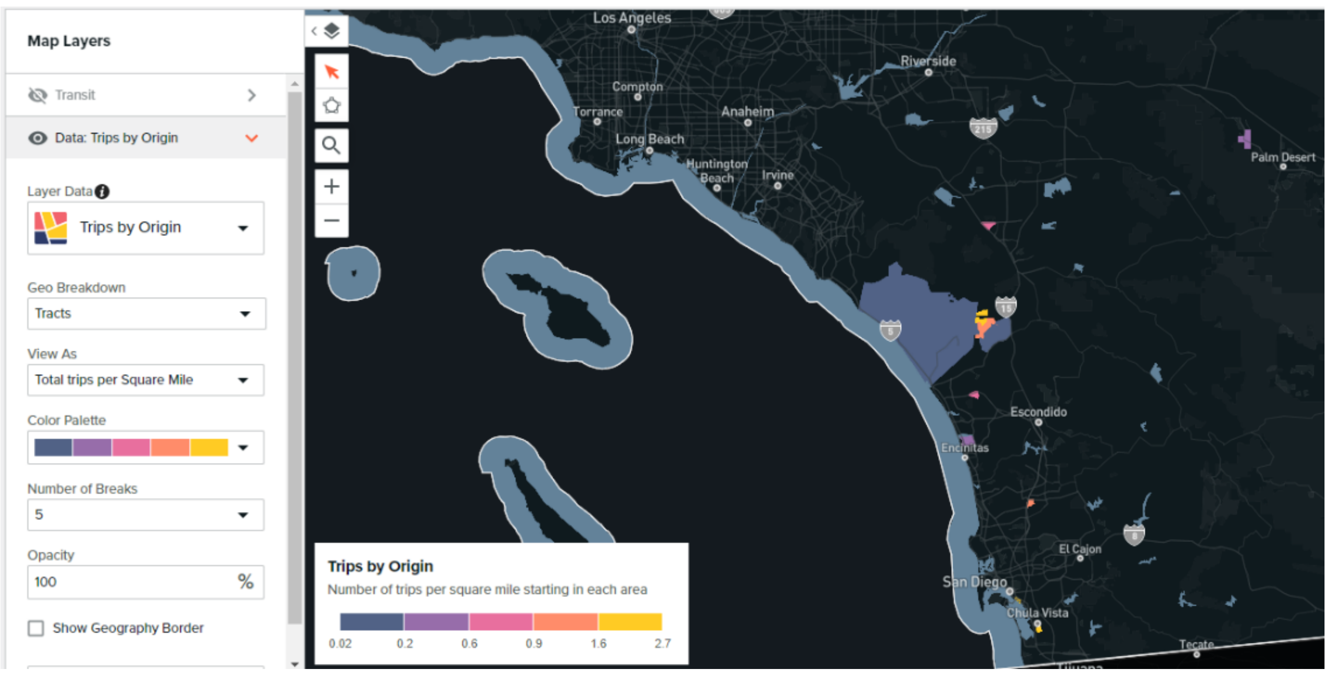

Figure 66 - Replica Trip Origin Heat Map for Fallbrook Airpark, Saturday, Spring 2021

Thursday, Fall 2021

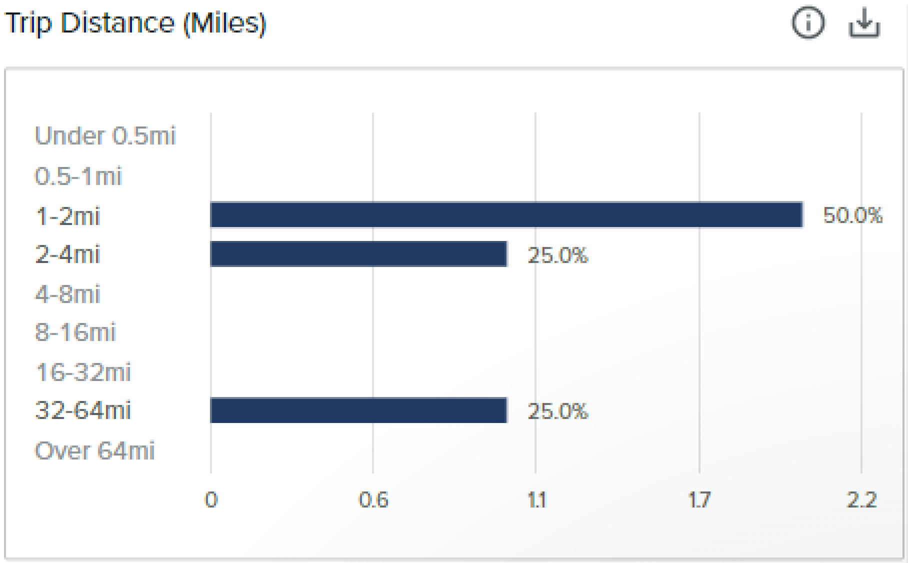

Figure 67 - Replica Trip Distance Histogram for Fallbrook Airpark, Thursday, Fall 2021

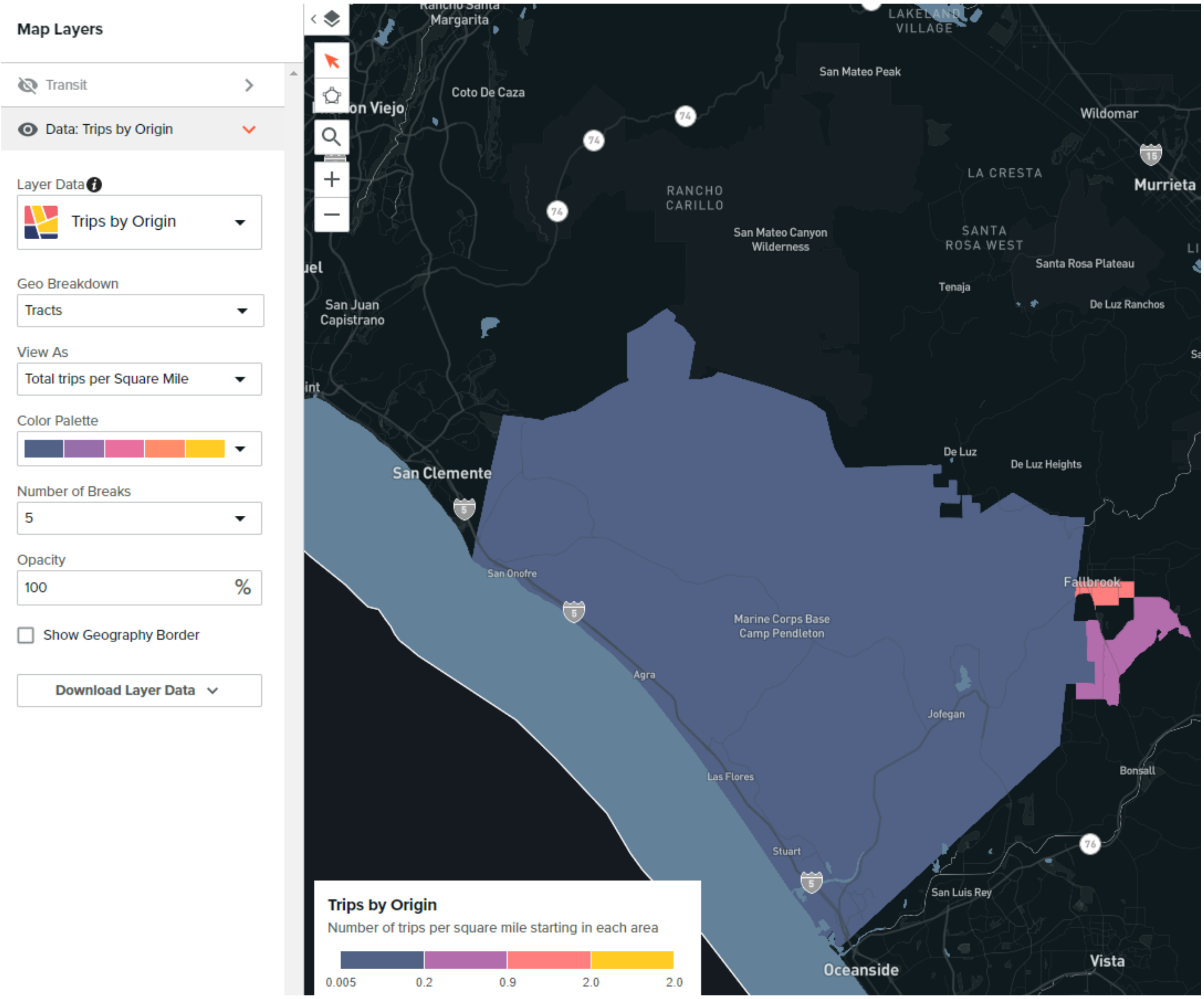

Figure 68 - Replica Trip Origin Heat Map for Fallbrook Airpark, Thursday, Fall 2021

Saturday, Fall 2021

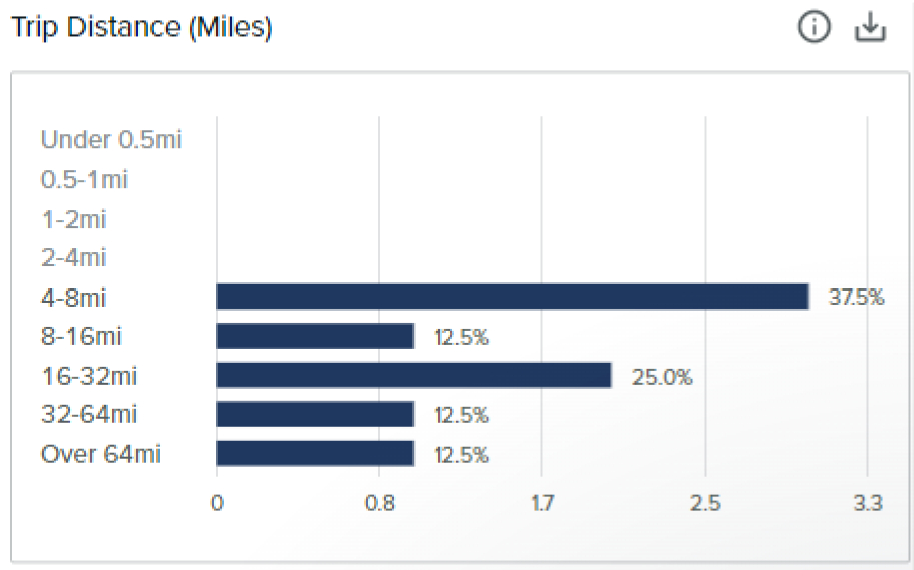

Figure 69 - Replica Trip Distance Histogram for Fallbrook Airpark, Saturday, Fall 2021

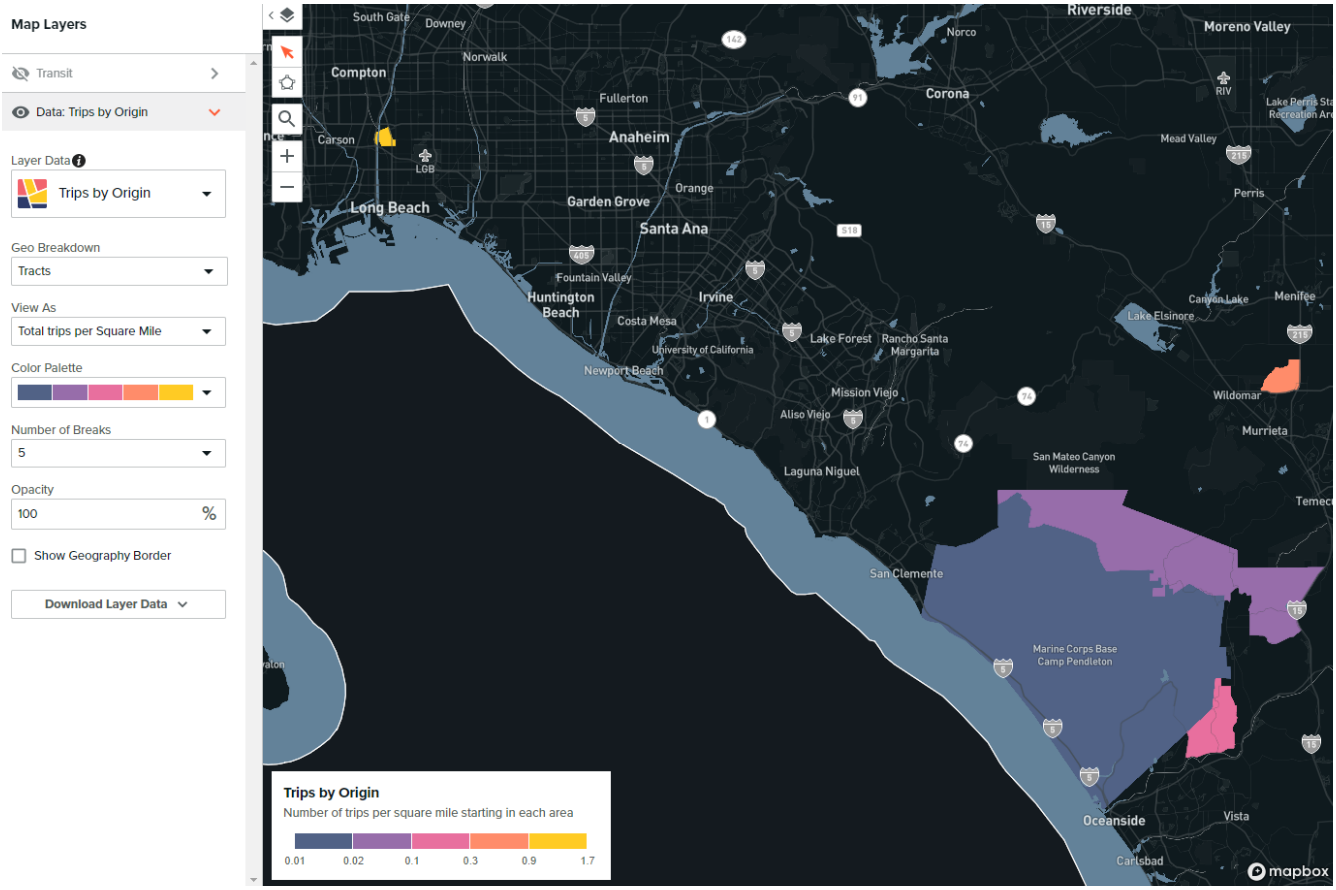

Figure 70 - Replica Trip Origin Heat Map for Fallbrook Airpark, Saturday, Fall 2021

Jacumba

Thursday / Saturday, Spring 2021

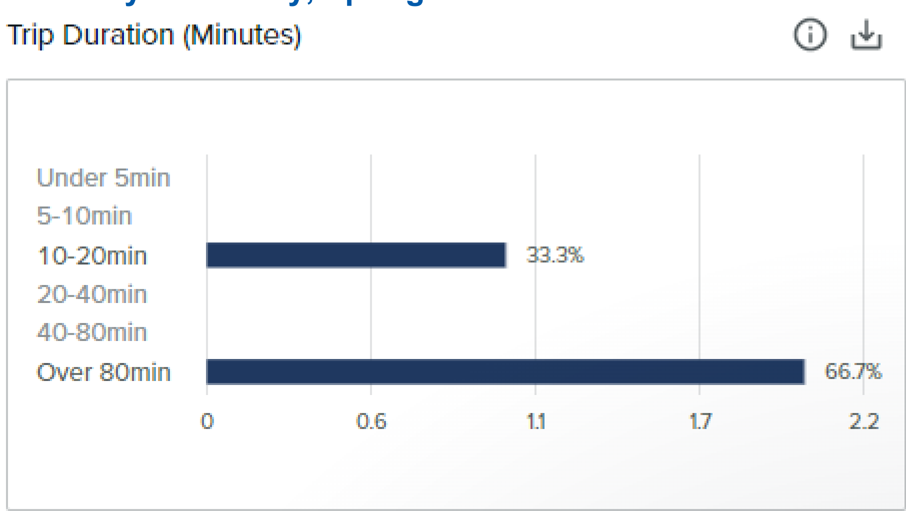

Figure 71 - Replica Trip Distance Histogram for Jacumba Airport, Thursday/Saturday, Spring 2021

