

ENERGY CALCULATIONS

ATTACHMENT C

to the
841 Old County Road Project Initial Study / Mitigated Negative Declaration

Construction Energy Use

To support the Energy Analysis for the following project: 841 Old County

Construction Equipment/Vehicles

	# of Vehicles	Hrs per Day	Horse- power	Load Factor	Days in Phase	Fuel Used (gallons)
Demolition						
Rubber Tired Dozers	2	2	247	0.4	20	418
Concrete Saws	1	0.1	81	0.73	20	7
Excavators	3	8	158	0.38	20	1,525
Below Grade Excavation/Grading						
Graders	1	0.7	187	0.41	65	185
Excavators	2	8	158	0.38	65	3,303
Rubber Tired Dozers	1	0.7	247	0.4	65	238
Tractors/Loaders/Backhoes	2	3.9	97	0.37	65	1,070
Below Grade Foundation						
Excavators	1	8	158	0.38	50	1,270
Tractors/Loaders/Backhoes	1	4	97	0.37	50	422
Garage Concrete						
Cranes	1	8	231	0.29	87	2,466
Forklifts	3	6	89	0.2	87	1,639
Generator Sets	1	1.8	84	0.74	87	572
Phase I - Building Construction North						
Cranes	1	8	231	0.29	180	5,103
Forklifts	3	6	89	0.2	180	3,391
Tractors/Loaders/Backhoes	2	1.8	97	0.37	180	1,367
Welders	3	0.9	46	0.45	180	592
Phase I Site						
Pavers	2	0.5	130	0.42	80	231
Paving Equipment	2	0.5	132	0.36	80	201
Rollers	2	0.5	80	0.38	80	143
Tractors/Loaders/Backhoes	2	3	97	0.37	80	1,013
Phase II - Building Construction South						
Cranes	1	8	231	0.29	200	5,670
Forklifts	3	6	89	0.2	200	3,768
Tractors/Loaders/Backhoes	2	1.6	97	0.37	200	1,351
Welders	3	0.8	46	0.45	200	584
Phase II Site						
Pavers	2	0.5	130	0.42	80	231
Paving Equipment	2	0.5	132	0.36	80	201
Rollers	2	0.5	80	0.38	80	143
Tractors/Loaders/Backhoes	2	3	97	0.37	80	1,013
Architectural Coating						
Air Compressors	0	0	78	0.48	18	0
Total Fuel Used for Construction Equipment/Vehicles						38,118 gallons (diesel)

Compression-Ignition Engine Brake-Specific Fuel Consumption (BSFC) Factors used in the above calculations are [1]
(in gallons per horsepower-hour/BSFC)

0.0588 <100 horsepower

0.0529 >100 horsepower

Worker Trips

Phase	MPG [2]	Trips	Trip		Days in Phase	Fuel Used (gallons)
			Length (miles)	Total Miles per Day		
Demolition	24	15	10.8	162	20	135
Below Grade Excavation	24	15	10.8	162	65	439
Below Grade Foundations	24	5	10.8	54	50	113
Garage Concrete	24	234	10.8	2527.2	87	9,161
Phase I Building Construction	24	234	10.8	2527.2	180	18,954
Phase I Site	24	20	10.8	216	80	720
Phase II Building Construction	24	234	10.8	2527.2	200	21,060
Phase II Site	24	20	10.8	216	80	720
Total Fuel Used for Construction Worker Trips						51,301 gallons (gasoline)

Vendor Trips

Phase	MPG [2]	Trips	Trip		Days in Phase	Fuel Used (gallons)
			Length (miles)	Total Miles per Day		
Demolition	7.4	0	7.3	0	20	0
Below Grade Excavation	7.4	0	7.3	0	65	0
Below Grade Foundations	7.4	0	7.3	0	50	0
Garage Concrete	7.4	105	7.3	766.5	87	9,012
Phase I Building Construction	7.4	105	7.3	766.5	180	18,645
Phase I Site	7.4	0	7.3	0	80	0
Phase II Building Construction	7.4	105	7.3	766.5	200	20,716
Phase II Site	7.4	0	7.3	0	80	0
Total Fuel Used for Vendor Trips						48,372 gallons (diesel)

Hauling Trips

Phase	MPG [2]	Trips in Phase	Trip		Fuel Used (gallons)
			Length (miles)	Total Miles in Phase	
Demolition	7.4	546	20	10920	1,476
Below Grade Excavation	7.4	15125	20	302500	40,878
Below Grade Foundations	7.4	0	20	0	0
Garage Concrete	7.4	8080	20	161600	21,838
Phase I Building Construction	7.4	380	20	7600	1,027
Phase I Site	7.4	26	20	520	70
Phase II Building Construction	7.4	590	20	11800	1,595
Phase II Site	7.4	24	20	480	65
Total Fuel Used for Hauling Trips					66,949 gallons (diesel)

Total Construction Fuel Use **153,439 gallons (diesel)**
51,301 gallons (gasoline)

Fuel Use Converted to MMBtu

	Total Construction Fuel Use (gallons)	Conversion Factor Btu/gallon	Source	Fuel Converted to Energy Use
Diesel	153,439	137,381	[3]	21,080 MMBtu
Gasoline	51,301	109,786	[4]	5,632 MMBtu
Total Energy Use from Construction Fuel				26,712 MMBtu

