

# Appendix M

## **Energy Assumptions and Modeling**

## Energy Assumptions and Modeling

### Appendix M

1. Assumptions
2. Fuel Consumption Summary
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3. EMFAC2017

## **Energy Assumptions and Modeling**

### **1. Assumptions**

## Castellina Assumptions

### CalEEMod Inputs (Non-Default information only)

Project Location		
County	Madera	
Air District	San Joaquin Valley	
Climate Zone		3
Phase 1 Construction Year		2020
Phase 1 Operating Year		2021
Buildout Construction Year		2021
Buildout Operation Year		2035
Utility Provider	Pacific Gas and Electric	
EMFAC		2017

	<b>2020</b>	<b>2021</b>	<b>2035</b>
CO intensity	625.966	610.932	255.124
% renewable	35%	36.14%	73.33%

<sup>1</sup> See CO<sub>2</sub> Intensity by Utility Provider

Note: When the analysis was completed, the Phase 1 Project was just under 92 acres. Since that time, the Phase 1 Project and Program areas were slightly re-designated with the Phase 1 Project increased to 96 acres. Although there is an increase in acreage, due to the size of the original site, the 4 acres is a nominal increase. There would be no increased equipment used during the site preparation and grading phases, nor would it result in any additional time to complete the work. Therefore, while the analysis is based on the original 92 acre designation, the emissions for construction of the 92 and 96 acres would remain the same. Additionally, there is no change to the development within the Phase 1 area, therefore operational emissions would also be consistent with what was modeled.

	Building SQFT	Building KFS	Units/ Students	Acres	CalEEMod
<b><u>Phase 1 (Total - Modeled for Construction and Operation)</u></b>				<b>91.90</b>	
Single Family Residential			117	34.60	Single Family
Very Low Density Residential			50	18.00	
Low Density			67	16.60	
Park				5.00	City Park
Wastewater Treatment	1,800	1.80		42.90	General Light Indust.
Emergency Generators			3		(WWTP)
Roads/Other				9.40	Parking Other Asphalt
<b><u>Buildout (Total - Modeled Operation Only)</u></b>					
Single Family Residential			2,066	391.80	single family
Very Low Density Residential			90	36.00	
Low Density Residential			1,104	230.00	
Medium Density Residential			872	125.80	
Medium Density Residential			154	22.20	Condo/Townhome
Mid Rise Apartments			450	22.50	Mid Rise Apartment
High Density Residential			248	12.00	
Mixed Use Residential			202	10.50	
Active Adult Community			402	84.00	Retirement Comm.
Village Center		107.00		8.38	Strip Mall
Mixed Use Commercial		27.00		2.12	General Office
City Park		10.00		71.00	City Park
Neighborhood Park				20.00	
Active Adult Center/Garden		10.00		51.00	
School	66,883		800	15.00	Elementary School
Wastewater Treatment Facility		1.80		61.00	
Roads/Other			3,072	114.00	Parking Other Asphalt
				678.00	
<b><u>Remainder to be built after Phase 1 (Total - Not Modeled)</u></b>					
Very Low Density Residential			40	18.00	
Low Density Residential			1,037	213.40	
Medium Density Residential			872	125.80	
Medium Density Residential			154	22.20	
High Density Residential			248	12.00	
Mixed Use Residential			202	10.50	
Active Adult Community			402	84.00	
Village Center		107.00		8.38	
Mixed Use Commercial		27.00		2.12	
Neighborhood Park				20.00	
Active Adult Center/Garden		10.00		51.00	
School			800	15.00	
Wastewater Treatment Facility				18.10	
Roads/Other				104.60	

**Remainder after Phase 1 (Average over 14 years - not modeled)**

Very Low Density Residential		3	1.29
Low Density Residential		74	15.24
Medium Density Residential		62	8.99
Medium Density Residential		11	1.59
High Density Residential		18	0.86
Mixed Use Residential		14	0.75
Active Adult Community		29	6.00
Village Center	8		0.60
Mixed Use Commercial	2		0.15
Neighborhood Park			1.43
Active Adult Center/Garden	1		3.64
School		57	1.07
Wastewater Treatment Facility			1.29
Roads/Other			7.47

**Remainder after Phase 1 (Conservative 15%) - Worst Case Annually**

Single Family Residential		292	54	single family
Very Low Density Residential		6	2.70	
Low Density Residential		156	32.01	
Medium Density Residential		131	18.87	
Medium Density Residential		23	3.33	Condo/Townhome
Midrise Apartments		68	3.38	Mid Rise Apartment
High Density Residential		37	1.80	
Mixed Use Residential		30	1.58	
Active Adult Community		60	12.60	Retirement Comm.
Village Center	16.05		1.26	Strip Mall
Mixed Use Commercial	4.05		0.32	General Office
City Park	5.00		10.7	City Park
Neighborhood Park			3.00	
Active Adult Center/Garden	5.00		7.65	
School		120	2.25	Elementary School
Wastewater Treatment Facility	0.01		2.72	(upgrades)
Roads/Other			15.69	Parking Other Asphalt