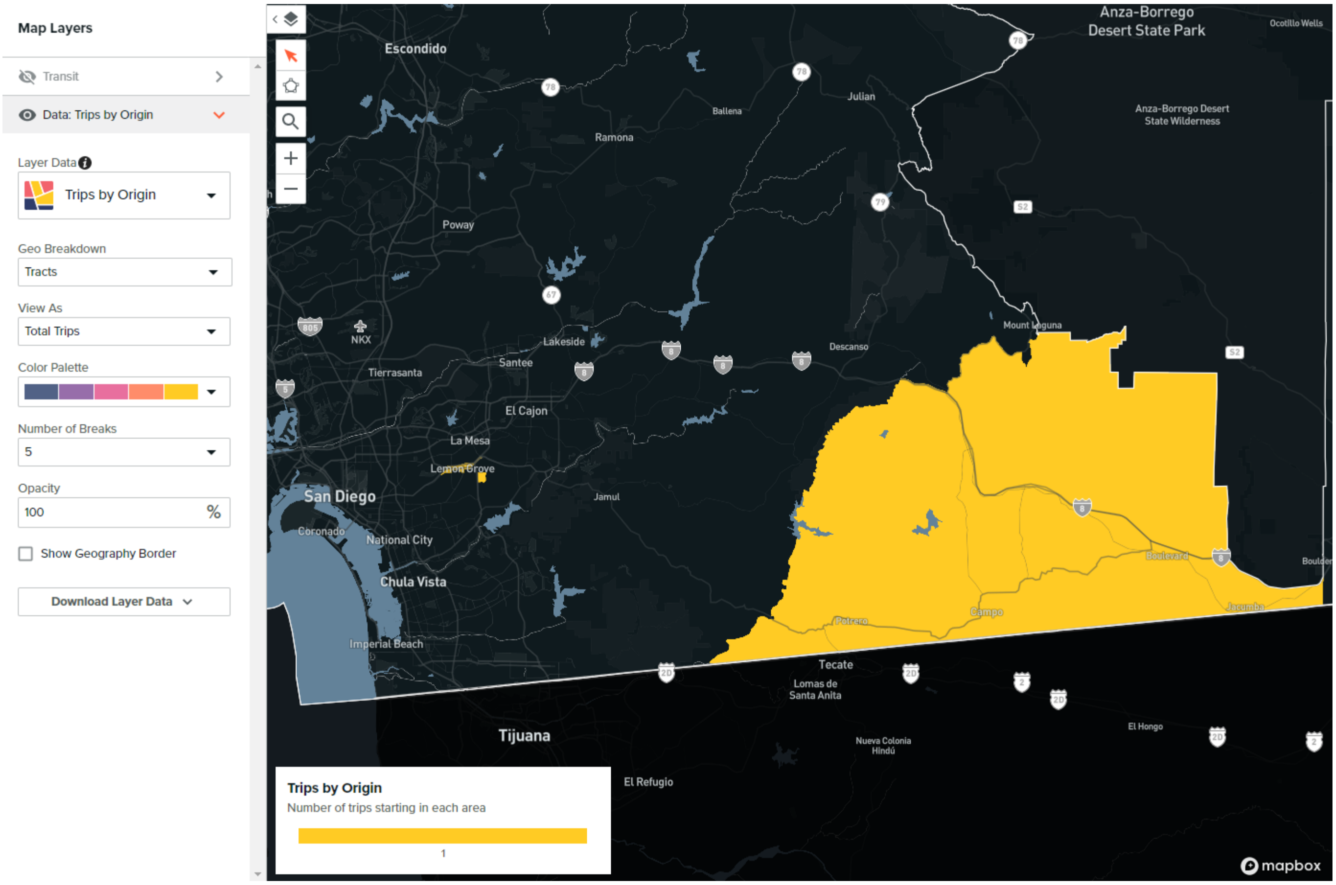

Figure 72 - Replica Trip Origin Heat Map for Jacumba Airport, Thursday/Saturday, Spring 2021

Thursday/Saturday, Fall 2021

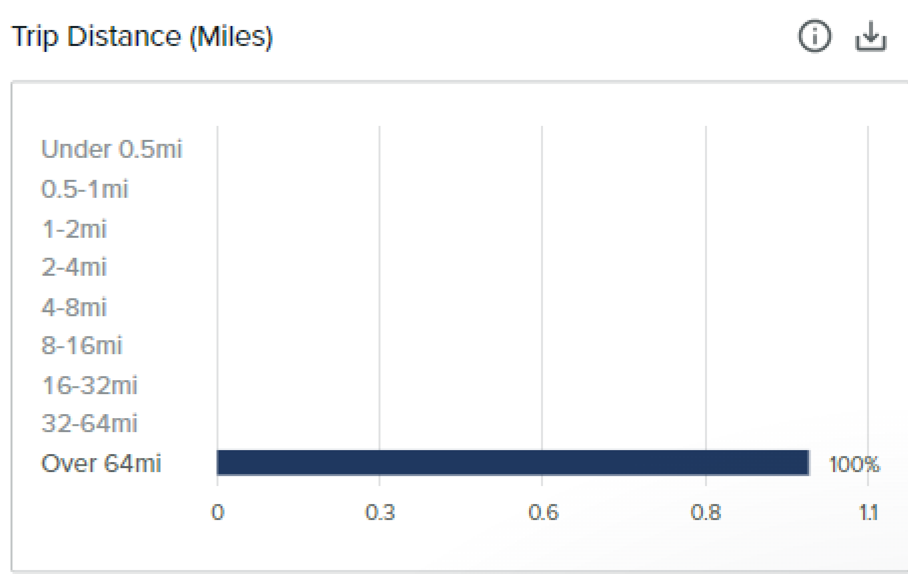

Figure 73 - Replica Trip Distance Histogram for Jacumba Airport, Thursday/Saturday, Fall 2021

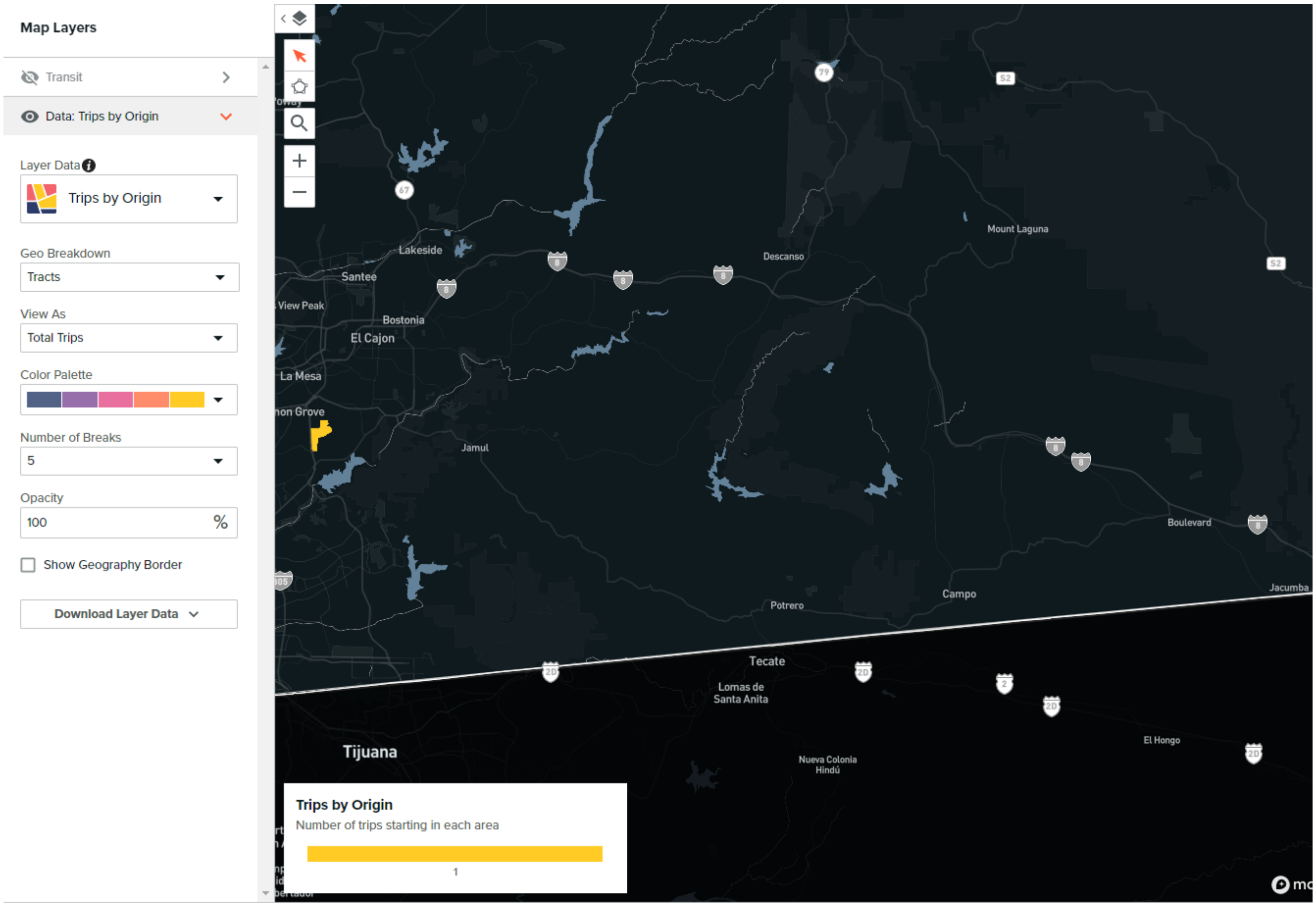

Figure 74 - Replica Trip Origin Heat Map for Jacumba Airport, Thursday/Saturday, Fall 2021

McClellan-Palomar

Thursday, Spring 2021

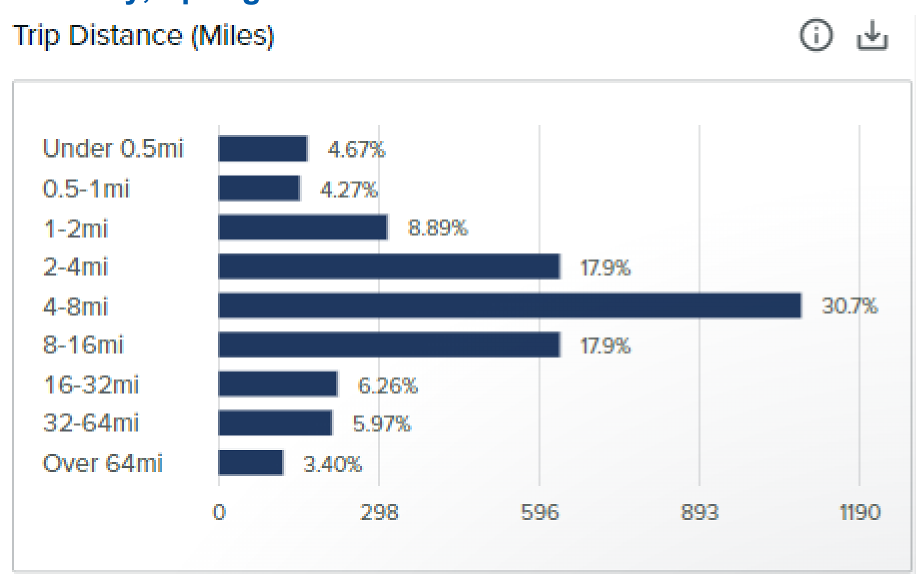

Figure 75 - Replica Trip Distance Histogram for McClellan-Palomar Airport, Thursday, Spring 2021

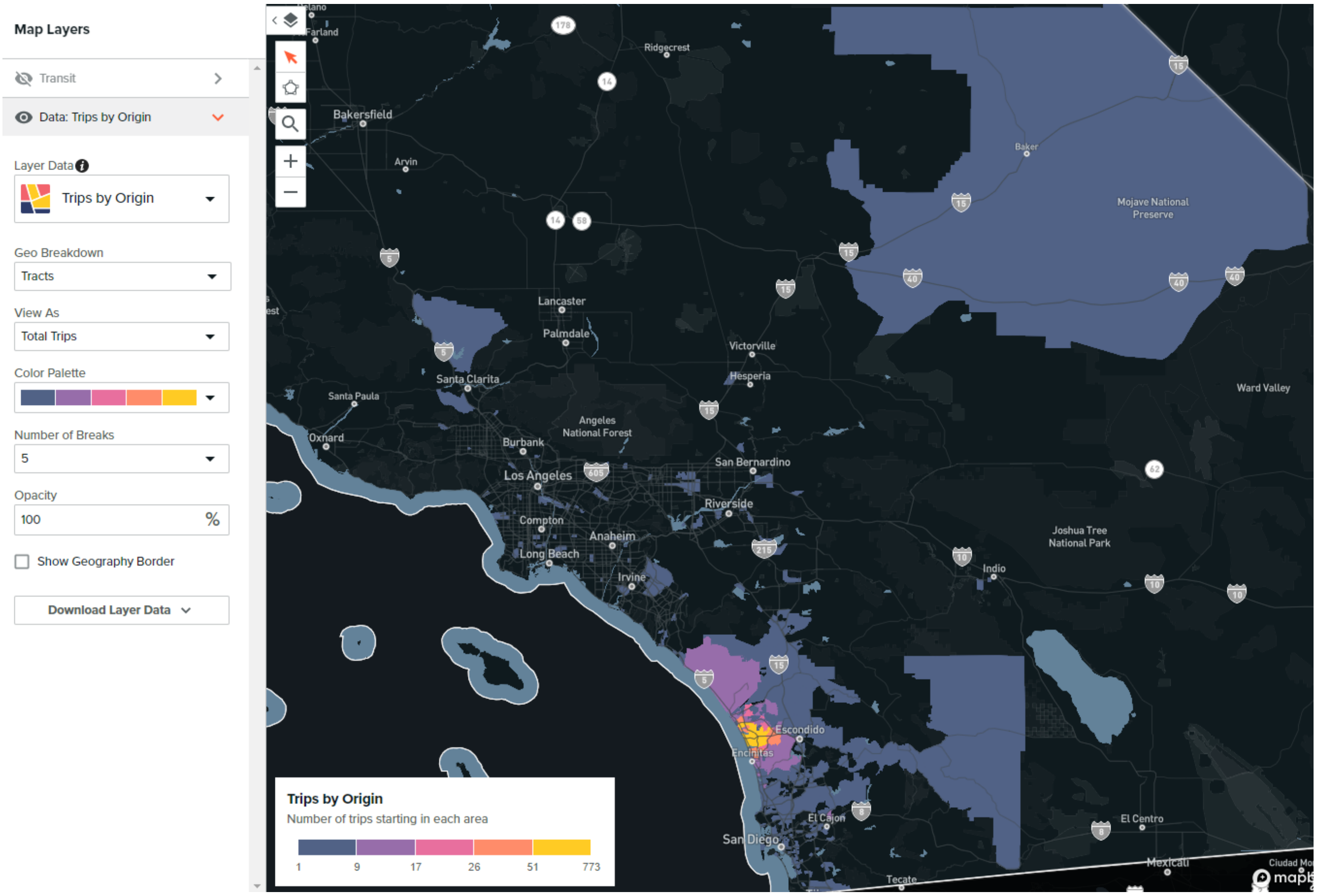

Figure 76 - Replica Trip Origin Heat Map for McClellan-Palomar Airport, Thursday, Spring 2021

