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TECHNICAL MEMORANDUM

To:	Nicholas Alex, CM Project Manager/Senior Aviation Planner C&S Companies 2355 Northside Drive, Suite 350 San Diego, CA 92108
From:	Heather Bruce, Senior Consultant Chris Nottoli, Consultant
Date:	December 16, 2019
Subject:	Airport Master Plan Study for Brown Field Municipal Airport – 2037 Forecast Noise and Air Quality Modeling Assumptions
Reference:	HMMH Project Number 308790

1. Background

HMMH is assisting the City of San Diego (California) in a Master Plan update at Brown Field Municipal Airport (SDM). HMMH used the Aviation Environmental Design Tool (AEDT), Version 2d to generate noise contours and air quality emissions for the SDM 2037 Master Plan forecast using the required inputs.

The subsequent sections address the AEDT inputs and results:

- Physical description of the airport layout
- Aircraft operations
- Aircraft noise and performance characteristics
- Runway utilization
- Flight track geometry and use
- Meteorological conditions
- Terrain data
- Contour results
- Aircraft Methodology and Emissions Characteristics
- Emission results

The purpose of this technical memorandum is to detail the changes in modeling assumptions from the baseline to the forecast aircraft noise and air quality modeling assumptions, inputs, and results for the SDM Master Plan for calendar year 2037.

2. Physical Description of the Airport Layout

SDM is located within San Diego County and the City of San Diego directly north of California Route 905 (Otay Mesa Freeway), and west of California Route 125 (South Bay Expressway). The Airport has two parallel runways: Runway 08L/26R and Runway 08R/26L. Figure 1 shows the current airport diagram and Table 1 provides the runway specifications used in modeling the 2037 forecast. The runway specifications remain unchanged from the 2017 baseline analysis.

The number used to designate each runway end reflects, with the addition of a trailing "0", the magnetic heading of the runway to the nearest 10 degrees from the perspective of the pilot. The two parallel runways, Runway 08L/26R and Runway 08R/26L, are oriented on approximate magnetic headings of 80° and 260° and are 7,972 feet long by 150 feet wide and 3,180 feet long by 75 feet wide, respectively. The parallel runways are distinguished from each other with letter endings "L", meaning left, and "R", meaning right, again, from the perspective of the pilot.

Runway length, runway width, instrumentation, and declared distances affect which runway an aircraft will use and under what conditions, and therefore, how often a runway is used relative to the other runways at the airport.

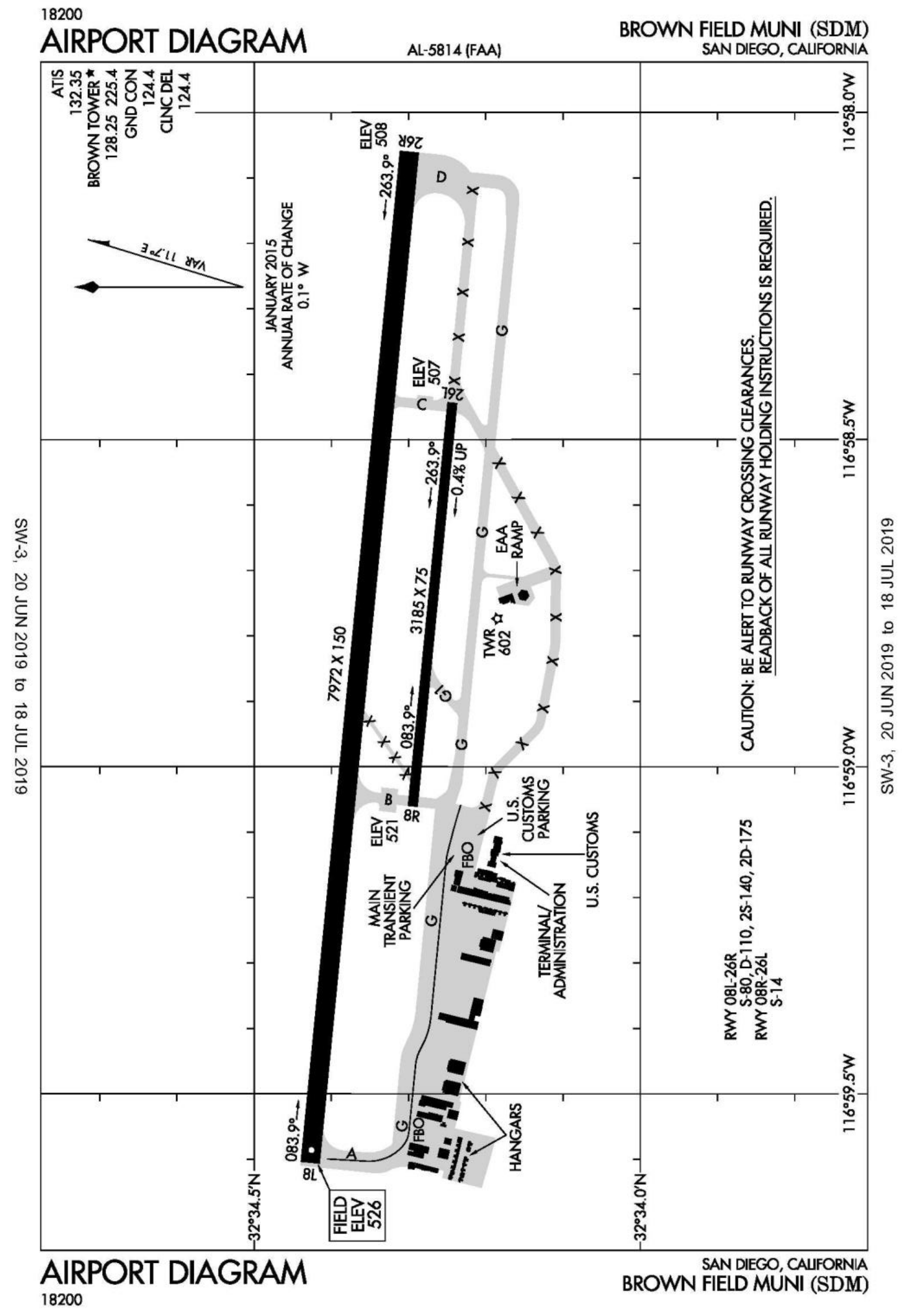

Figure 1: Airport Diagram

Source: FAA, effective, 20 June 2019 to 18 Jul 2019

Table 1: Current Runway Data

Source: Aviation Environmental Design Tool (AEDT) 2c Service Pack2 and FAA 5010 data accessed 08/28/17 at http://www.faa.gov/airports/airport_safety/airportdata_5010/menu/

Runway End	Latitude	Longitude	Elevation (ft. MSL)	Length (ft.)	Approach Angle (degrees)	Displaced Thresholds
8L	32.573789	-116.993422	526.3	7972	3	0
26R	32.571649	-116.967669	507.6	7972	4	0
8R	32.571582	-116.984332	520.8	3180	3	0
26L	32.570731	-116.974058	505.0	3180	3	0

3. Aircraft Operations

The derivation of the fleet mix utilized existing aircraft operations at SDM and includes charter, local and itinerant general aviation aircraft. The operations described below comprise the proposed 2037 forecast conditions for submittal of the SDM Master Plan. The aircraft operations data entered into AEDT includes the number of day, evening, and night arrivals, departures, and pattern/touch-and-go operations (as appropriate). The number of operations is an expression of an annual average day, determined by dividing the annual operations by 365 days. Additional inputs include taxi time and auxiliary power unit (APU) time for each aircraft where applicable. Table 2 through Table 5 on pages 3 through 4 list the modeled annual average day arrival, departure, and circuit operations, respectively, by aircraft type at SDM for forecast 2037 conditions.