<b><u>Population</u></b>	<b>Phase 1</b>	<b>Buildout</b>	<b>15%</b>
Single Family Residential	<b>433</b>	<b>7,212</b>	<b>1,082</b>
Very Low	185	148.00	
Low	248	3,837.00	
Medium		3,227.00	
Medium Density (Condo/TH)		<b>569.00</b>	<b>85</b>
Mid Rise Apartment		<b>900.00</b>	<b>135</b>
High Density		496.00	
Mixed Use		404.00	
Active Adult Community		<b>804.00</b>	<b>121</b>

Buildout column represent amount of population after Phase 1

15% represent the maximum annual increase in population in remaining buildout years

## Construction

### 1. Construction Schedule

	Start	End	Days <sup>1</sup>
<b><u>Phase 1</u></b>			
Site Preparation	1/1/2020	3/24/2020	60
Grading	2/1/2020	9/4/2020	155
Building Construction	3/1/2020	12/16./2020	208
Paving	3/1/2020	7/31/2020	110
Architectural Coating	5/1/2020	12/31/2020	175
<b><u>Buildout (Worst Case Year) <sup>2</sup></u></b>			
Same as Phase 1 per project; max 4 projects per year			
Demolition	1/1/2020	1/14/2020	10

#### Notes:

- 1 Assumes 5 days per week construction activity. Monday through Friday, 10 hour days (max 8 hour equipment operation)
- 2 Assumes that buildout is in 2020 as it assumes construction equipment fleet will not change throughout the project (i.e. the same grader used for grading one area would be moved to the next) for conservative emissions estimates.

### 2. Soil Export

Assumes cut/fill balanced onsite

### 3. Demolition Information

5,000 sqft demolished

### 4. Construction Vehicles

PhaseName	Worker Trips	Vendor Trips	Haul Trips
<b>Phase 1</b>			
Site Preparation	18	0	0
Grading	20	0	0
Building Construction	306	116	0
Paving	15	0	0
Architectural Coating	61	0	0
<b>Buildout</b>			
Same as Phase 1 (per project; 4 projects per year)			
Demolition	15	0	23

Miles per trip

**5. Construction Equipment by Phase**

**Phase 1**

<u>PhaseName</u>	<u>OffRoadEquipmentType</u>	<u>OffRoadEquipment</u>	<u>UsageHours</u>	<u>HorsePower</u>	<u>LoadFactor</u>
Site Preparation	Rubber Tired Dozers	3	8	247	0.4
Site Preparation	Tractors/Loaders/Backhoes	4	8	97	0.37
Grading	Excavators	2	8	158	0.38
Grading	Graders	1	8	187	0.41
Grading	Rubber Tired Dozers	1	8	247	0.4
Grading	Scrapers	2	8	367	0.48
Grading	Tractors/Loaders/Backhoes	2	8	97	0.37
Building Construction	Cranes	1	7	231	0.29
Building Construction	Forklifts	3	8	89	0.2
Building Construction	Generator Sets	1	8	84	0.74
Building Construction	Tractors/Loaders/Backhoes	3	7	97	0.37
Building Construction	Welders	1	8	46	0.45
Paving	Pavers	2	8	130	0.42
Paving	Paving Equipment	2	8	132	0.36
Paving	Rollers	2	8	80	0.38
Architectural Coating	Air Compressors	3	6	78	0.48

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**Buildout Year**

**Assumes up to 4 projects occur at one time (106 acres total, or up to 30 acres per project)**

**Equipment per project the same as Phase 1 with the exception of Demolition Equipment per project**

<u>PhaseName</u>	<u>OffRoadEquipmentType</u>	<u>OffRoadEquipment</u>	<u>UsageHours</u>	<u>HorsePower</u>	<u>LoadFactor</u>
Demolition	Concrete/Industrial Saws	1	8	81	0.73
Demolition	Excavators	3	8	158	0.38
Demolition	Rubber Tired Dozers	2	8	247	0.4





**Area source emissions**

Defaults Used unless other information provided

Project Fireplaces

	Wood	Gas	Propane	No	Hrs/day	Days/year	Wood mass
Single Family Housing	0	64.35	0	52.65	3	82	3078.4

Buildout Fireplaces

	Wood	Gas	Propane	No	Hrs/day	Days/year	Wood mass
Apartments Mid Rise	0	247.5	0	202.5	3	82	3078.4
Condo/Townhouse	0	84.7	0	69.3	3	82	3078.4
Retirement Community	0	221.1	0	180.9	3	82	3078.4
Single Family Housing	0	1213.3	0	992.7	3	82	3078.4

**Water and Wastewater**

Source: Tully & Young. 2018. *Administrative Draft Castellina Specific Plan Project SB 610 Water Supply Assessment* . January.