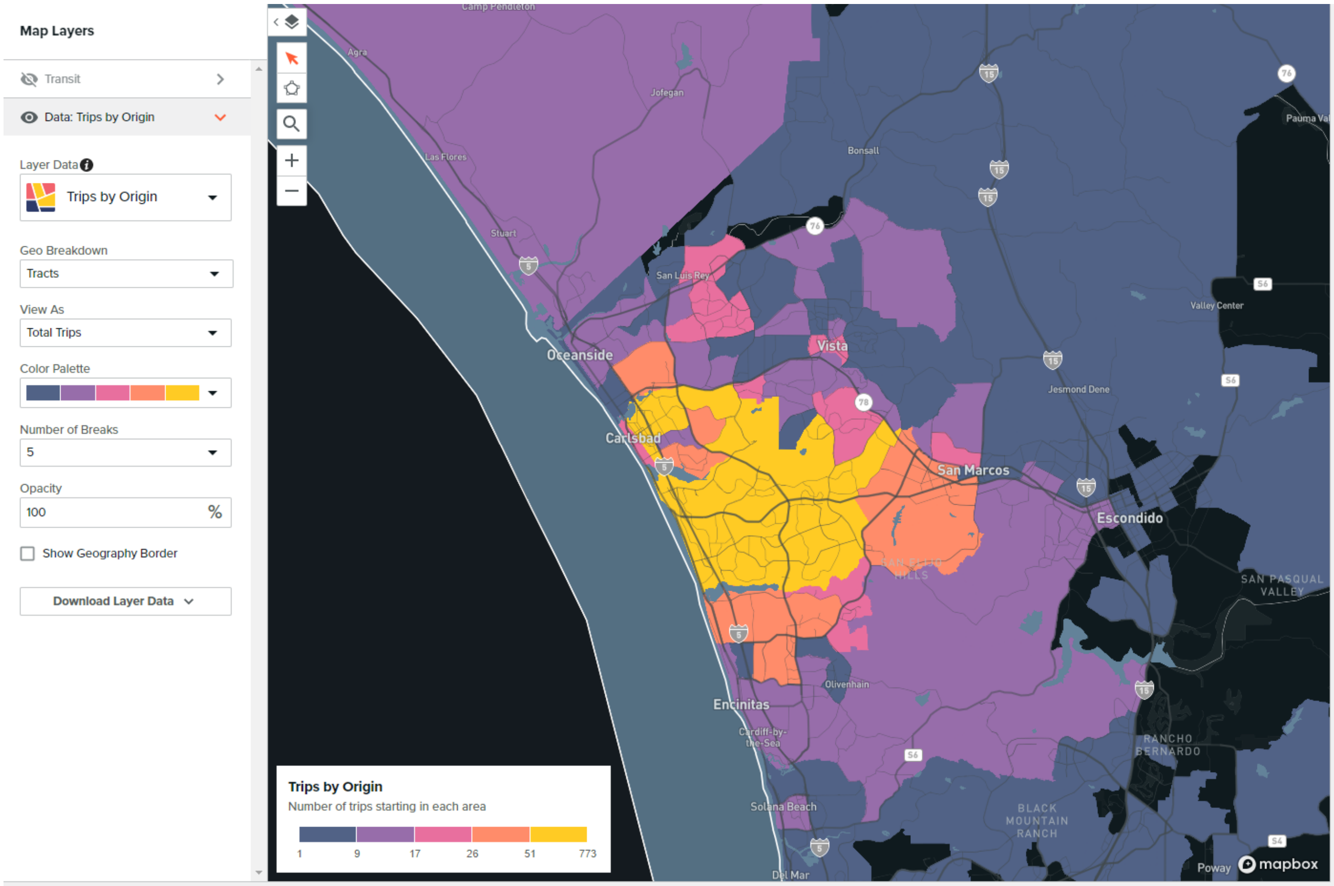

Figure 77 - Replica Trip Origin Heat Map for McClellan-Palomar Airport Magnified, Thursday, Spring 2021

Saturday, Spring 2021

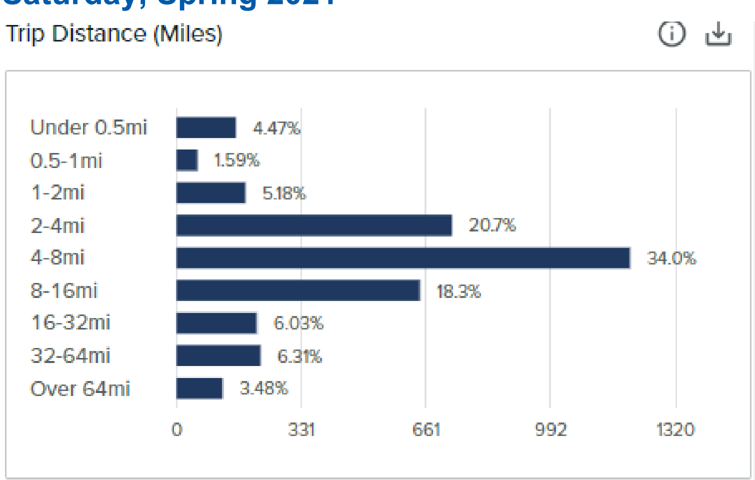

Figure 78- Replica Trip Distance Histogram for McClellan-Palomar Airport, Saturday, Spring 2021

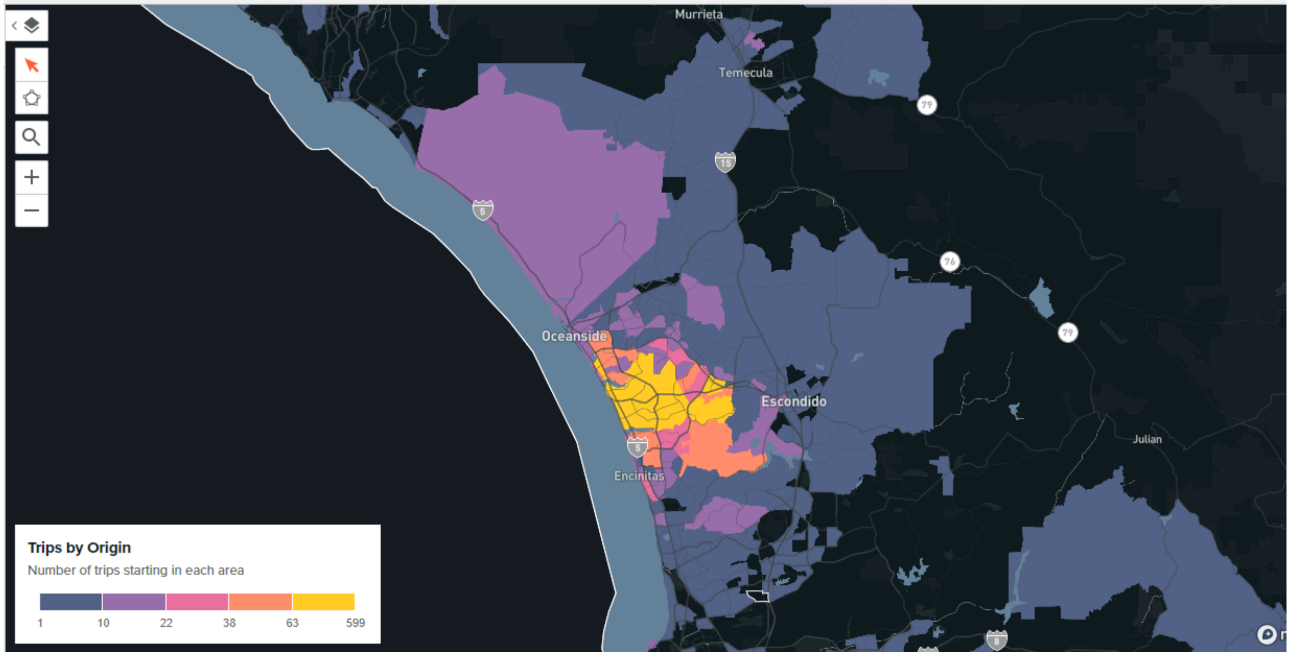

Figure 79- Replica Trip Origin Heat Map for McClellan-Palomar Airport, Saturday, Spring 2021

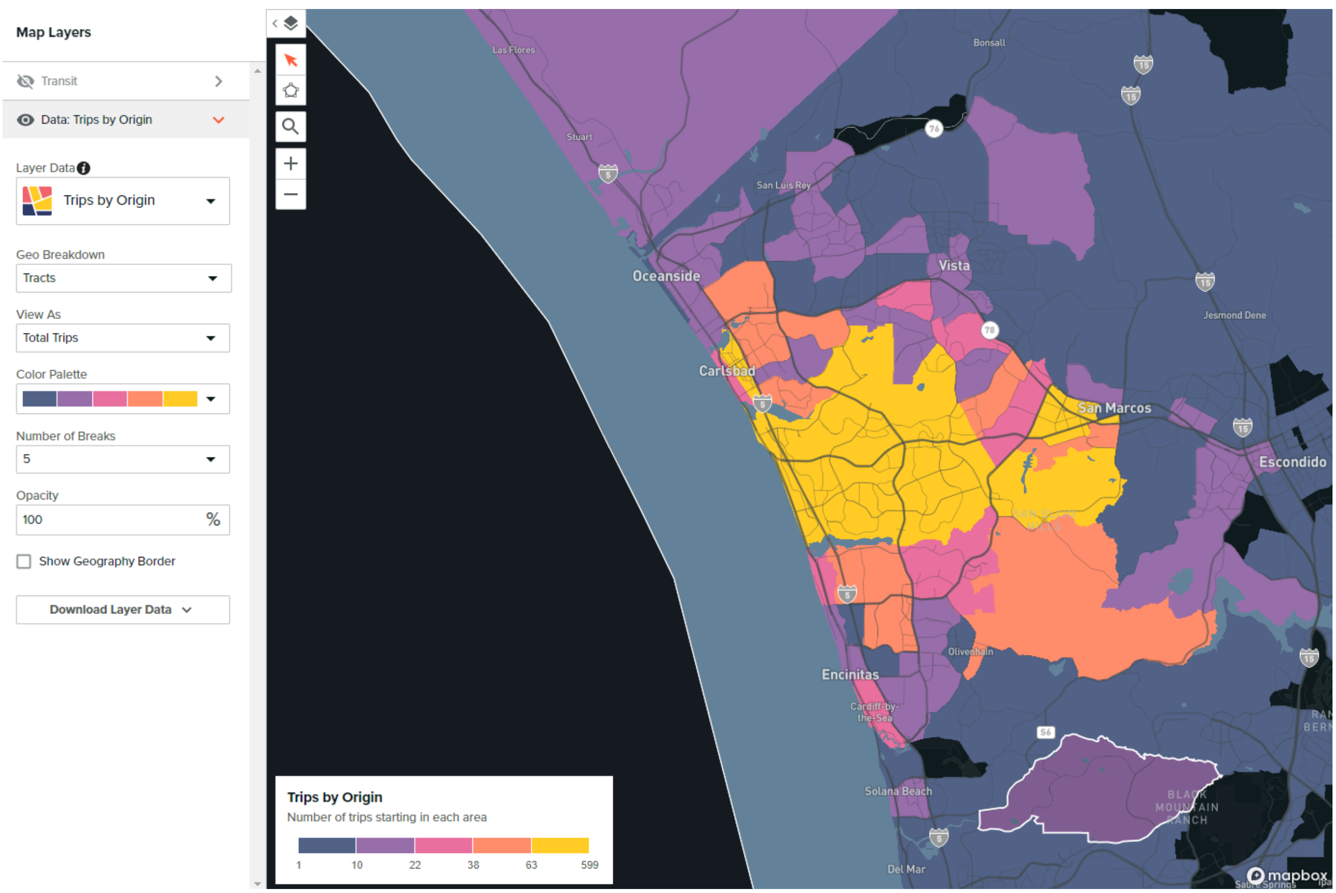

Figure 80 - Replica Trip Origin Heat Map for McClellan-Palomar Airport Magnified, Saturday, Spring 2021

Thursday, Fall 2021

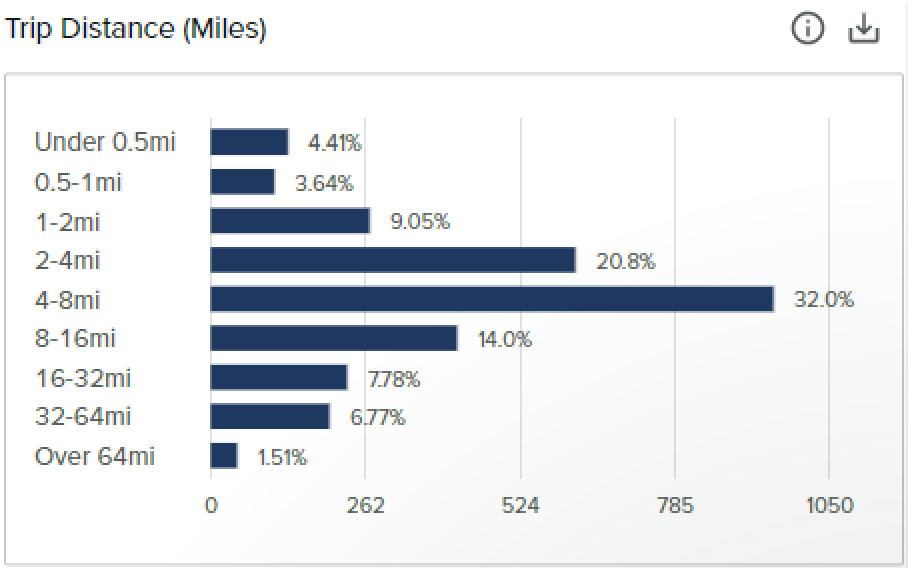

Figure 81 - Replica Trip Distance Histogram for McClellan-Palomar Airport, Thursday, Fall 2021