Table 2: Modeled Average Daily Arrivals - Aircraft Fleet Mix and Operations at SDM for 2037

AEDT Type	Engine	Taxi Time (seconds)	Annual Average Day Operations – Arrivals			
			Day	Evening	Night	Total
LEAR35	TFE731-2-2B	600	3.723	0.301	0.217	**4.241**
LEAR35	TFE731-3	600	2.501	0.233	0.156	**2.891**
CL600	CF34-3B	600	5.668	0.529	0.354	**6.550**
GV	BR700-710A2-20	600	0.415	0.039	0.026	**0.479**
F-18	F404-GE-400	600	0.990	0.084	0.035	**1.109**
CNA208	PT6A-67B	600	0.391	0.026	0.015	**0.433**
CNA172	O-320	600	8.028	0.384	0.205	**8.617**
COMSEP	TIO-540-J2B2[1]	600	0.917	0.044	0.023	**0.985**
GASEPV	TIO-540-J2B2[1]	600	1.070	0.051	0.027	**1.149**
GASEPV	TIO-540-J2B2[1]	600	5.855	0.280	0.150	**6.285**
GASEPV	TSIO36	600	8.783	0.421	0.224	**9.428**
BEC58P	TSIO-360C	600	0.287	0.009	0.016	**0.312**
BEC58P	IO-360-B	600	0.287	0.009	0.016	**0.312**
BEC58P	TIO540[2]	600	4.023	0.124	0.227	**4.373**
BEC58P	TIO-540-J2B2	600	3.448	0.106	0.195	**3.749**
BEC58P	TIO540[2]	600	2.873	0.088	0.162	**3.124**
DHC6	PT6A-42[3]	600	0.727	0.049	0.028	**0.804**
DHC6	PT6A-42[3]	600	2.025	0.118	0.095	**2.238**
EC130	TPE331-3	600	0.148	0.011	0.000	**0.159**
R44	TIO-540-J2B2	600	0.099	0.008	0.000	**0.106**
S70	T700-GE-700	600	0.033	0.066	0.230	**0.329**
C130	T56 series III	600	1.880	0.104	0.094	**2.079**
JPATS	PT6A-62	600	0.342	0.019	0.017	**0.378**
Subtotal			**54.514**	**3.104**	**2.513**	**60.131**

[1] Repeated GASEPV aircraft with engine type TIO-540-J2B2 indicate multiple AEDT equipment IDs used for airframe identification.
[2] Repeated BEC58P aircraft with engine type TIO540 indicate multiple AEDT equipment IDs used for airframe identification.
[3] Repeated DHC6 aircraft with engine type TIO540 indicate multiple AEDT equipment IDs used for airframe identification.
Note: Totals may not match exactly due to rounding. Repeated Aircraft and engine type indicates change in AEDT equipment ID.

Table 3. Modeled Average Daily Departures - Aircraft Fleet Mix and Operations at SDM for 2037

Aircraft	Engine	Taxi Time (seconds)	Stage Length	Annual Average Day Operations – Departures			
				Day	Evening	Night	Total
LEAR35	TFE731-2-2B	600	1	3.877	0.185	0.179	**4.241**
LEAR35	TFE731-3	600	1	2.615	0.137	0.138	**2.891**
CL600	CF34-3B	600	1	5.926	0.311	0.313	**6.550**
GV	BR700-710A2-20	600	1	0.434	0.023	0.023	**0.479**
F-18	F404-GE-400	600	1	1.012	0.065	0.032	**1.109**
CNA208	PT6A-67B	600	1	0.382	0.029	0.022	**0.433**
CNA172	O-320	600	1	8.378	0.136	0.104	**8.617**
COMSEP	TIO-540-J2B2[1]	600	1	0.957	0.015	0.012	**0.985**
GASEPV	TIO-540-J2B2[1]	600	1	1.117	0.018	0.014	**1.149**
GASEPV	TIO-540-J2B2[1]	600	1	6.110	0.099	0.076	**6.285**
GASEPV	TSIO36	600	1	9.165	0.148	0.114	**9.428**
BEC58P	TSIO-360C	600	1	0.293	0.015	0.004	**0.312**
BEC58P	IO-360-B	600	1	0.293	0.015	0.004	**0.312**
BEC58P	TIO540[2]	600	1	4.102	0.213	0.058	**4.373**
BEC58P	TIO-540-J2B2	600	1	3.516	0.182	0.050	**3.749**
BEC58P	TIO540[2]	600	1	2.930	0.152	0.041	**3.124**
DHC6	PT6A-42[3]	600	1	0.709	0.054	0.040	**0.804**
DHC6	PT6A-42[3]	600	1	2.062	0.097	0.079	**2.238**
EC130	TPE331-3	600	1	0.133	0.027	0.000	**0.159**
R44	TIO-540-J2B2	600	1	0.088	0.018	0.000	**0.106**
S70	T700-GE-700	600	1	0.033	0.066	0.230	**0.329**
C130	T56 series III	600	1	1.941	0.074	0.063	**2.079**
JPATS	PT6A-62	600	1	0.353	0.014	0.011	**0.378**
Subtotal				**56.428**	**2.095**	**1.608**	**60.131**

[1] Repeated GASEPV aircraft with engine type TIO-540-J2B2 indicate multiple AEDT equipment IDs used for airframe identification.
[2] Repeated BEC58P aircraft with engine type TIO540 indicate multiple AEDT equipment IDs used for airframe identification.
[3] Repeated DHC6 aircraft with engine type TIO540 indicate multiple AEDT equipment IDs used for airframe identification.
Note: Totals may not match exactly due to rounding. Repeated Aircraft and engine type indicates change in AEDT equipment ID.

Table 4: Modeled Average Daily Circuits - Aircraft Fleet Mix and Operations at SDM for 2037

Aircraft	Engine	Taxi Time (seconds)	Annual Average Day Operations – Circuits			
			Day	Evening	Night	Total
CNA172	O-320	600	92.757	0.000	0.000	92.757
COMSEP	TIO-540-J2B2	600	10.601	0.000	0.000	10.601
GASEPV	TIO-540-J2B2	600	12.368	0.000	0.000	12.368
EC130	TPE331-3	600	0.319	0.000	0.000	0.319
R44	TIO-540-J2B2	600	0.212	0.000	0.000	0.212
S70	T700-GE-700	600	0.198	0.395	1.383	1.975
Subtotal			**116.453**	**0.395**	**1.383**	**118.231**

Note: Totals may not match exactly due to rounding. Repeated Aircraft and engine type indicates change in AEDT equipment ID.

Table 5. Modeled Average Daily Operations at SDM for 2037

Operation	Annual Average Day Operations			
	Day	Evening	Night	Total
Arrivals	54.514	3.104	2.513	**60.131**
Departures	56.428	2.095	1.608	**60.131**
Circuits	116.453	0.395	1.383	**118.231**
Subtotal	**227.395**	**5.594**	**5.504**	**238.493**

Note: Totals may not match exactly due to rounding.

4. Aircraft Noise and Performance Characteristics

AEDT requires the use of specific noise and performance data for each aircraft type operating at the airport. Noise data is in the form of Sound Exposure Level (SEL) at a range of distances (from 200 feet to 25,000 feet) from a particular aircraft with engines at a range of thrust levels. Performance data include thrust, speed and altitude profiles for takeoff and landing operations. The AEDT database contains standard noise and performance data for over 300 different fixed-wing aircraft types, most of which are civilian aircraft.

Within the AEDT database, it is standard for aircraft takeoff or departure profiles to be defined by a range of trip distances identified as "stage lengths." Higher stage lengths (longer trip distances) are associated with a heavier aircraft due to the increase in fuel requirements for the flight. For the SDM Master Plan, stage lengths are defined using city pair distances, determined by the great-circle distance from the originating airport to the planned arrival city.

Aside from identifying the aircraft type in the database, AEDT has STANDARD and International Civil Aviation Organization (ICAO) aircraft flight profiles for takeoffs, landings, and flight patterns or touch-and-go operations. HMMH used STANDARD profiles for all non-military aircraft types. A standard NOISEMAP profile (only one available in the model) was used to model the F-18 aircraft.

5. Runway Utilization

The primary factor affecting runway use at airports is weather; specifically, the wind direction and wind speed. An additional factor that may affect runway use includes the position of the facility or ramp relative to the runway.

HMMH utilized 2016 radar data obtained from the City of San Diego's Symphony EnvironmentalVue® environmental monitoring system to compile runway use tables and categorized this information by arrival or departure as well as day, evening, and night.

Table 6 and Table 7 present the runway utilization rates used to model the CNEL contours for the forecast 2037 operations at SDM for all civilian fixed-wing aircraft. Table 8 and Table 9 show runway utilization for the F-18 aircraft. Table 10 and Table 11 show runway utilization for the helicopters.