Operational Energy Use

Operational Vehicular Fuel Use

Gross Annual VMT	7,098,639
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Fleet Class	2026 Fleet Mix	VMT per Class	Fuel Economy [3]	Fuel Consumption (gallons)	
Light Duty Auto (LDA)	0.430608	3056730.7	30.9	98923.33	
Light Duty Truck 1 (LDT1)	0.03901	276917.91	26.63	10398.72	
Light Duty Truck 2 (LDT2)	0.288195	2045792.3	24.36	83981.62	
Medium Duty Vehicle (MDV)	0.168896	1198931.7	20.2	59353.06	
Motorcycle (MCY)	0.00432	30666.12	37.06	827.47	Total Gasoline 253,484
Light Heavy Duty 1 (LHD1)	0.033969	241133.67	18.23	13227.30	gallons
Light Heavy Duty 2 (LHD2)	0.007587	53857.374	16.24	3316.34	
Medium Heavy Duty (MHD)	0.012483	88612.311	9.43	9396.85	
Heavy Heavy Duty (HHD)	0.007199	51103.102	6.42	7959.98	
Other Bus (OBUS)	0.004815	34179.947	8.26	4138.01	
Urban Bus (UBUS)	0.001838	13047.298	5.17	2523.66	
School Bus (SBUS)	0.00042	2981.4284	7.25	411.23	
Motorhome (MH)	0.000661	4692.2004	9.91	473.48	Total Diesel 41,447
					gallons

Note that the above numbers represent gross fuel consumption.

The project is required to implement a TDM program, which would be expected to reduce VMT, resulting in the following gasoline usage:

Anticipated TDM VMT reduction: [4] 20%

Resultant Total Gasoline Use with TDM Reductions: 202,787 gallons (gasoline)

	Total Fuel Use (gallons)	Conversion Factor Btu/gallon	Source	Fuel Converted to Use	Energy
Diesel	41,447	137,381	[3]	5,694 MMBtu	
Gasoline	202,787	109,786	[4]	22,263 MMBtu	
Total Energy Use from Operational Fuel				27,957 MMBtu	

Operational Built Environment

Type of Energy	Annual Usage	Units	Converted to MMBtu
Electricity	4.15E+06 kWh		14,167
Natural Gas		0 kBtu	0

Sum of above

Total Annual Operational Energy Use 42,124 MMBtu

Existing and Net Energy Use

Net Operational Vehicular Fuel Energy Use

To determine the net increase in fuel usage, fuel usage of the existing uses at the site can be subtracted from the gross consumption above. The

Existing Use VMT: 2,080,916
 Resultant Net Annual Gasoline Use: 143,342 gallons
 Resultant Net Annual Diesel Use: 29,297 gallons

	Net Fuel Use (gallons)	Conversion Factor Btu/gallon	Source	Fuel Converted to Use	Energy
Diesel	29,297	137,381	[3]	4,025 MMBtu	
Gasoline	143,342	109,786	[4]	15,737 MMBtu	
Total Energy Use from Net Operational Fuel				19,762 MMBtu	

Existing and Net Operational Built Environment

Type of Energy	Existing			Net
	Annual Usage	Units	Converted to MMBtu	Energy Use in MMBtu
Electricity	1.18E+05	kWh	404	13,763
Natural Gas	3.47E+05	kBtu	347	(347)
Total			750	13,417

Sum of above

Total Net Annual Operational Energy Use	33,178 MMBtu
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Sources

Unless otherwise noted, information in these calculations is from the project-specific Air Quality/Emissions Assessment for the project, including CalEEMod output tables.

[1] United States Environmental Protection Agency. 2018. Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES2014b . July 2018. Available at: <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100UXEN.pdf>.

[2] United States Department of Transportation, Bureau of Transportation Statistics. 2018. National Transportation Statistics 2018 . Available at: <https://www.bts.gov/sites/bts.dot.gov/files/docs/browse-statistical-products-anddata/national-transportation-statistics/223001/ntsntire2018q4.pdf>.

[3] U.S. Energy Information Administration, Energy Units and Calculations Explained, last updated June 29, 2022. Available at: <https://www.eia.gov/totalenergy/data/monthly/archive/00352205.pdf>

[4] California Air Resources Board, CA-GREET 2.0 Supplemental Document and Tables of Changes, Appendix C, Supplement to the LCFS CA-GREET 2.0 Model, 12/15/2014 , page C-24, Table 10. Available at: <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2015/lcfs2015/lcfs15appc.pdf>

[5] California Air Resources Board (CARB), EMFAC2021 v1.0.0., 2021. Available at <https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools-emfac-software-and>

[6] Anticipated TDM reduction information is from the the project-specific CEQA Transportation Analysis.

Acronyms used include:

Btu = British Thermal Units

hrs = hours

kBtu = Thousand British Thermal Units

kWH = kilowatt hours

MMBtu = Million British Thermal Units

MPG = miles per gallon

TDM = Transportation Demand Management

VMT = vehicle miles traveled