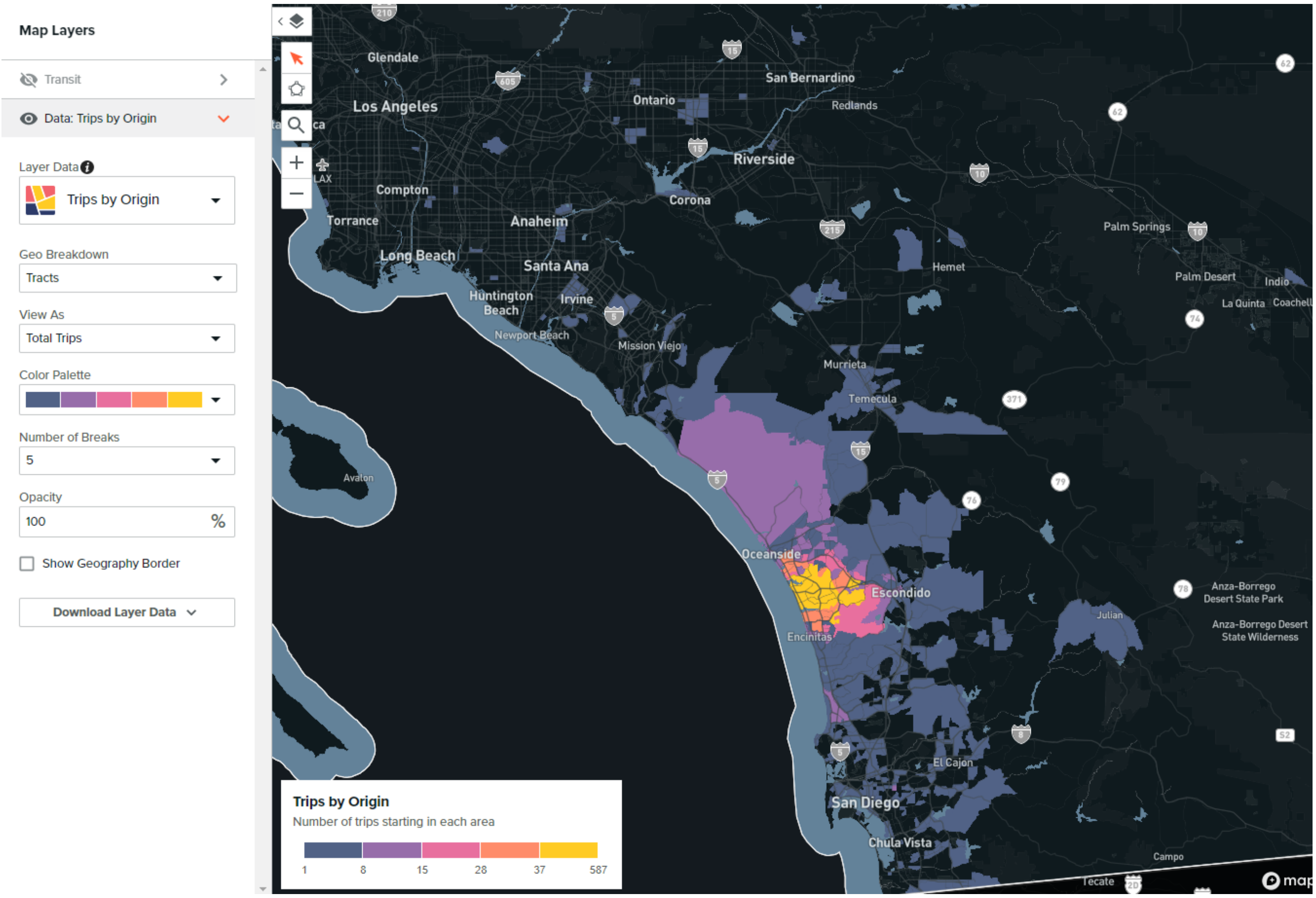

Figure 82 - Replica Trip Origin Heat Map for McClellan-Palomar Airport, Thursday, Fall 2021

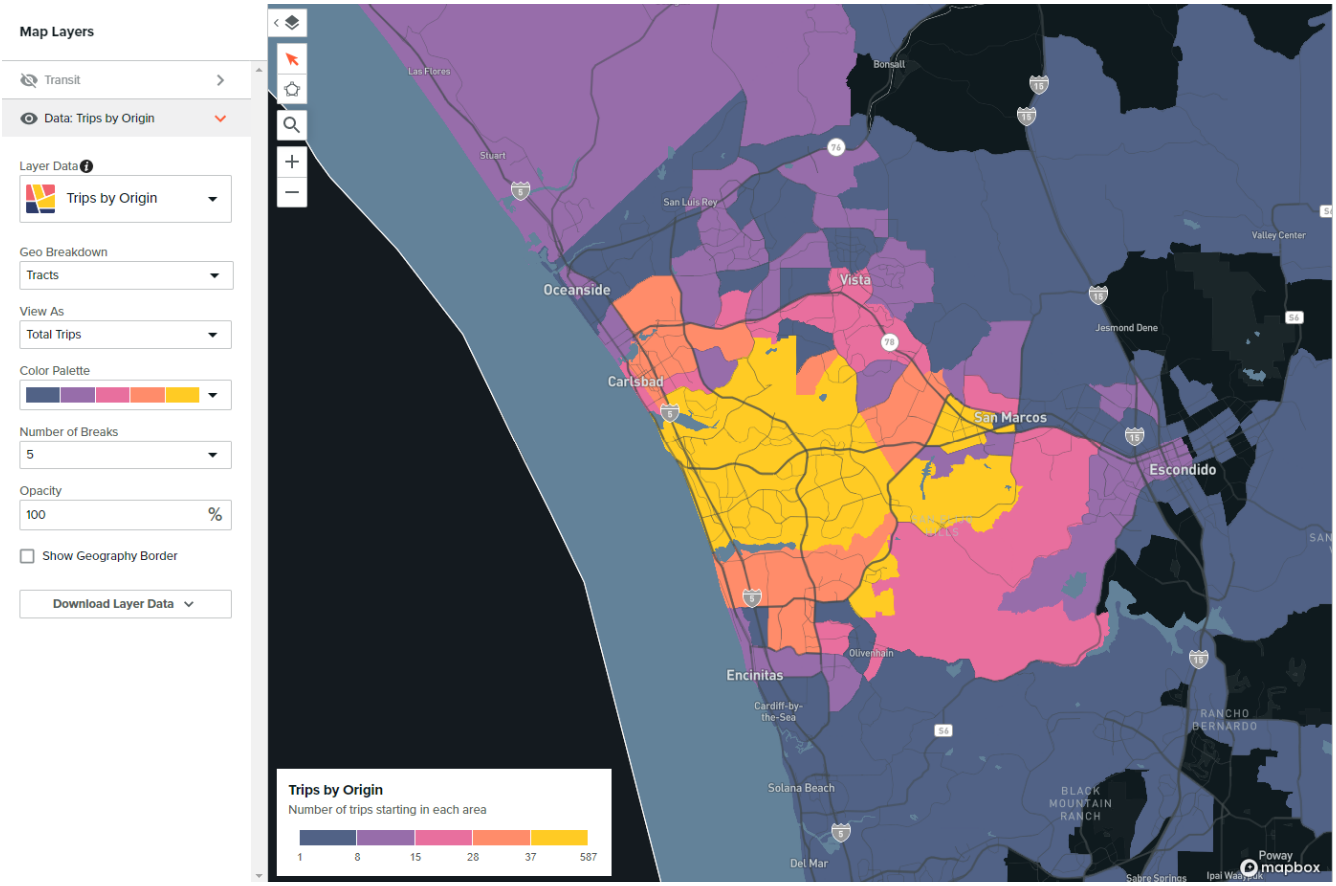

Figure 83 - Replica Trip Origin Heat Map for McClellan-Palomar Airport Magnified, Thursday, Fall 2021

Saturday, Fall 2021

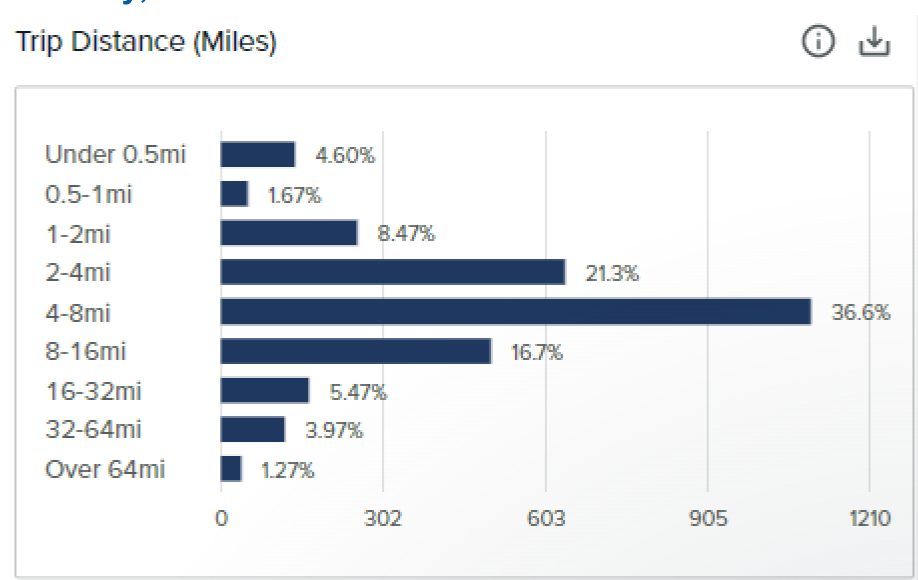

Figure 84 - Replica Trip Distance Histogram for McClellan-Palomar Airport, Saturday, Fall 2021

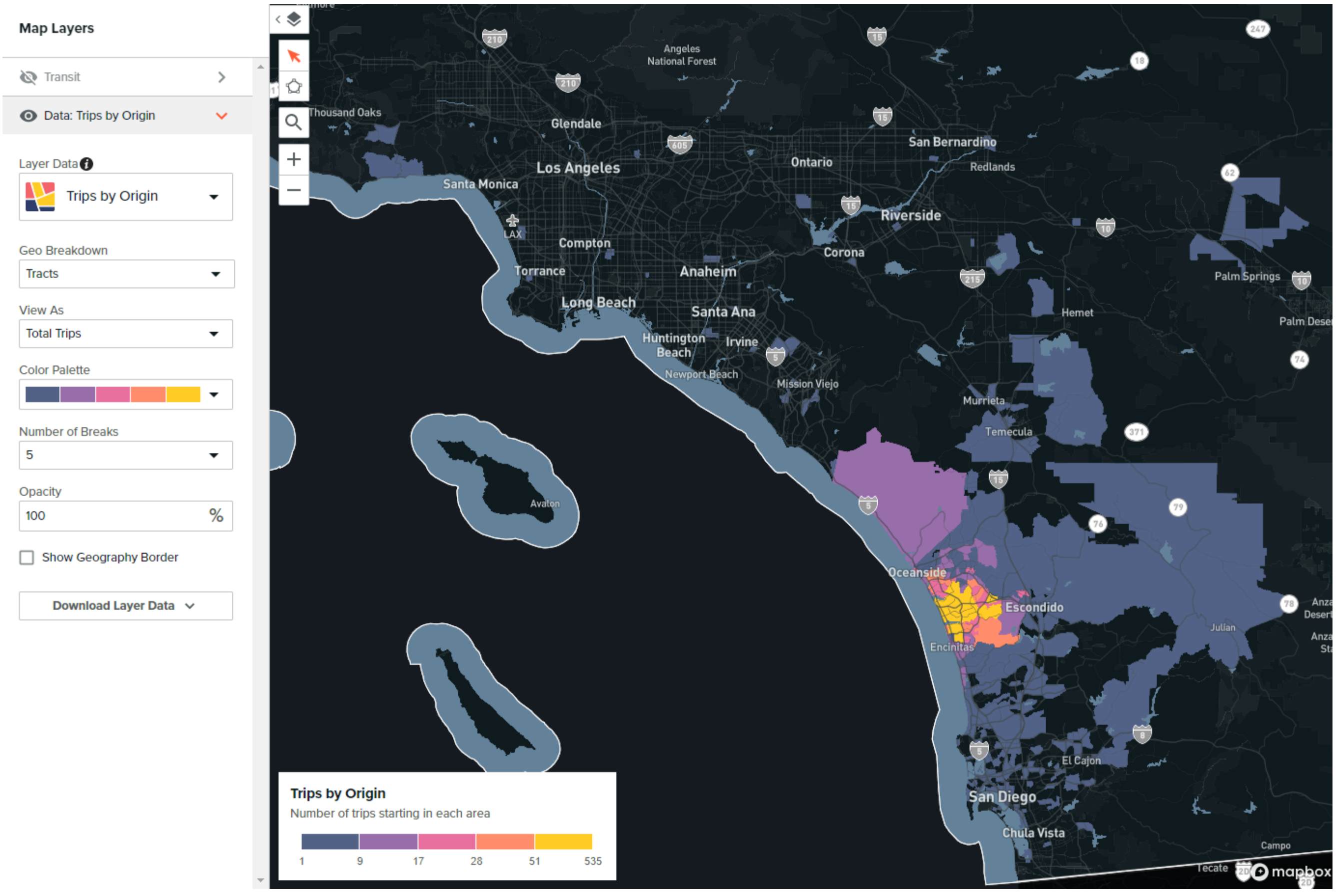

Figure 85 - Replica Trip Origin Heat Map for McClellan-Palomar Airport, Saturday, Fall 2021

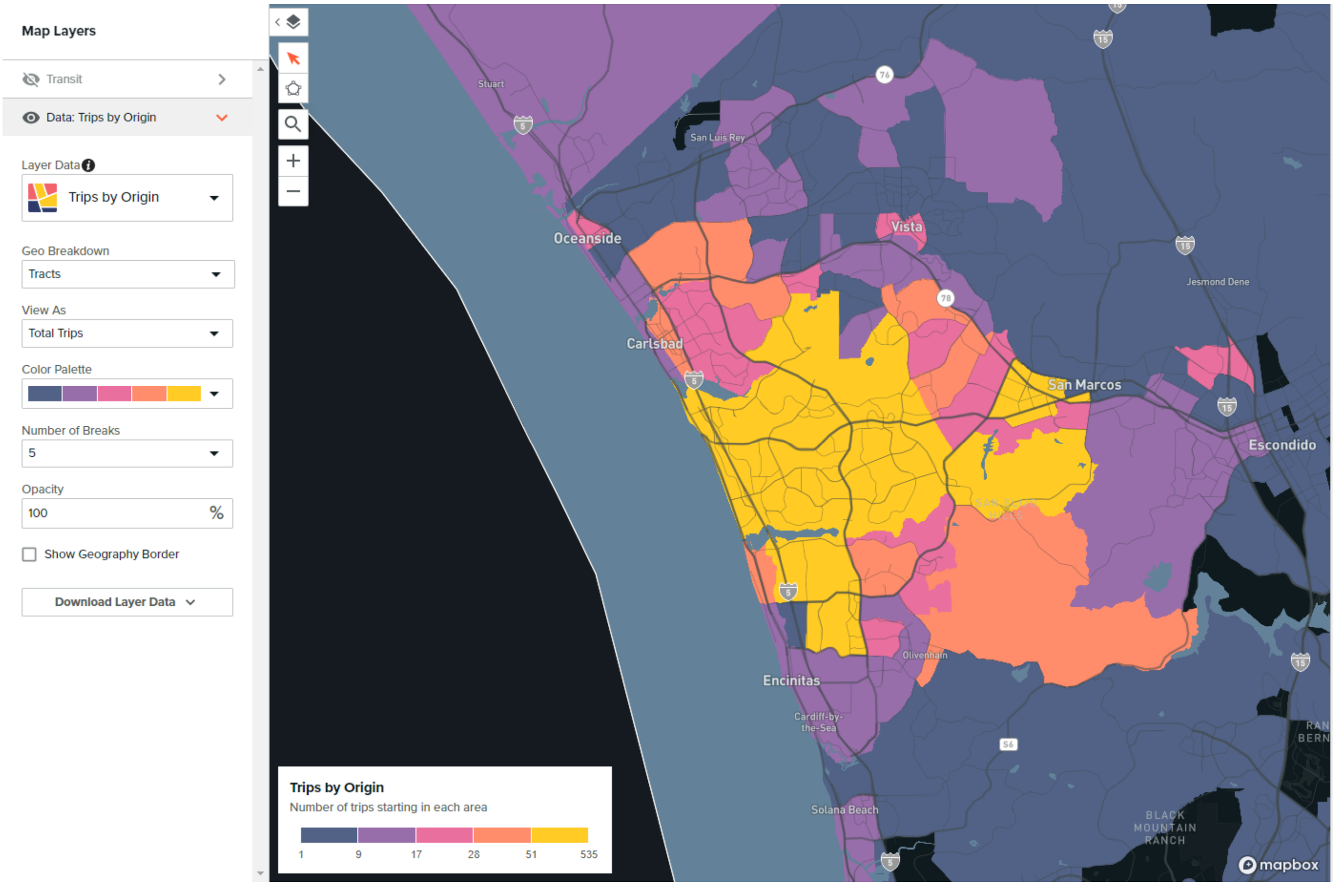

Figure 86 - Replica Trip Origin Heat Map for McClellan-Palomar Airport Magnified, Saturday, Fall 2021