Table 6. Runway Utilization for Fixed-wing Aircraft

Operation	Runway	Day	Evening	Night
Arrival	08L	7.4%	17.5%	49.6%
	08R	0.4%	0.0%	0.8%
	26L	13.5%	10.1%	4.0%
	26R	78.7%	72.5%	45.6%
	Total	**100%**	**100%**	**100%**
Departure	08L	5.7%	7.3%	21.5%
	08R	0.7%	0.8%	3.8%
	26L	0.3%	0.6%	0.0%
	26R	93.2%	91.3%	74.7%
	Total	**100%**	**100%**	**100%**
Circuit	08L	6.6%	0.0%	0.0%
	08R	0.0%	0.0%	0.0%
	26L	89.9%	0.0%	0.0%
	26R	3.5%	0.0%	0.0%
	Total	**100%**	**100%**	**100%**
Note: Totals may not match exactly due to rounding				

Table 7. Average Daily Runway Utilization for Fixed-wing Aircraft

Arrival/Departure	Runway				Total
	08L	08R	26L	26R	
Arrivals	8.6%	0.4%	13.2%	77.8%	**100%**
Departures	6.1%	0.8%	0.3%	92.8%	**100%**
Circuits	8.1%	0.0%	87.6%	4.3%	**100%**
Note: Totals may not match exactly due to rounding					

Table 8. Runway Utilization for F-18 Aircraft

Operation	Runway	Day	Evening	Night
Arrival	08L	8.5%	19.4%	52.1%
	08R	0.0%	0.0%	0.0%
	26L	0.0%	0.0%	0.0%
	26R	91.5%	80.6%	47.9%
	Total	**100%**	**100%**	**100%**
Departure	08L	5.8%	7.4%	22.4%
	08R	0.0%	0.0%	0.0%
	26L	0.0%	0.0%	0.0%
	26R	94.2%	92.6%	77.6%
	Total	**100%**	**100%**	**100%**
Note: Totals may not match exactly due to rounding				

Table 9. Average Daily Runway Utilization for F-18 Aircraft

Arrival/Departure	Runway				Total
	08L	08R	26L	26R	
Arrivals	10.0%	0.0%	0.0%	90.0%	**100%**
Departures	6.1%	0.0%	0.0%	93.9%	**100%**
Note: Totals may not match exactly due to rounding					

Table 10. Runway Utilization for Helicopters

Operation	Runway	Day	Evening	Night
Arrival	08L	1.5%	3.5%	10.1%
	08R	6.2%	14.0%	40.3%
	26L	73.8%	66.0%	39.7%
	26R	18.5%	16.5%	9.9%
	Total	**100%**	**100%**	**100%**
Departure	08L	1.3%	1.6%	5.1%
	08R	5.2%	6.5%	20.2%
	26L	74.8%	73.5%	59.8%
	26R	18.7%	18.4%	14.9%
	Total	**100%**	**100%**	**100%**
Circuit	08L	0.0%	0.0%	0.0%
	08R	9.0%	9.0%	9.0%
	26L	91.0%	91.0%	91.0%
	26R	0.0%	0.0%	0.0%
	Total	**100%**	**100%**	**100%**
Note: Totals may not match exactly due to rounding				

Table 11. Average Daily Runway Utilization For Helicopters

Operation	Runway				Total
	08L	08R	26L	26R	
Arrivals	1.80%	7.2%	72.8%	18.2%	**100%**
Departures	1.4%	5.5%	74.5%	18.6%	**100%**
Circuits	9.0%	0.0%	0.0%	91.0%	**100%**
Note: Totals may not match exactly due to rounding					

6. Flight Track Geometry and Use

HMMH used an industry-standard method to develop model tracks that entails analyzing all radar data for SDM by splitting the flight tracks into similar and manageable groups. The standard procedure entails separating tracks by operation type, (e.g., arrival or departure) and runway end. Next, the destination direction (e.g. northeast, south, west, etc.) define flight track groups. HMMH analyzed flight tracks with the same operation type, runway end, and destination direction for similar geometry and this resulted in the final flight track bundles used to create model tracks. For example, Runway 28R Arrivals (A28RJT10) that originated north of SDM were bundled into one geometrically similar group. Geometrically similar groups with wide dispersion have a 'backbone' track and one 'dispersion' sub tracks on either side of the backbone, for three tracks (one backbone and 2 'dispersion' tracks). All other geometrically similar groups were assigned one backbone track. Figure 2 through Figure 7 on pages 8 through 13 show the modeled tracks layered over the airport base map.