Gillespie

Thursday, Spring 2021

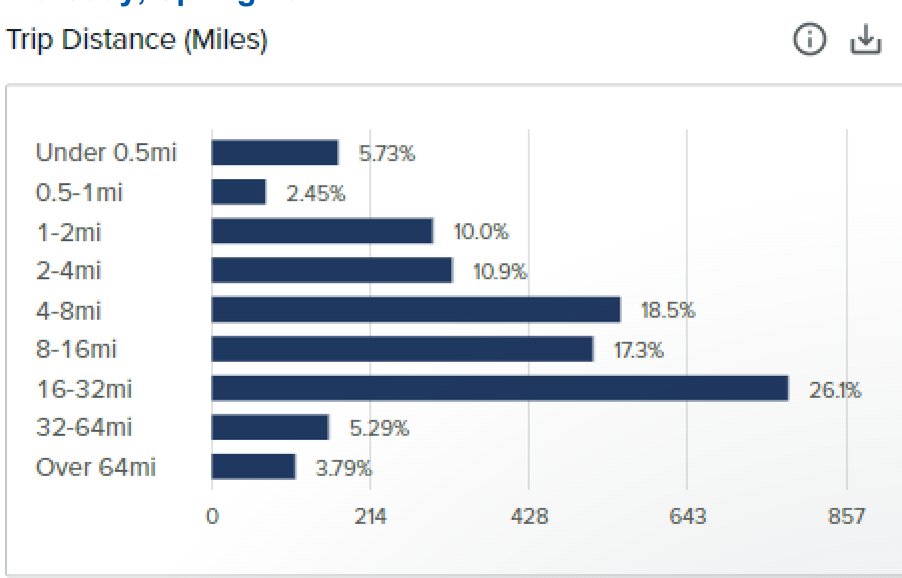

Figure 87 - Replica Trip Distance Histogram for Gillespie Field, Thursday, Spring 2021

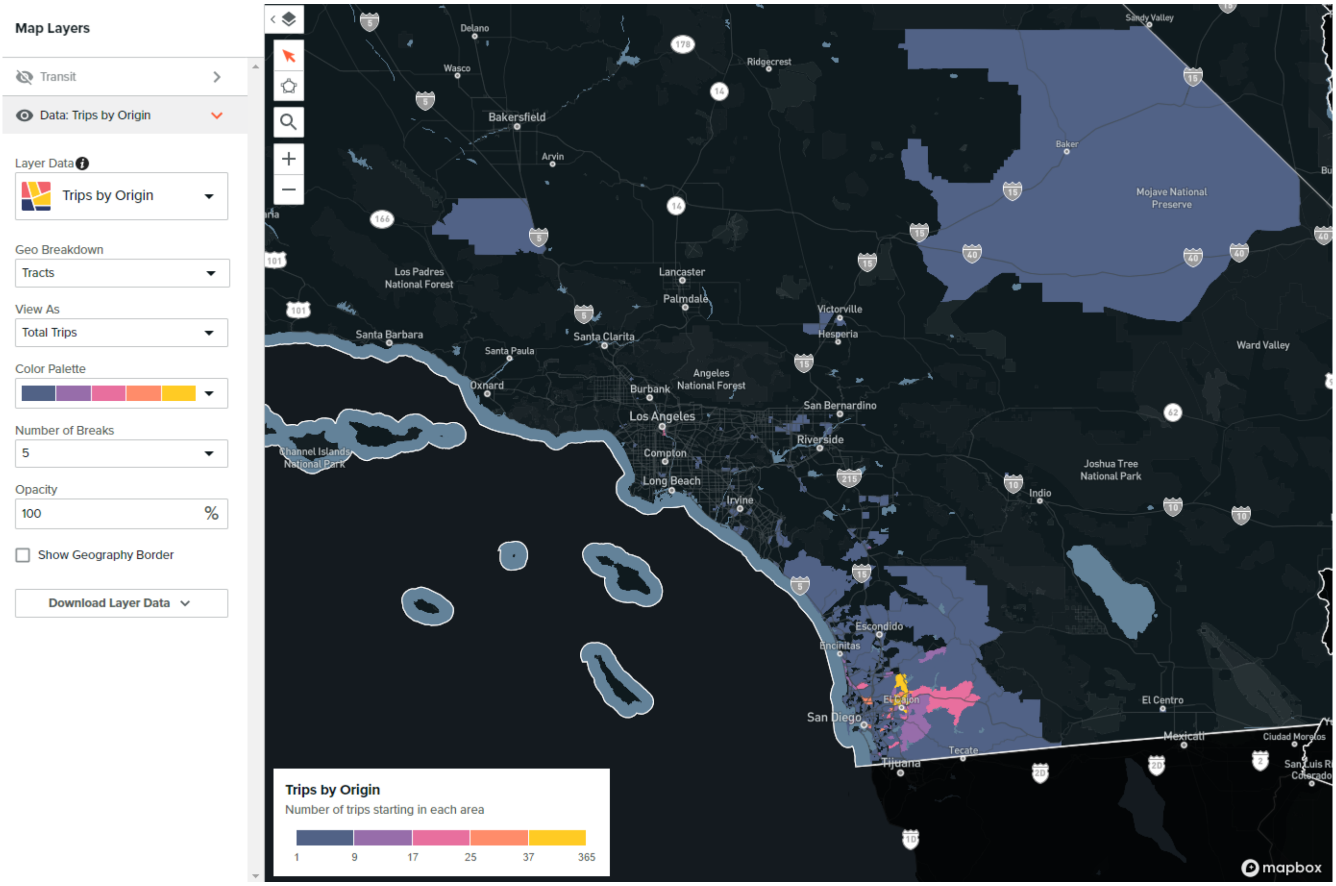

Figure 88 - Replica Trip Origin Heat Map for Gillespie Field, Thursday, Spring 2021

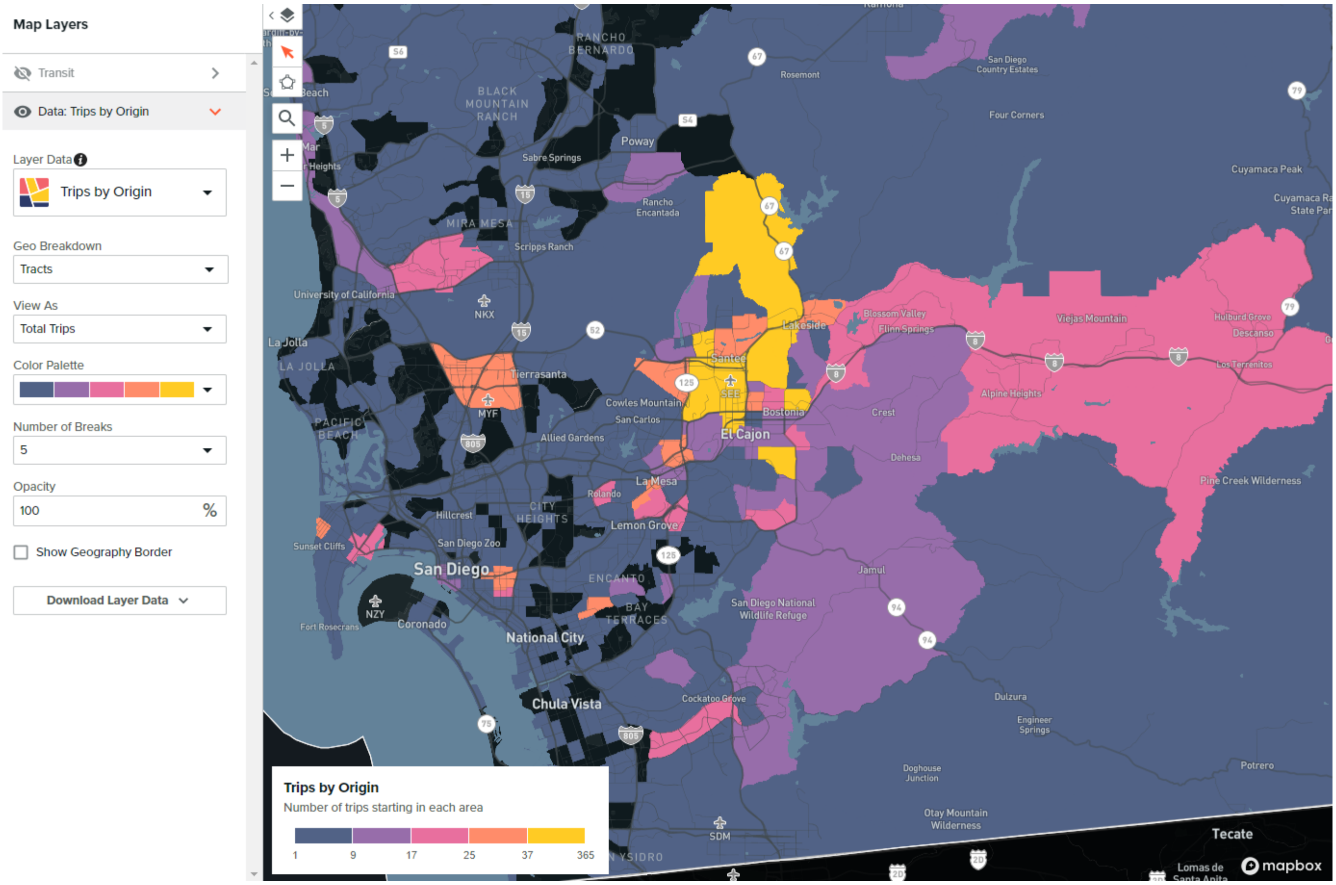

Figure 89 - Replica Trip Origin Heat Map for Gillespie Field Magnified, Thursday, Spring 2021

Saturday, Spring 2021

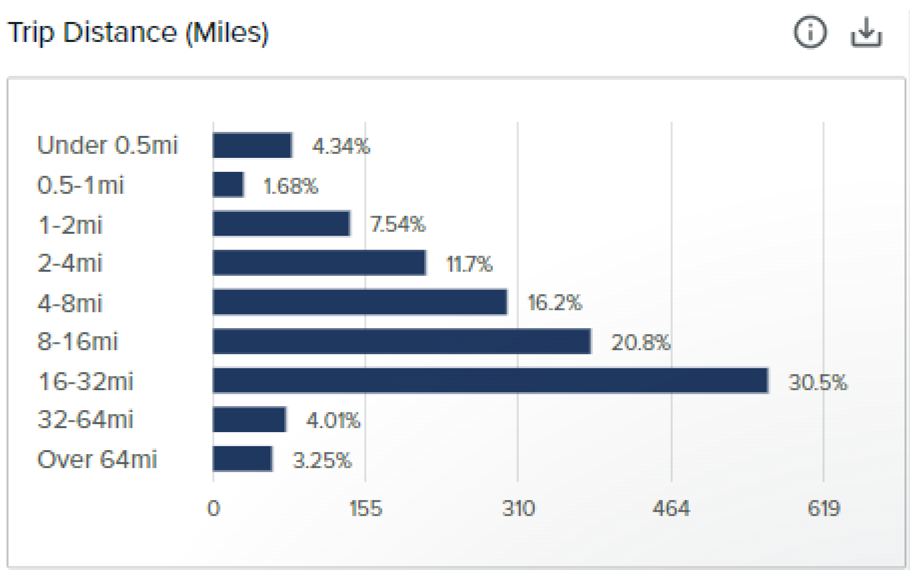

Figure 90 - Replica Trip Distance Histogram for Gillespie Field, Saturday, Spring 2021

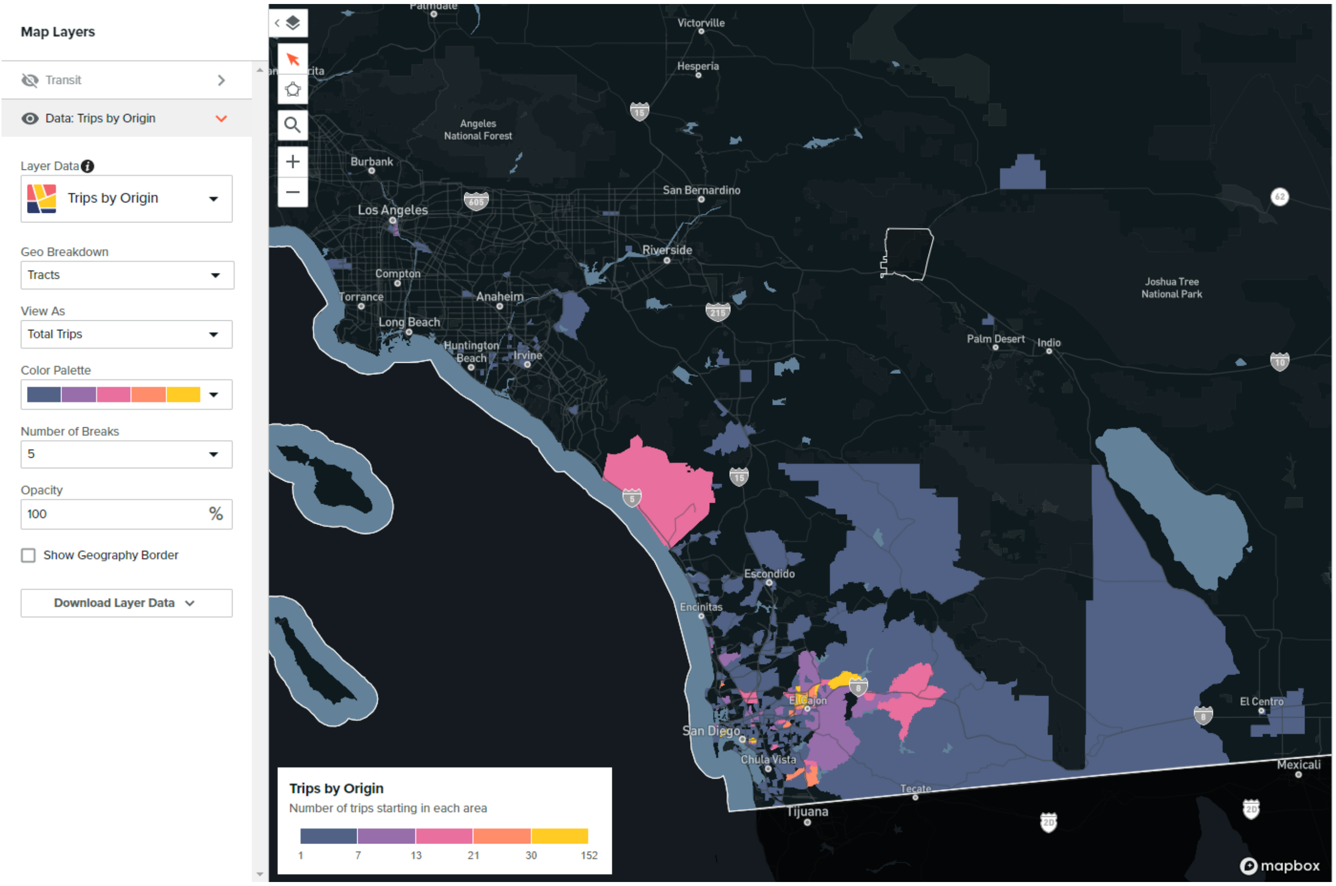

Figure 91 - Replica Trip Origin Heat Map for Gillespie Field, Saturday, Spring 2021

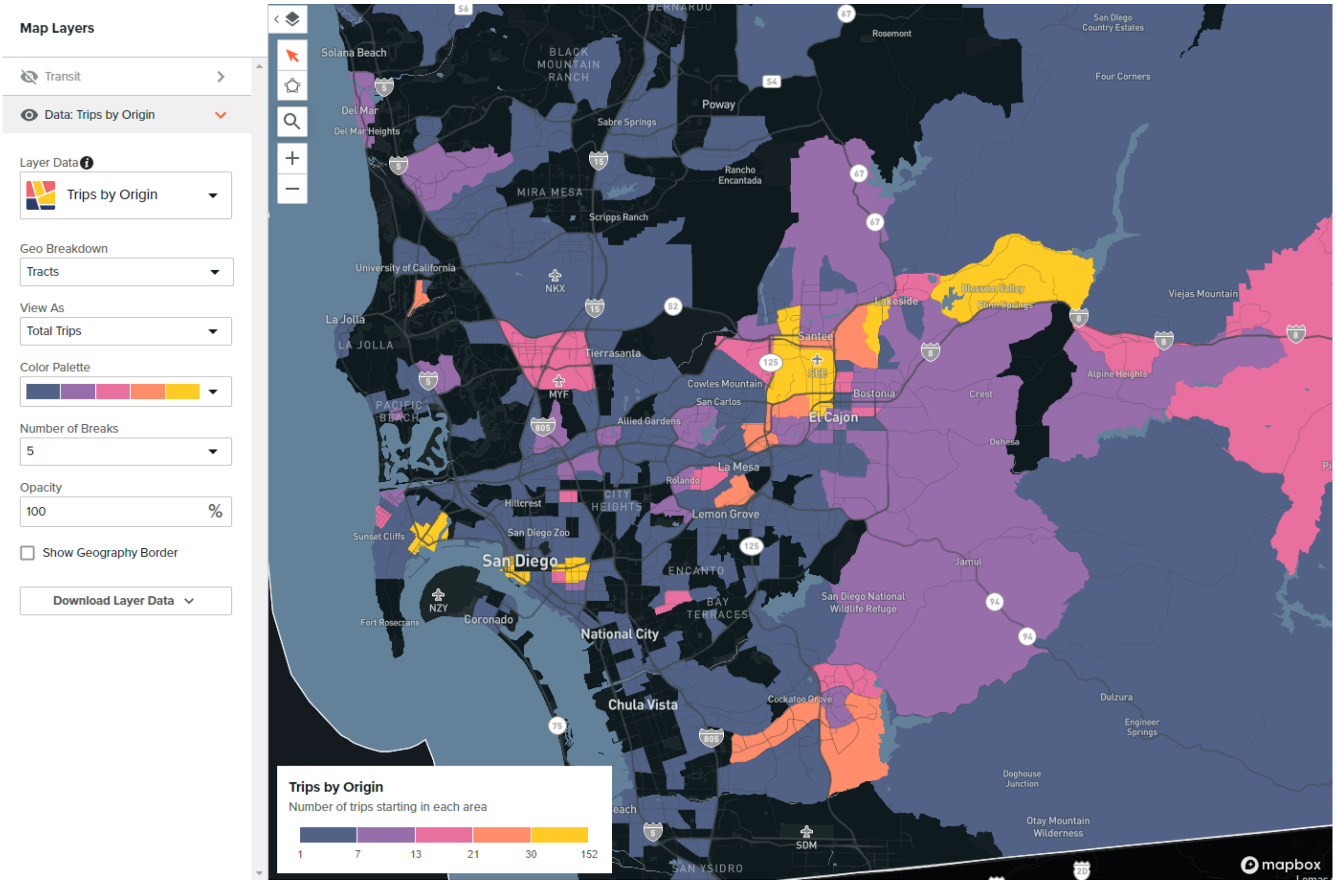

Figure 92 - Replica Trip Origin Heat Map for Gillespie Field Magnified, Saturday, Spring 2021

Thursday, Fall 2021

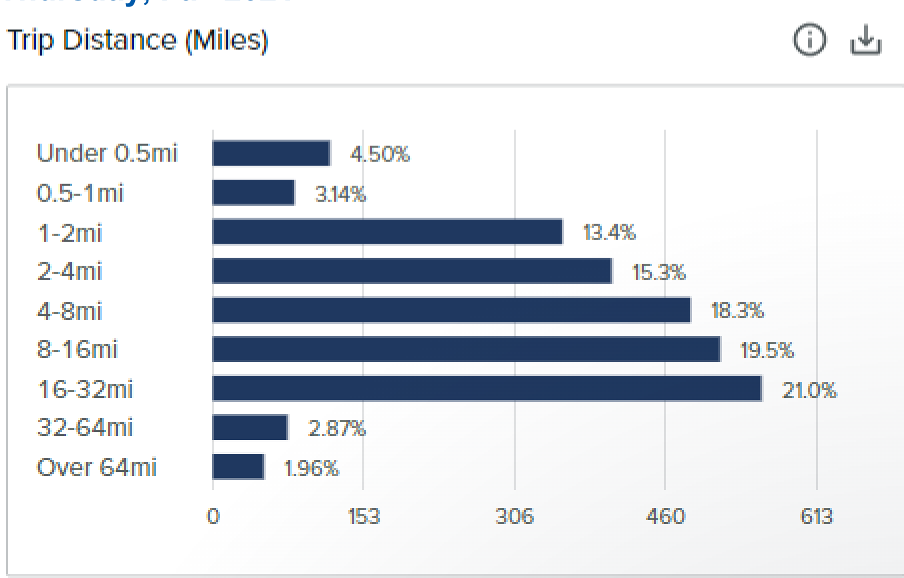

Figure 93 - Replica Trip Distance Histogram for Gillespie Field, Thursday, Fall 2021

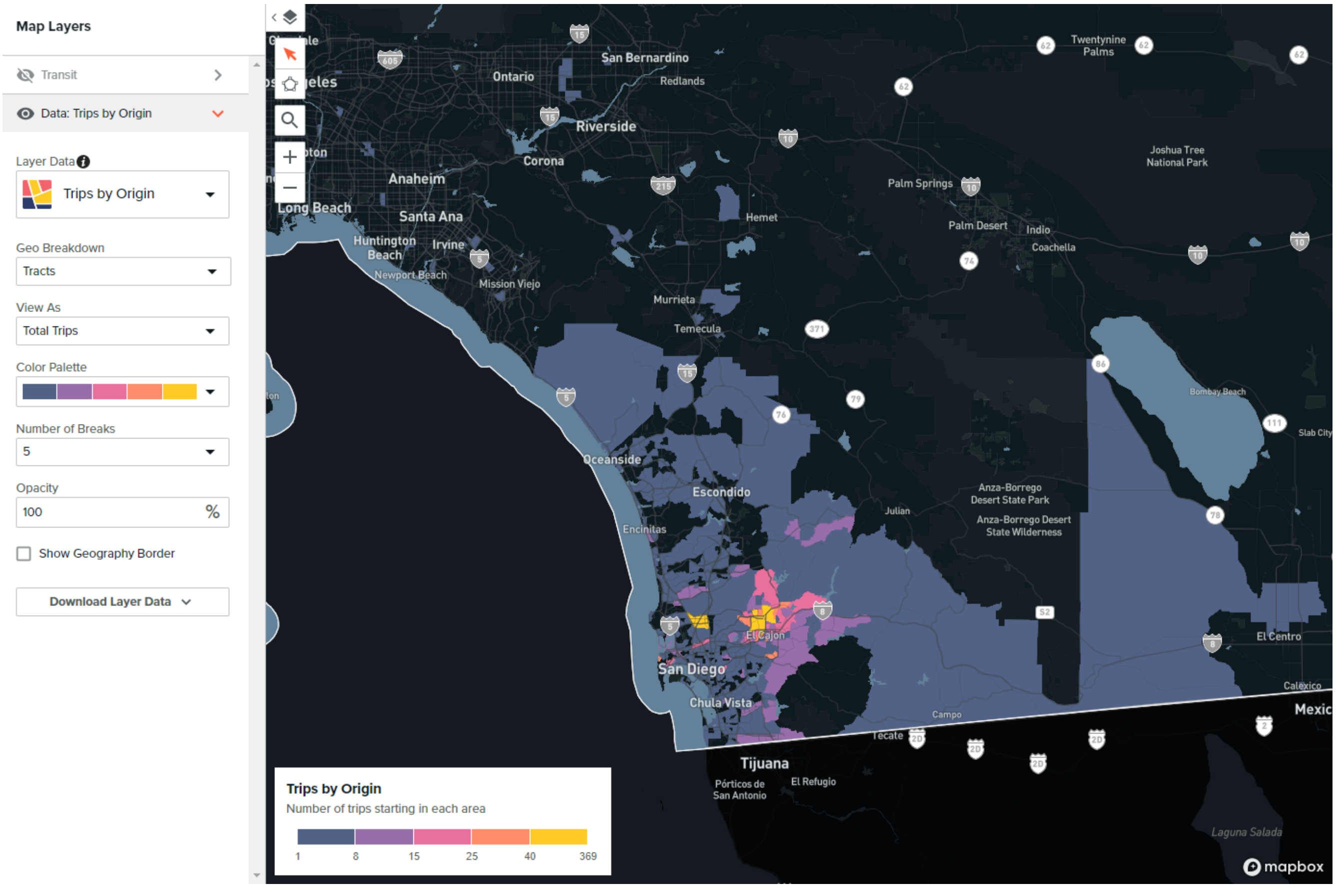

Figure 94 - Replica Trip Origin Heat Map for Gillespie Field, Thursday, Fall 2021

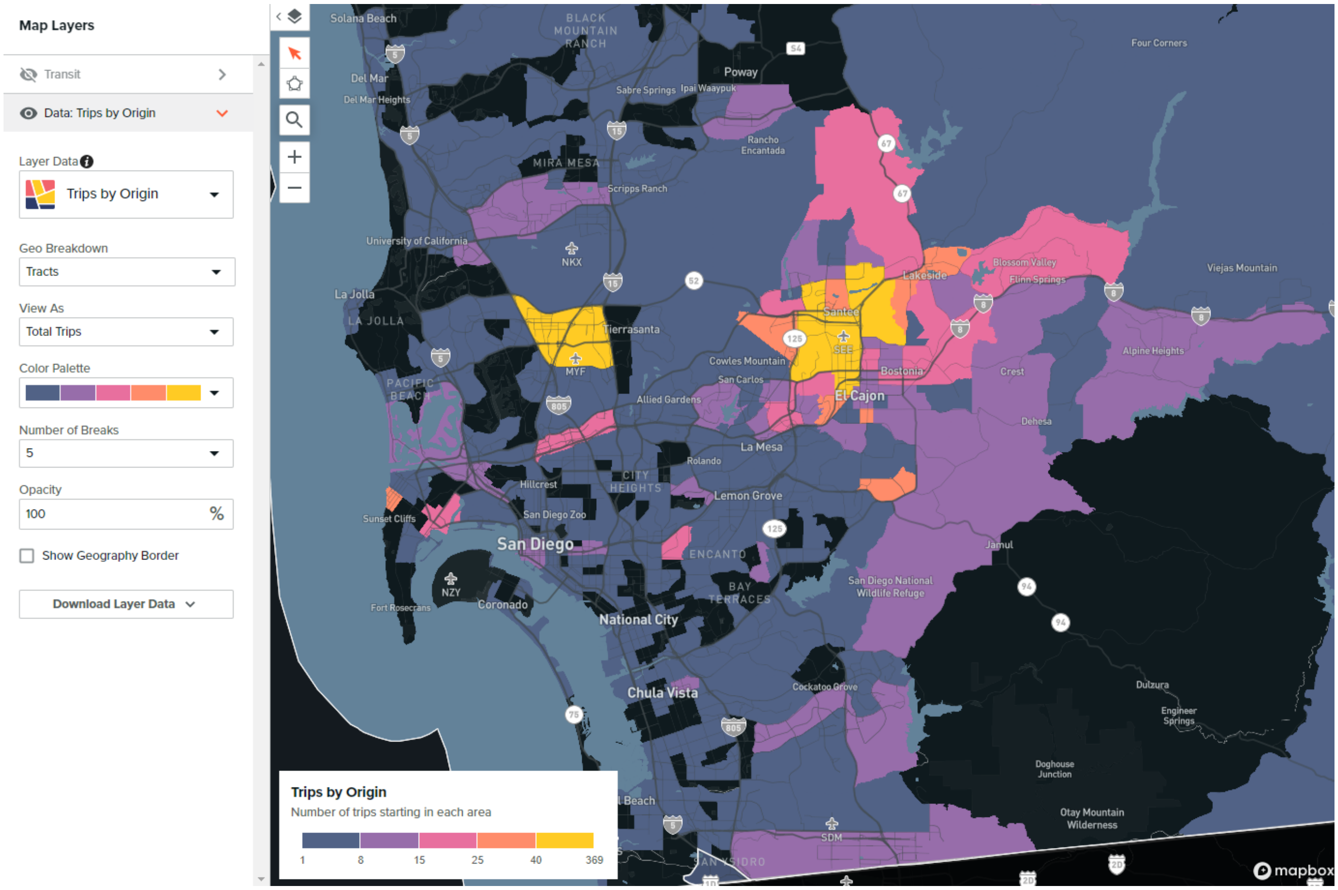

Figure 95 - Replica Trip Origin Heat Map for Gillespie Field Magnified, Thursday, Fall 2021