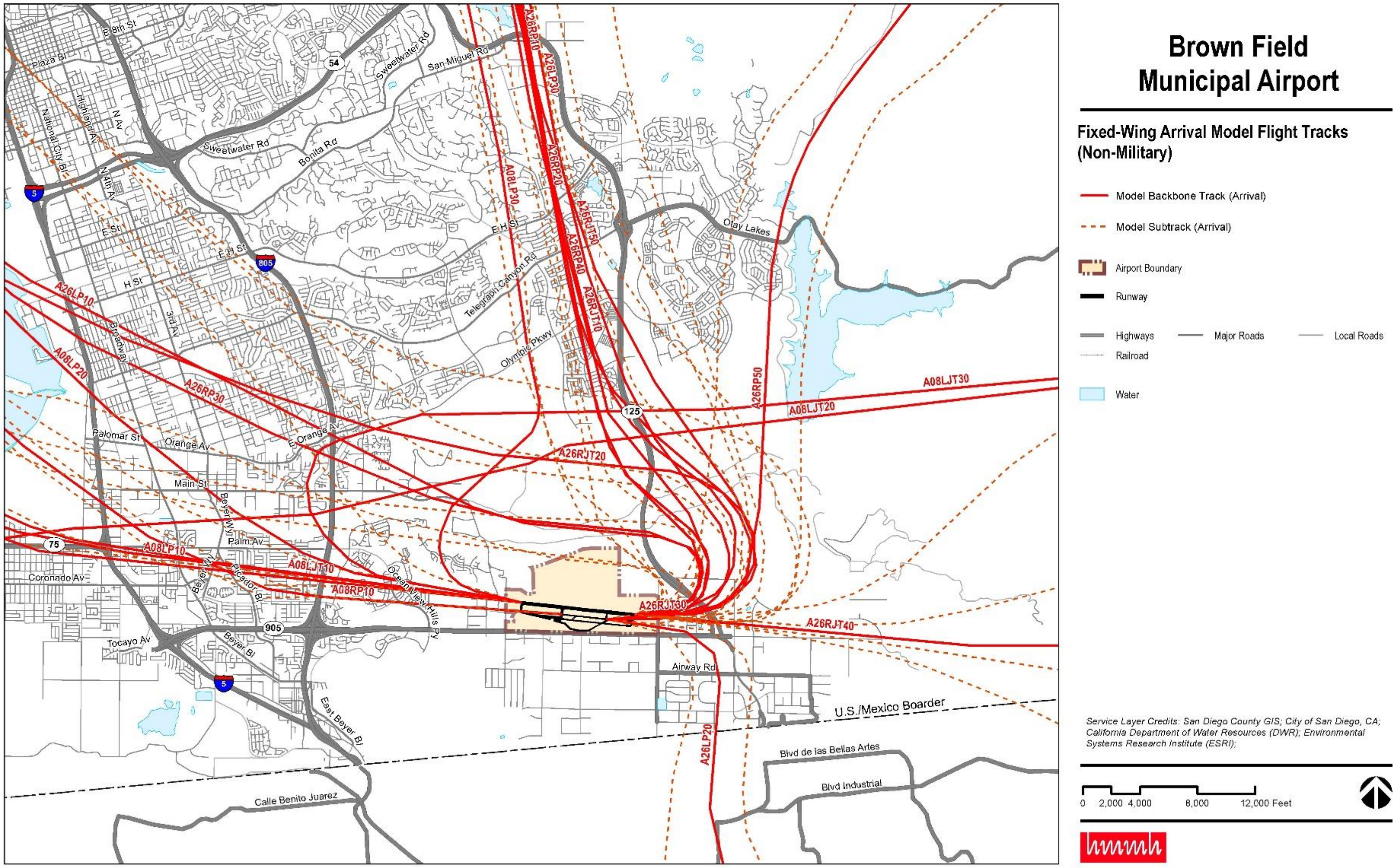

Figure 2. Civilian Fixed-Wing Arrival Model Tracks

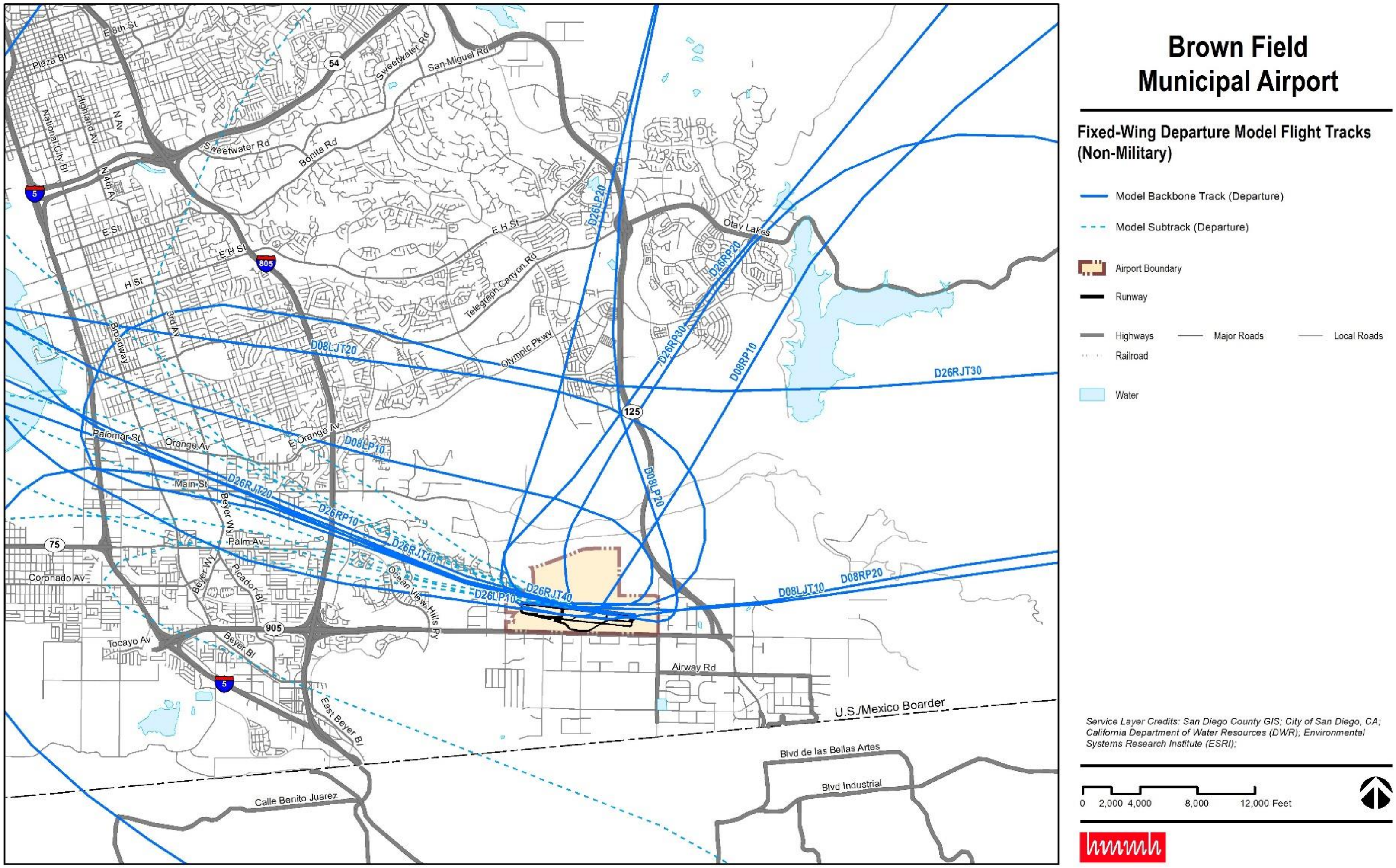

Figure 3. Civilian Fixed-Wing Departure Model Tracks