Saturday, Fall 2021

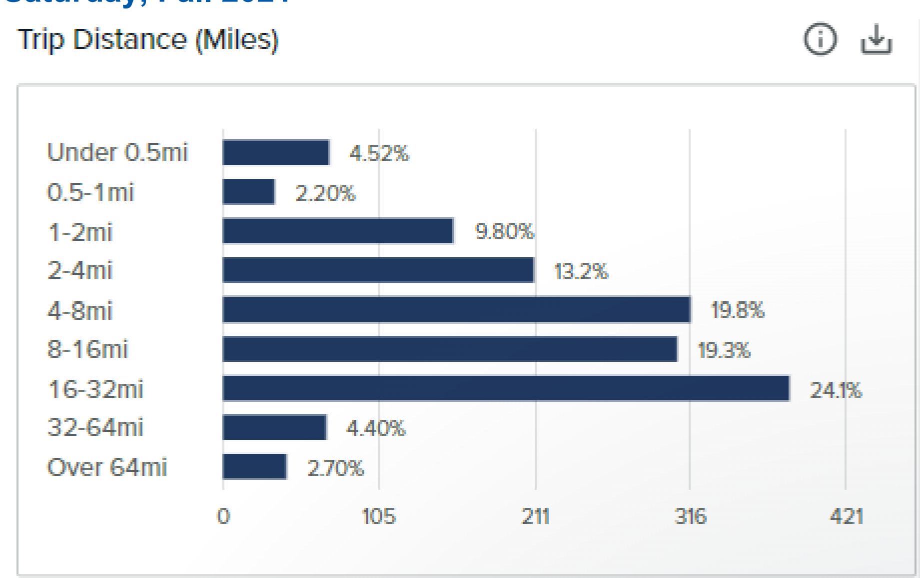

Figure 96 - Replica Trip Distance Histogram for Gillespie Field, Saturday, Fall 2021

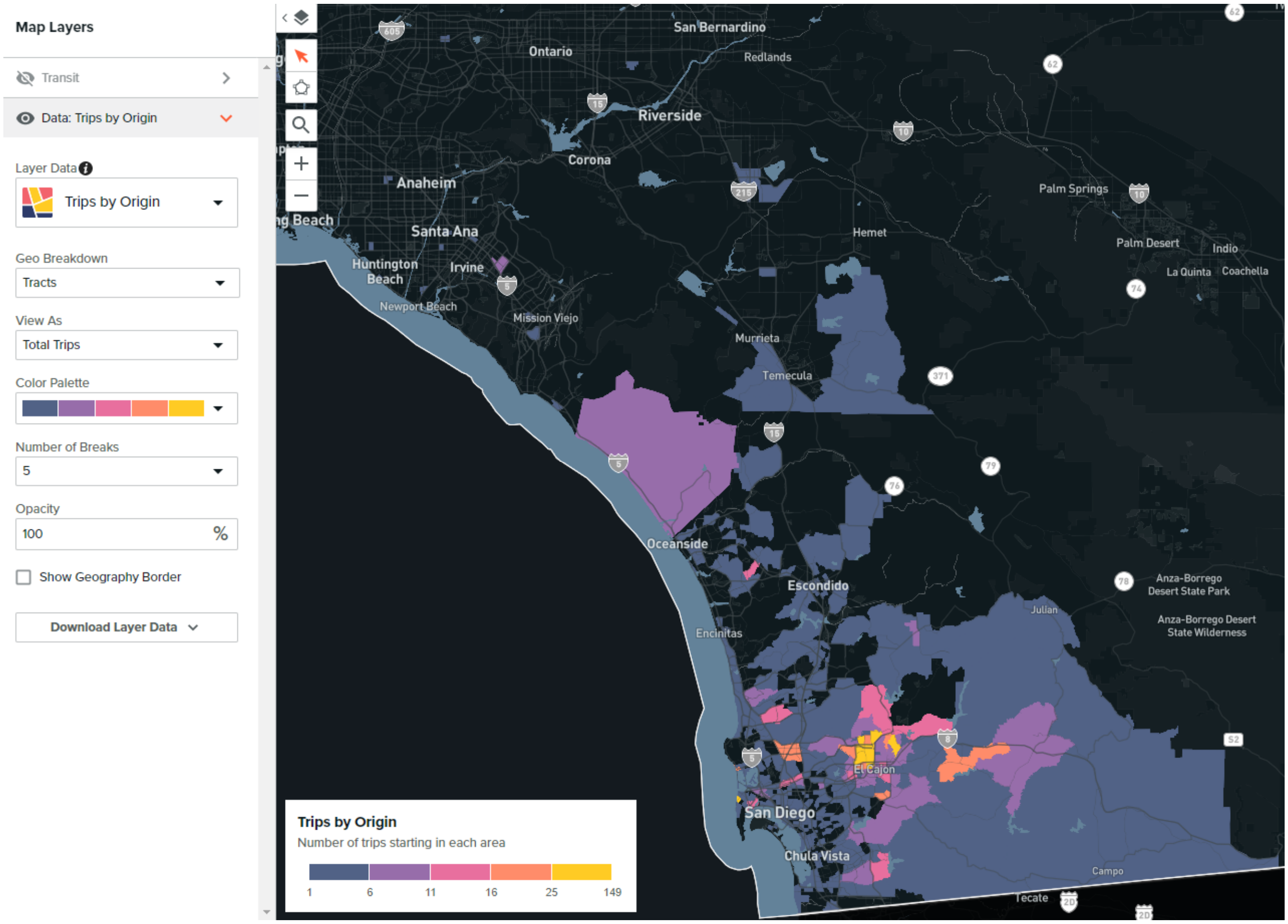

Figure 97 - Replica Trip Origin Heat Map for Gillespie Field, Saturday, Fall 2021

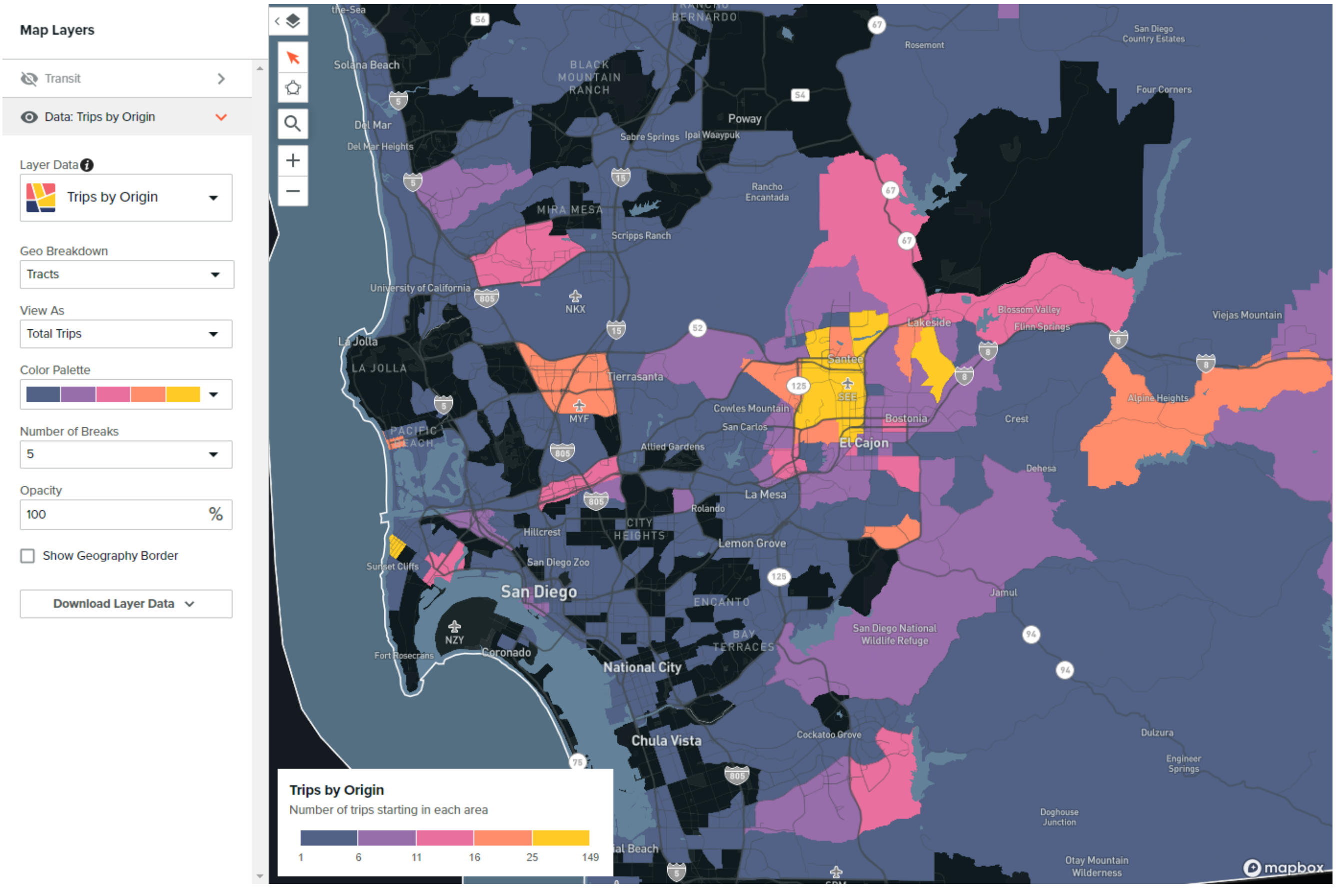

Figure 98 - Replica Trip Origin Heat Map for Gillespie Field Magnified, Saturday, Fall 2021

Borrego

Thursday, Spring 2021

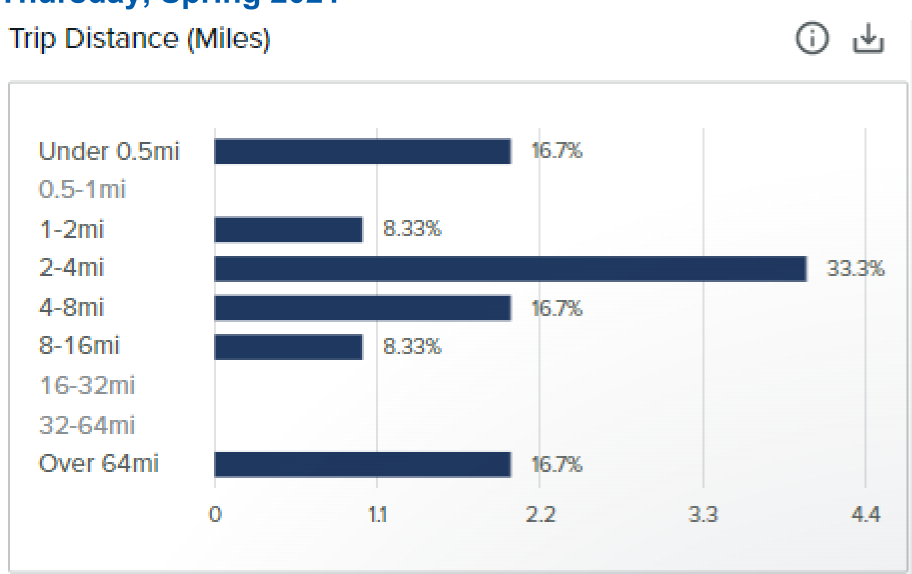

Figure 99 - Replica Trip Distance Histogram for Borrego Airport, Thursday, Spring 2021

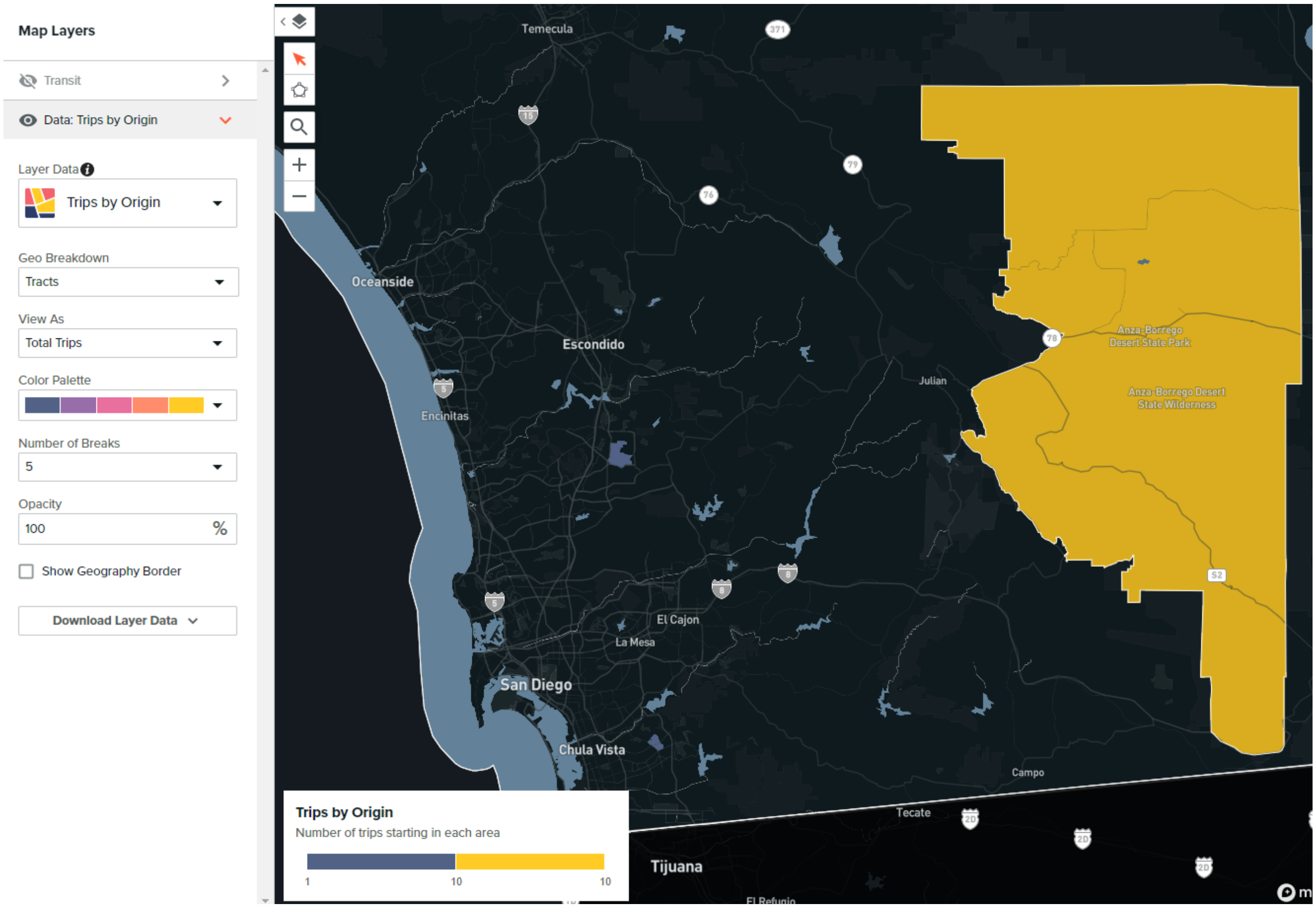

Figure 100 - Replica Trip Origin Heat Map for Borrego Airport, Thursday, Spring 2021

Saturday, Spring 2021

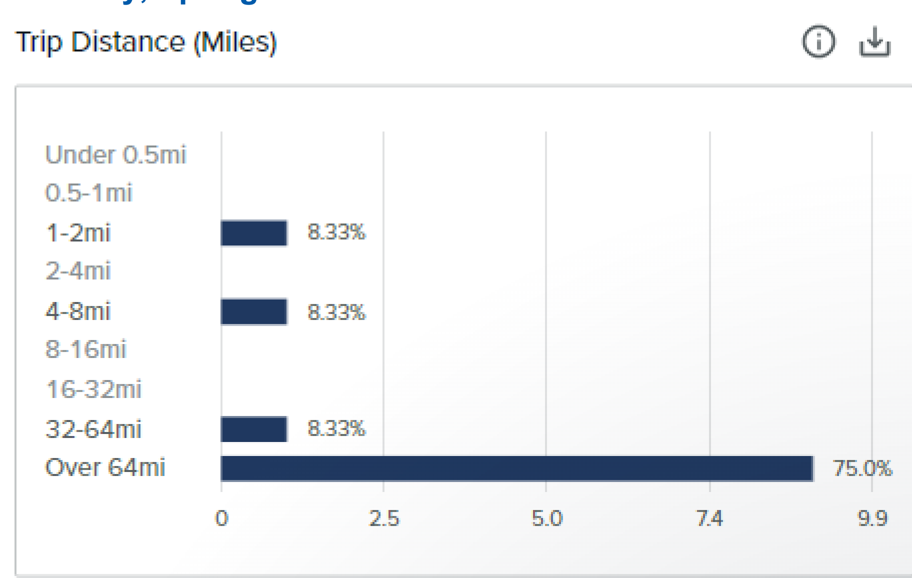

Figure 101 - Replica Trip Distance Histogram for Borrego Airport, Saturday, Spring 2021

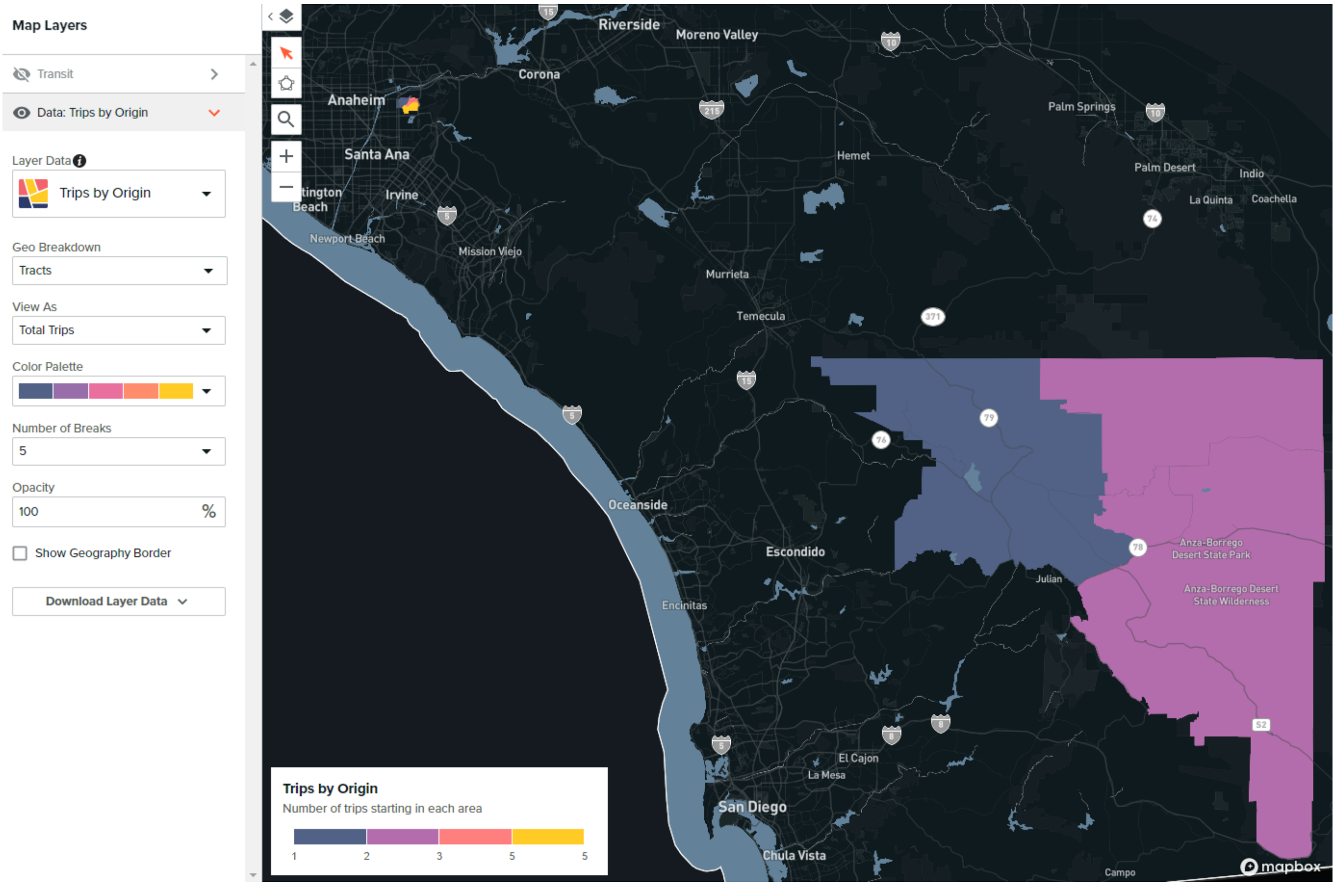

Figure 102 - Replica Trip Origin Heat Map for Borrego Airport, Saturday, Spring 2021

Thursday, Fall 2021

Ocotillo

Thursday, Spring 2021

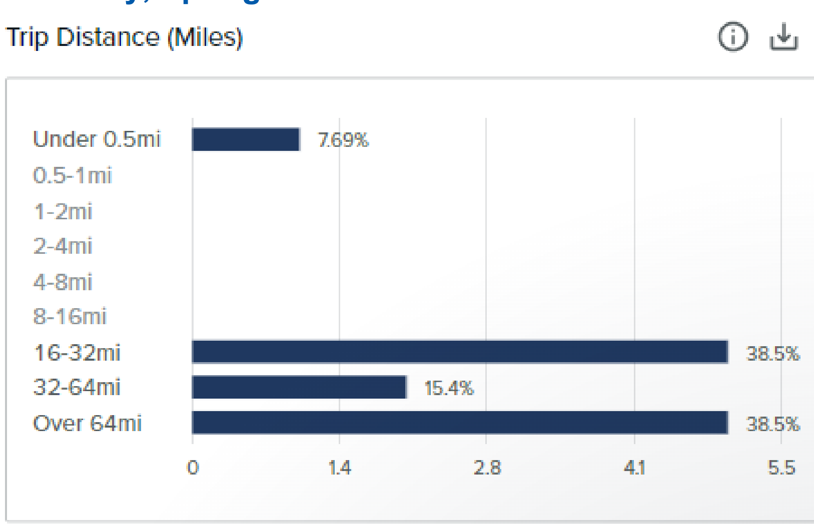

Figure 103 - Replica Trip Distance Histogram for Ocotillo Airport, Thursday, Spring 2021

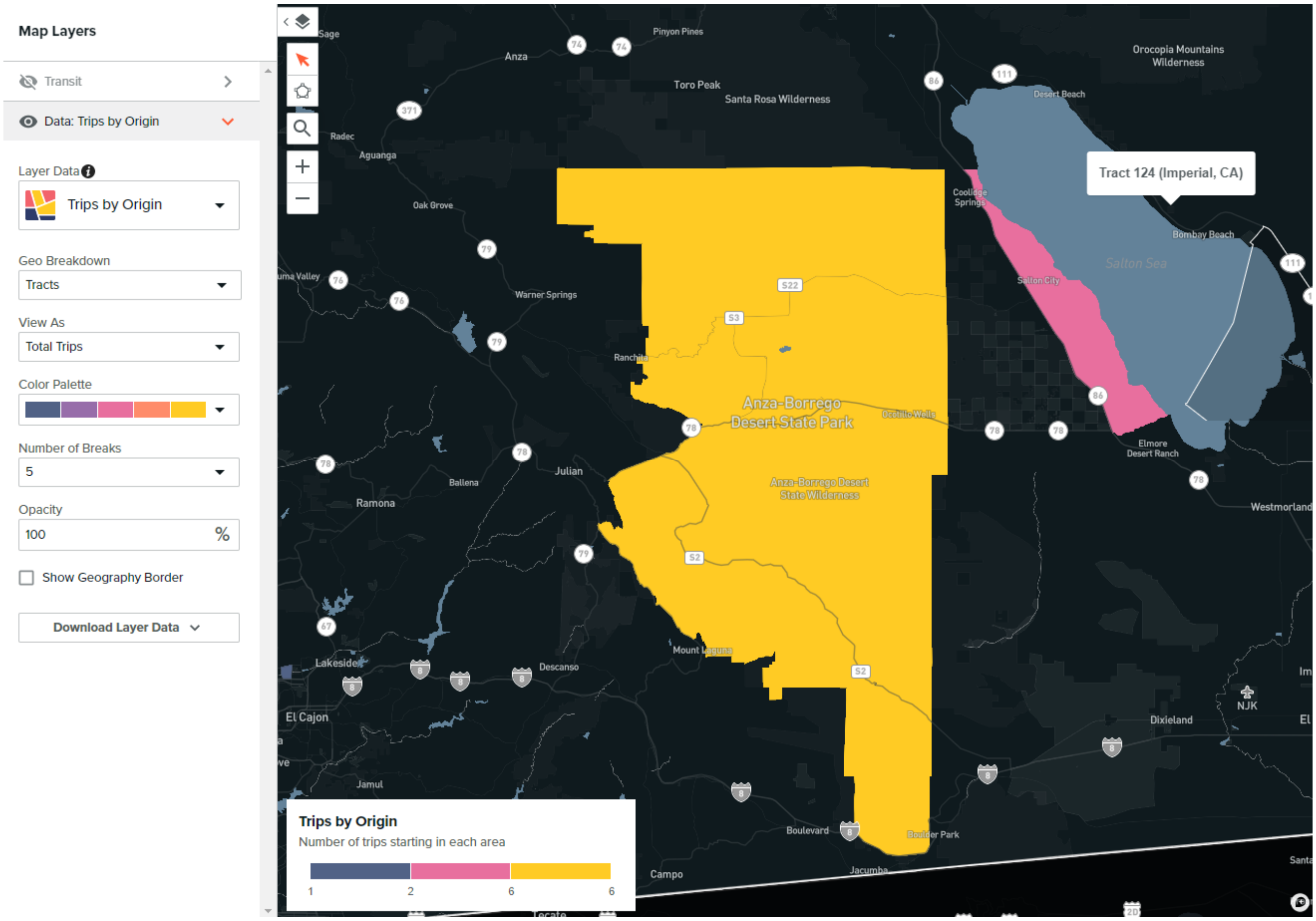

Figure 104 - Replica Trip Origin Heat Map for Ocotillo Airport, Thursday, Spring 2021

Saturday, Spring 2021

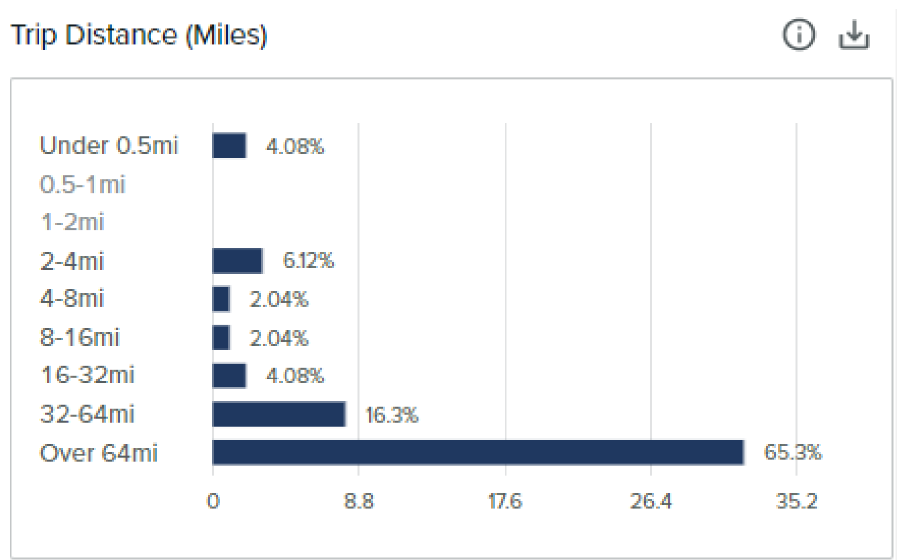

Figure 105 - Replica Trip Distance Histogram for Ocotillo Airport, Saturday, Spring 2021

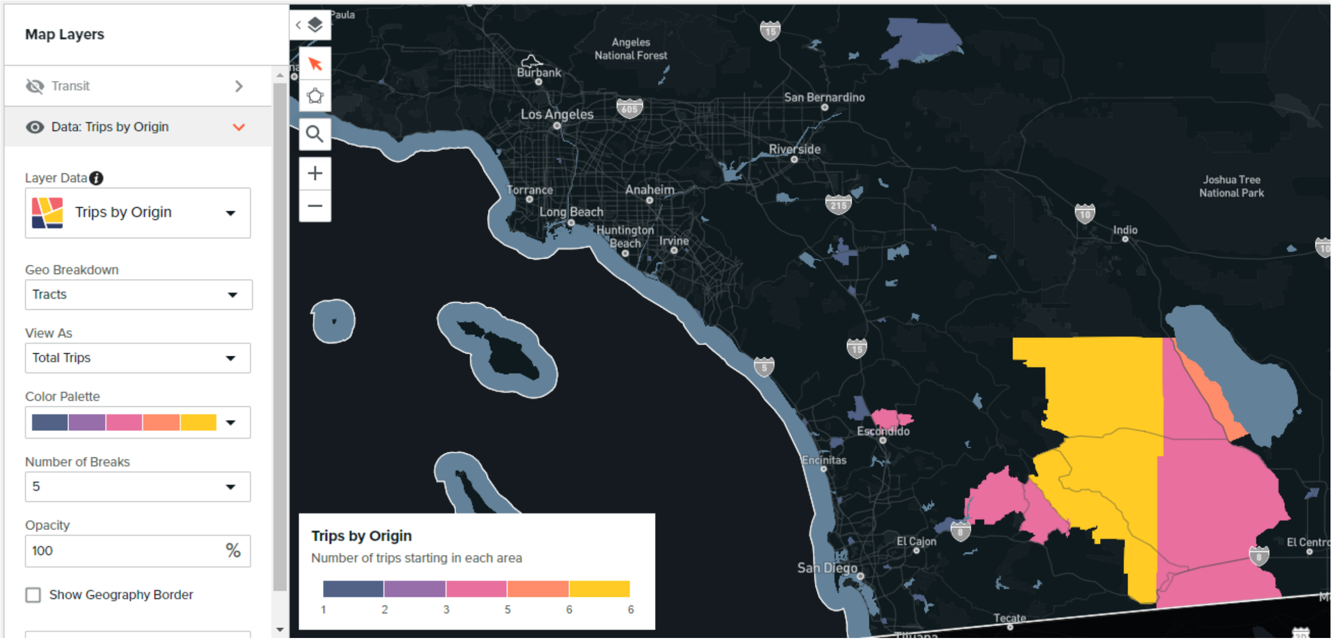

Figure 106 - Replica Trip Origin Heat Map for Ocotillo Airport, Saturday, Spring 2021

Thursday, Fall 2021

N/A – Not trips taken.

Saturday, Fall 2021

N/A – Not trips taken.

Agua Caliente

Thursday, Spring 2021

N/A – Not trips taken.

Saturday, Spring 2021

N/A – Not trips taken.

Thursday, Fall 2021

N/A – Not trips taken.

Saturday, Fall 2021

N/A – Not trips taken.