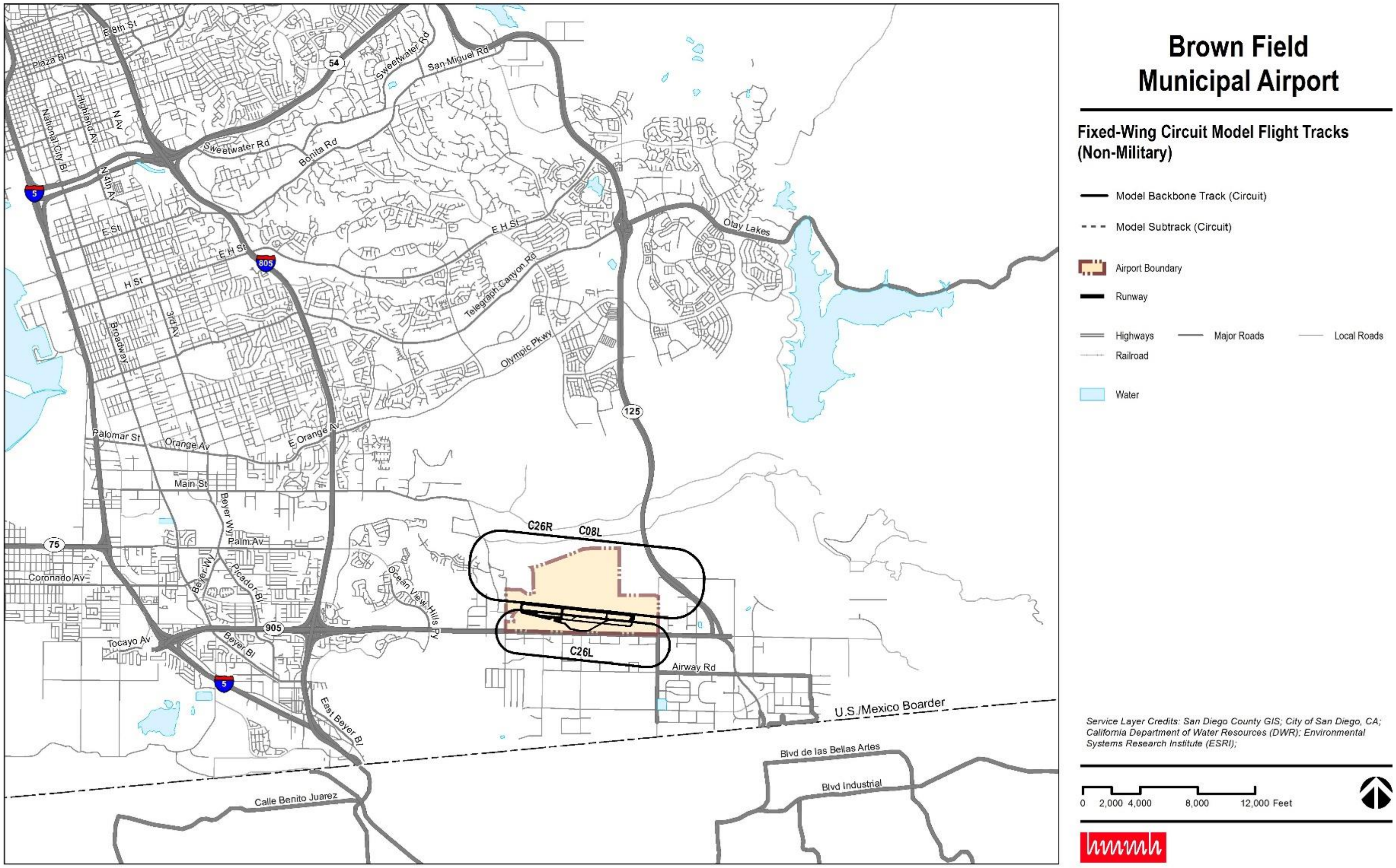

Figure 4. Civilian Fixed-Wing Circuit Model Tracks

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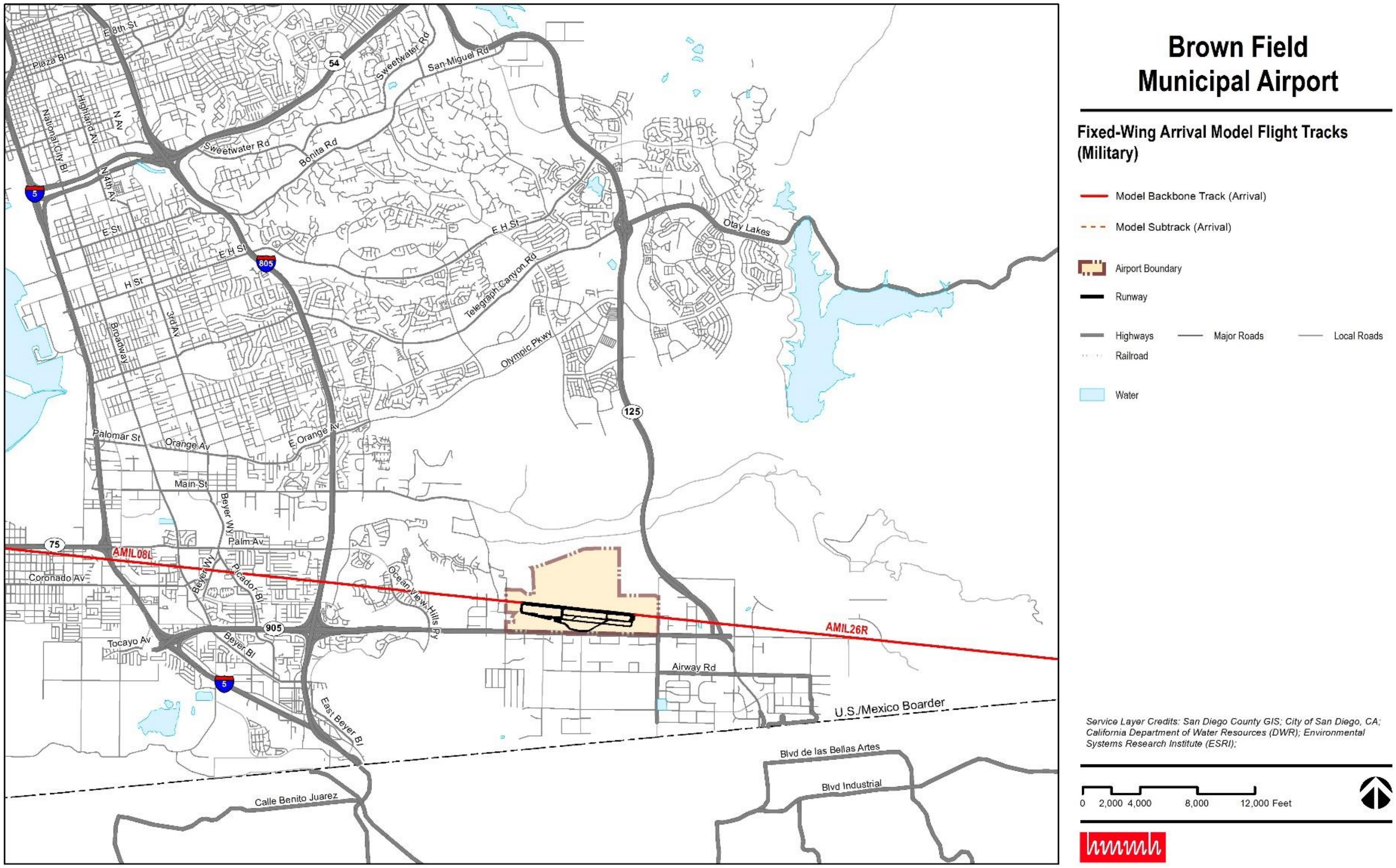

Figure 5. Military Departure Model Tracks

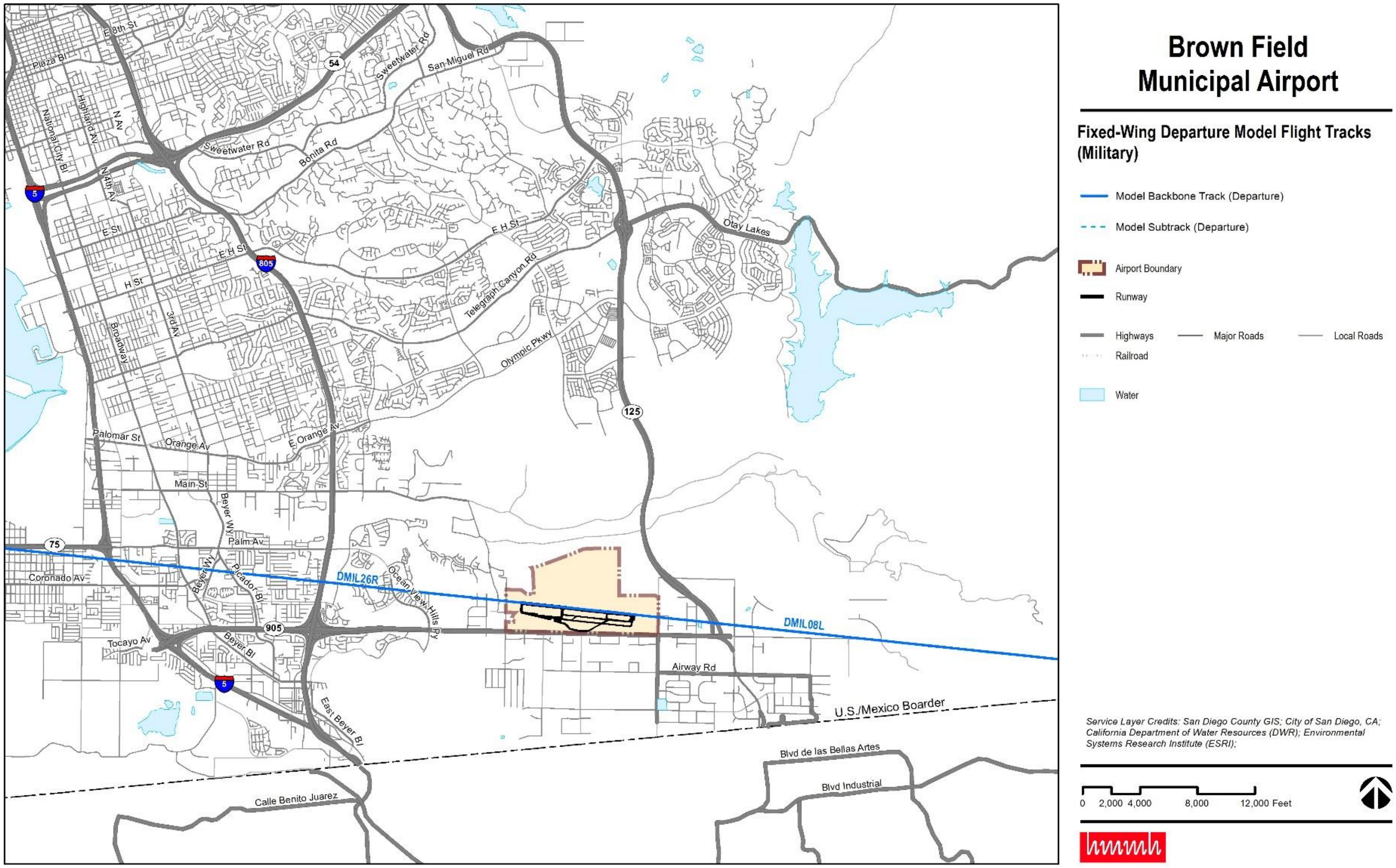

Figure 6. Military Departure Model Tracks

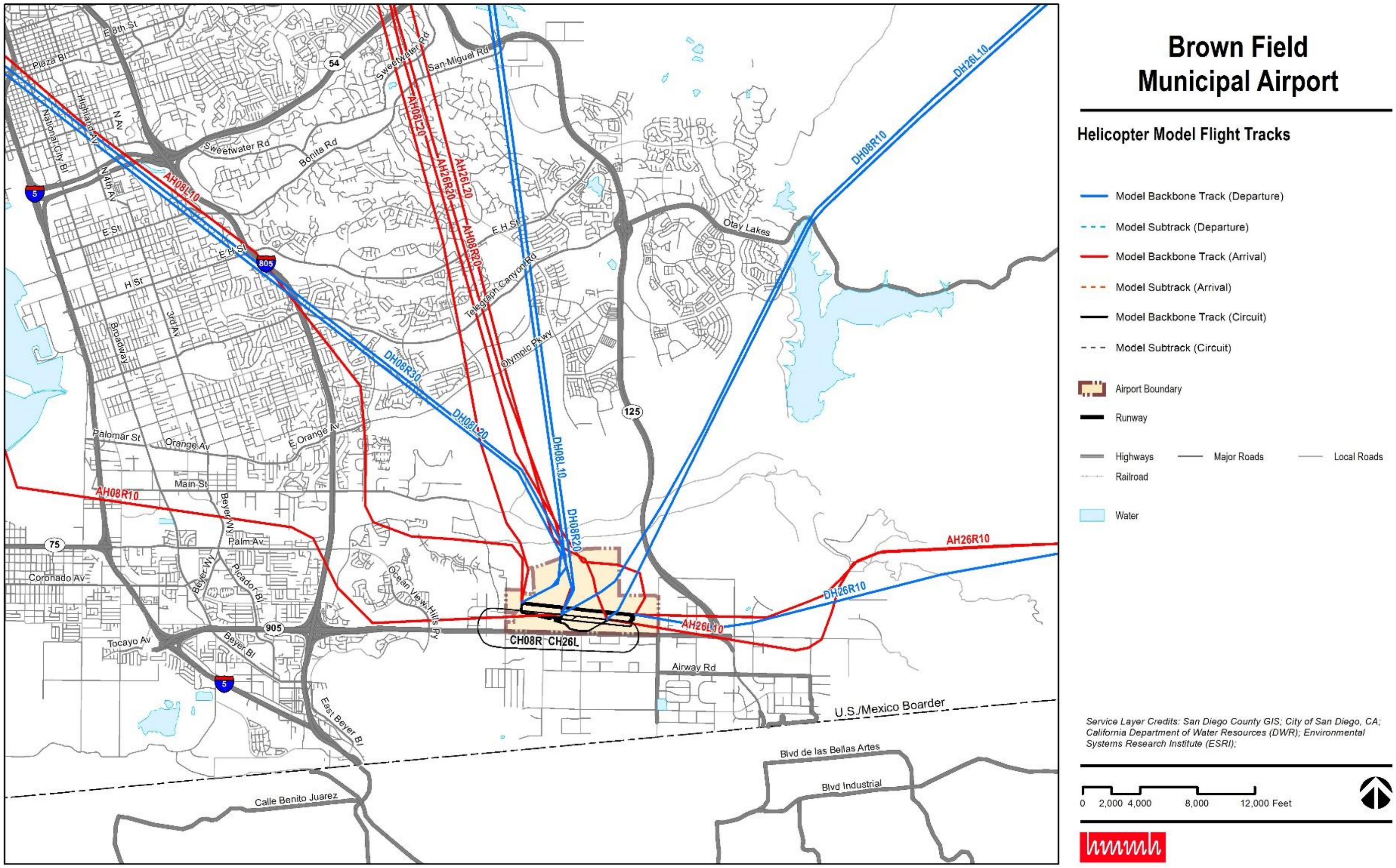

Figure 7. Helicopter Model Tracks

Table 12 presents the utilization rates for each of the developed model tracks. The relative ratio of flight track usage is consistent with those ratios in the entire radar dataset.

Table 12. Flight Track Utilization for Civilian Aircraft

Operation Type	Runway	Aircraft Type	Track ID	Percent Use
Arrivals	**08L**	**Civilian**	A08LJT10	23.92%
			A08LJT11	5.56%
			A08LJT12	5.56%
			A08LJT20	5.84%
			A08LJT30	10.22%
			A08LP10	14.60%
			A08LP20	18.44%
			A08LP21	4.29%
			A08LP22	4.29%
			A08LP30	7.30%
		Rwy 08L Civilian Aircraft Arrival Subtotal		**100%**
		Ⓗ	AH08L10	60.00%
			AH08L20	40.00%
		Rwy 08L Ⓗ Arrival Subtotal		**100%**
		Military	AMIL08L	100.00%
		Rwy 08L Military Arrival Subtotal		**100%**
	08R	**Civilian**	A08RP10	68.26%
			A08RP11	15.87%
			A08RP12	15.87%
		Rwy 08R Civilian Aircraft Arrival Subtotal		**100%**
		Ⓗ	AH08R10	55.56%
			AH08R20	44.44%
		Rwy 08R Ⓗ Arrival Subtotal		**100%**
	26L	Ⓗ	A26LP10	17.53%
			A26LP11	4.07%
			A26LP12	4.07%
			A26LP20	31.36%
			A26LP21	7.29%
			A26LP22	7.29%
			A26LP30	28.38%
		Rwy 26L Civilian Aircraft Arrival Subtotal		**100%**
		Ⓗ	AH26L10	60.00%
			AH26L20	40.00%
		Rwy 26L Ⓗ Arrival Subtotal		**100%**
	26R	**Civilian**	A26RJT10	2.51%
			A26RJT20	6.34%
			A26RJT21	1.47%
			A26RJT22	1.47%
			A26RJT30	5.63%
			A26RJT31	1.31%
			A26RJT32	1.31%
			A26RJT40	17.47%
			A26RJT41	11.04%
			A26RJT42	11.04%
			A26RJT43	2.85%
			A26RJT44	2.85%
			A26RJT50	1.62%
			A26RP10	5.38%
			A26RP11	1.25%
			A26RP12	1.25%
			A26RP20	3.57%

Operation Type	Runway	Aircraft Type	Track ID	Percent Use
			A26RP21	0.83%
Arrivals (Continued)	26R (Continued)	Civilian (Continued)	A26RP22	0.83%
			A26RP30	9.86%
			A26RP31	2.29%
			A26RP32	2.29%
			A26RP40	1.56%
			A26RP41	0.36%
			A26RP42	0.36%
			A26RP50	2.21%
			A26RP51	0.51%
			A26RP52	0.51%
		Rwy 26R Civilian Aircraft Arrival Subtotal		**100%**
		Ⓗ	AH26R10	42.86%
			AH26R20	57.14%
		Rwy 26R Ⓗ Arrival Subtotal		**100%**
		Military	AMIL26R	100.00%
		Rwy 26R Military Aircraft Arrival Subtotal		**100%**
Departures	**08L**	**Civilian**	D08LJT10	14.93%
			D08LJT20	32.84%
			D08LP10	25.37%
			D08LP20	26.87%
		Rwy 08L Civilian Aircraft Departure Subtotal		**100%**
		Ⓗ	DH08L10	42.86%
			DH08L20	57.14%
		Rwy 08L Ⓗ Departure Subtotal		**100%**
		Military	DMIL08L	100.00%
		Rwy 08L Military Departure Subtotal		**100%**
	08R	**Civilian**	D08RP10	64.71%
			D08RP20	35.29%
		Rwy 08R Civilian Aircraft Departure Subtotal		**100%**
		Ⓗ	DH08R10	52.63%
			DH08R20	26.32%
			DH08R30	21.05%
		Rwy 08R Ⓗ Departure Subtotal		**100%**
	26L	**Civilian**	D26LP10	53.85%
			D26LP20	46.15%
		Rwy 26L Civilian Aircraft Departure Subtotal		**100%**
		Ⓗ	DH26L10	100.00%
		Rwy 26L Ⓗ Departure Subtotal		**100%**
	26R	**Civilian**	D26RJT10	38.09%
			D26RJT11	8.86%
			D26RJT12	8.86%
			D26RJT20	2.00%
			D26RJT21	0.47%
			D26RJT22	0.47%
			D26RJT30	4.04%
			D26RJT40	10.86%
			D26RJT41	2.52%
			D26RJT42	2.52%
			D26RP10	11.79%
			D26RP11	2.74%
			D26RP12	2.74%
			D26RP20	1.69%
			D26RP30	2.35%
		Rwy 26R Civilian Aircraft Departure Subtotal		**100%**

Operation Type	Runway	Aircraft Type	Track ID	Percent Use
		Ⓗ	DH26R10	100.00%
		Rwy 26R Ⓗ Departure Subtotal		**100%**
Departures (Continued)	**26R Continued)**	**Military**	DMIL26R	100.00%
		Rwy 26R Military Departure Subtotal		**100%**
Circuits	**08L**	**Civilian**	C08L	100.00%
		Rwy 08L Civilian Aircraft Circuit Subtotal		**100%**
	08R	Ⓗ	CH08R	100.00%
		Rwy 08R Ⓗ Circuit Subtotal		**100%**
	26L	**Civilian**	C26L	100.00%
		Rwy 26L Civilian Aircraft Circuit Subtotal		**100%**
	26L	Ⓗ	CH26L	100.00%
		Rwy 26L Ⓗ Circuit Subtotal		**100%**
	26R	**Civilian**	C26R	100.00%
		Rwy 26L Civilian Aircraft Circuit Subtotal		**100%**

Note: Totals may not match exactly due to rounding
Note: Ⓗ denotes helicopter track utilization

7. Meteorological Conditions

The AEDT has several settings that affect aircraft performance profiles and sound propagation based on meteorological data. Meteorological settings include average annual temperature, barometric pressure, and relative humidity at the airport. The AEDT holds the following default values for annual average weather conditions at SDM:

- Temperature: 63.0º F
- Sea-level Pressure: 1015.3 millibars
- Relative Humidity 69.69%
- Dew Point: 51.16° F
- Wind Speed: 5.39 Knots

8. Terrain Data

Terrain data describes the elevation of the ground surrounding the airport and on airport property. The AEDT uses terrain data to adjust the ground level under the flight paths. The terrain data does not change the aircraft's performance or noise levels, but does alter the vertical distance between the aircraft and a "receiver" on the ground. This affects assumptions about how noise propagates over ground. HMMH obtained the terrain data from the Department of Agriculture (USDA) Geospatial Data Gateway and utilized this in conjunction with the terrain feature of the AEDT to generate the noise contours and air quality emissions for the SDM Master Plan.

9. Contour Results

Figure 8 presents the 2037 Master Plan CNEL forecast contour at SDM. Figure 9 presents a comparison of the 2017 baseline and 2037 forecast CNEL contours at SDM.

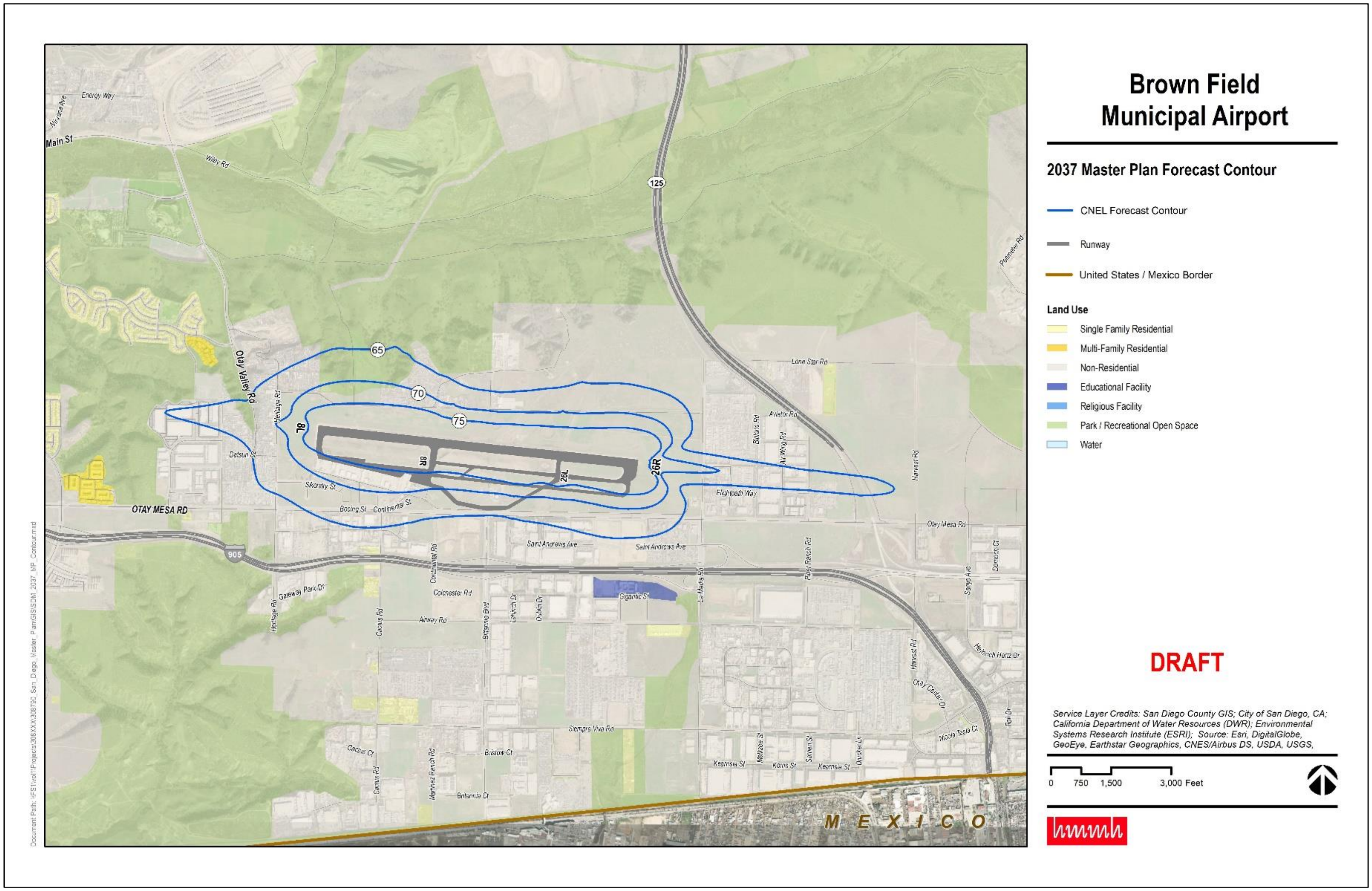

Figure 8. 2037 Master Plan Forecast CNEL Contour

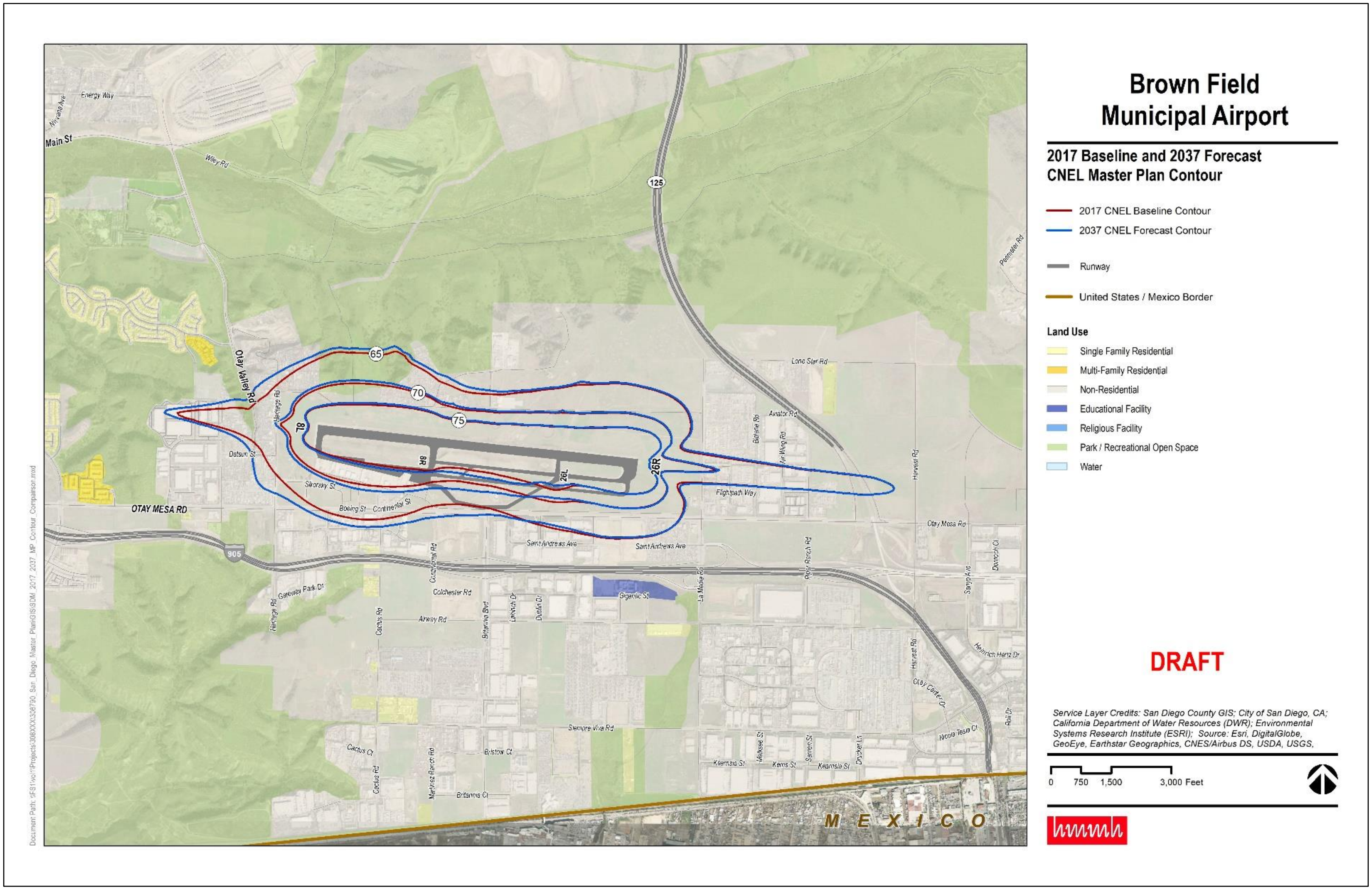

Figure 9. 2017 Baseline and 2037 Forecast CNEL Contour Comparison

10. Aircraft Methodology and Emissions Characteristics

The sources assessed in this emission inventory include aircraft engines and auxiliary power units (APU), where applicable.[1] HMMH conducted the analysis following FAA's *Aviation Emissions and Air Quality Handbook, Version 3 Update 1*[2] *and* AEDT. AEDT is the FAA-required computer model for assessing air emissions associated with airports. The fleet mix, LTO and touch and go operations were consistent with the noise analysis.

The U.S. Environmental Protection Agency (EPA) enforces the Clean Air Act (CAA), established in 1970 and last amended in 1990, which established National Ambient Air Quality Standards (NAAQS) for six principal criteria. Prior to the CAA, in 1959, the California State Department of Public Health received direction from their state legislature to develop California Ambient Air Quality Standards (CAAQS), established in 1962. In 1967, the legislature created the Air Resources Board (ARB). In 1969, the CAAQS became under the jurisdiction of the ARB, prior to any federal law on air quality.[3] CAAQS criteria pollutants include all six NAAQS criteria pollutants, plus an additional four, two of which are covered under particulate matter, one odor-based, and the final a historical CAAQS, in place should sources of it arise again. The six overlapping criteria air pollutants analyzed for the purposes of the MYF master plan include:[4]

1. Carbon monoxide (CO)
2. Nitrogen dioxide (NO_2); calculated and expressed as NO_x
3. Particulate Pollution PM (PM10) and (PM2.5)
4. Sulfur dioxide (SO_2)
5. Lead (Pb)
6. Ozone (O_3)

It should be noted that ozone is an indirect or secondary pollutant that occurs due to chemical reactions primarily between NO_x and volatile organic compounds (VOCs). As a result, volatile organic compounds (VOCs) and NOx, the primary precursors to ozone formation, provide surrogate information for assessing ozone levels. In addition, HMMH estimated carbon dioxide (CO_2) emissions as a greenhouse gas, though this estimation does not account for the varying greenhouse gases and their associated emissions factors in comparison to CO_2.

AEDT requires additional input data for air quality analysis including aircraft type operating at the airport. Engine type, taxi times, and auxiliary power unit (APU) usage is needed to determine air quality pollutant emissions; including greenhouse gas emissions and fuel burn. The analysis of aircraft taxi activity to and from the ramps included both aircraft types selected from the 2037 forecast fleet mix at SDM and default taxi times from the AEDT as inputs. Similarly, HMMH assumed default AEDT APU times for each aircraft type. Annual aircraft emissions are a function of the number of aircraft operations expressed as landing and takeoff (LTO) cycles, the aircraft fleet mix (types of aircraft used), and the length of time aircraft spend in each of the modes of operation defined in AEDT. For this analysis, estimates for emissions came from the following aircraft modes[5]:

- Startup;
- Taxiing;
- Takeoff ground roll;
- Climb to mixing height and Descend from mixing height; and
- Landing ground roll.

Pollutant emissions for aircraft operations using the above assumptions were estimated using AEDT for the LTO modes and touch and go (e.g. circuit model) operations below the mixing height including idle, taxing, climb, and descent. Per standard, HMMH assumed a default mixing height of 3,000 feet above ground level. Lead emissions are associated with leaded aviation fuel used in GA piston engine aircraft. AEDT does not estimate

[1] APU emissions at SDM we modeled for aircraft type CL60 and are included in the overall aircraft emissions in Table 13.
[2] FAA. *Aviation Emissions and Air Quality Handbook.* https://www.faa.gov/regulations_policies/policy_guidance/envir_policy/airquality_handbook/media/Air_Quality_Handbook_Appendices.pdf
[3] ARB. 2017. *CAAQS.* https://www.arb.ca.gov/research/aaqs/caaqs/caaqs.htm. Accessed September 20, 2017.
[4] EPA. 2017. *NAAQS Table.* https://www.epa.gov/criteria-air-pollutants/naaqs-table. Accessed September 20, 2017.
[5] In the AEDT output, these modes are all represented in the "ClimbBelowMixingHeight" and "DescendBelowMixingHeight" source grouping.

lead emissions directly. Therefore, HMMH calculated these emissions seperately based on fuel consumption and lead fuel content consistent with FAA/EPA methodology described in the Handbook.[6]

11. Emission Results

Table 13 presents a comparison of the 2017 baseline and 2037 forecast pollutant emissions in tons per year (TPY) for all SDM aircraft operations.[7] The first six pollutants are the overlapping NAAQS/CAAQS criteria pollutant (PM10 and PM2.5 are considered in the CAA as one Pollutant category Particle Pollution PM) according to the EPA and California ARB, as discussed in Section 10. HMMH has also chosen to report tons of CO_2 directly from the AEDT model for the baseline in order to continually track this number, though it is not a criteria pollutant, it is standard to report this number when assessing air quality emissions.[8] . The results show that a slight increase in emissions is expected for all pollutants except lead which we believe is attributable to slightly less avgas usage in 2037.

Table 13 Baseline 2017 and Forecast 2037 Aircraft Emissions (Tons Per Year) at SDM

Source	CO	NO_x	PM10	PM2.5	SO_2	VOC	Lead (Pb)	CO_2
2017 Baseline Aircraft Total	**504.771**	**7.394**	**0.647**	**0.647**	**1.605**	**18.167**	**0.398**	**4,212.908**
2037 Forecast Aircraft Total	**551.548**	**19.219**	**0.866**	**0.866**	**4.093**	**35.879**	**0.378**	**10,821.730**
Difference (2037-2017)	**46.777**	**11.825**	**0.219**	**0.219**	**2.488**	**17.712**	**-0.020**	**6,608.822**

Note: All emissions were modeled using AEDT as the model and Aviation Emissions and Air Quality Handbook, Version 3 Update 1 aside from Lead (Pb) which utilized guidance given in the Handbook; specifically Equation A1-3 – Lead Emission Calculation. See Section 10 and footnote 6 for further information.

[6] FAA. Equation A1-3 (Lead Emission Calculation) found on page 4 of Appendix A, page 119 of the full document. *Aviation Emissions and Air Quality Handbook.* https://www.faa.gov/regulations_policies/policy_guidance/envir_policy/airquality_handbook/media/Air_Quality_Handbook_Appendices.pdf

[7] APU emissions at SDM we modeled for aircraft type CL60 and are included in the overall aircraft emissions in Table 13.

[8] CO2 emissions alone do not account for the full range of greenhouse gas emissions at an airport but is a useful metric to track for that purpose.