**Water Demand - Project**

	DUs	Indoor af/du/year	AF/yr	outdoor af/du/year	AF/yr
<b><u>Residential</u></b>					
Very Low Density	50	0.23	11.5	0.36	18
Low Density	67	0.23	15.41	0.14	9.38
Total			27		27
Gallons/acre foot			325,851		325,851
gallons /year			8,768,662		8,921,812
Total gallons/year					17,690,474

**Water Demand - Buildout**

**Residential**

	DUs	Indoor af/du/year	AF/yr	outdoor af/du/year	AF/yr
Very Low Density	90	0.23	20.7	0.36	32.4
Low Density	1,104	0.23	253.92	0.14	154.56
Active Adult	402	0.12	48.24	0.15	60.3
Medium Density	1,026	0.23	235.98	0.1	102.6
High Density	248	0.12	29.76	0.01	2.48
Mixed Use	202	0.12	24.24	0	0
Non-Residential			36	0	0
Open Space			0		88
Total			649		440
Gallons/acre foot			325,851		325,851
gallons /year			211,425,440		143,485,417
Total gallons/year					354,910,857

	Buildout	
	Indoor af/du/year	outdoor af/du/year
Residential	611	349
Non-Residential	36	0
Total	647	349
Gallons/acre foot	325,851	325,851
gallons /year	210,825,873	113,722,148

**Stationary Sources**

3 Emergency Generators at the waste water plant  
750 hp assumed

**Solid Waste**

Defaults will be used unless Utilities section provides specifics before modeling occurs

Defaults

	tons/year	
	Project	Buildout
Apartments Mid Rise	-	207
City Park	0.43	6.11
Condo/Townhouse	-	70.84
Elementary School	-	146
General Light Industry	2.23	2.23
General Office Building	-	25.11
Other Asphalt Surfaces	0	0
Retirement Community	-	184.92
Single Family Housing	155.88	2596.32
Strip Mall	-	112.35

**Energy Use**

Electricity

Defaults Used and adjusted for Title 24 changes.

Natural Gas

Defaults Used and adjusted for Title 24 changes.

Default	KWhr/size/year)			KBTU/size/yr	
	T24E	NT24E	Lighting	T24NG	NT24NG
Apartments Mid Rise	700.71	3054.1	741.44	8454.86	3723
City Park	0	0	0	0	0
Condo/Townhouse	711.99	3795.01	1001.1	14242.58	3723
Elementary School	2.14	1.89	2.99	23.19	1.92
General Light Industry	1.96	4.16	2.7	17.03	3.84
General Office Building	2.62	3.58	2.92	12.77	0.28
Other Asphalt Surfaces	0	0	0	0	0
Retirement Community	694.4	3172.76	1001.1	10413.46	3723
Single Family Housing	995.93	6155.97	1608.84	22422.24	3723
Strip Mall	2.14	2.3	3.71	8.62	2.08

Adjusted to 2019 Title24

CalEEMod currently uses Title 24 efficiency standards. The project will be built post 2019 therefore as a conservative estimate of T24 efficiencies required, the emission factors are updated to account for the inclusion of 2019 Title 24 standards.

	T24 Electricity	Lighting	T24 NG
Residential 2019	7%	0%	7%
Non-Residential 2019	30%	0%	30%

Adjusted	KWhr/size/year)			KBTU/size/yr	
	T24E	NT24E	Lighting	T24NG	NT24NG
Apartments Mid Rise	651.6603	3054.1	741.44	7863.0198	3723
City Park	0	0	0	0	0
Condo/Townhouse	662.1507	3795.01	1001.1	13245.5994	3723
Elementary School	1.498	1.89	2.99	16.233	1.92
General Light Industry	1.372	4.16	2.7	11.921	3.84
General Office Building	1.834	3.58	2.92	8.939	0.28
Other Asphalt Surfaces	0	0	0	0	0
Retirement Community	645.792	3172.76	1001.1	9684.5178	3723
Single Family Housing	926.2149	6155.97	1608.84	20852.6832	3723
Strip Mall	1.498	2.3	3.71	6.034	2.08



**Energy Assumptions and Modeling**

**2. Fuel Consumption Summary**

**a. Construction**

# Castellina

## Construction Energy Summary

### Construction Fuel Consumption Summary

Phase	gallons		# Years
	Diesel	Gas	
<b>Project</b>	<b>202,955</b>	<b>67,324</b>	1
Annual Average	202,955	67,324	
<b>Program</b>	<b>451,004</b>	<b>137,109</b>	1.00
Annual Average	451,004	137,109	
<b>County Usage<sup>1</sup></b>	28,000,000	49,000,000	
<b>Project % County</b>	0.7248%	0.1374%	
<b>Project % County</b>	1.6107%	0.2798%	

Construction Project	Total Gallons	
Onsite Equipment	156,018	diesel
Haul Trucks	0	diesel
Vendor Trucks	46,938	diesel
Worker Trips	67,324	gasoline
<b>Program</b>		
Onsite Equipment	356,946	diesel
Haul Trucks	183	diesel
Vendor Trucks	93,875	diesel
Worker Trips	137,109	gasoline

# Castellina

## Unmitigated Fuel Conversion - Construction

	Total CO <sub>2</sub> MT/yr	Fuel Type	Factor KGCO <sub>2</sub> /gal	Gallons
<b>Offroad</b>				
<b>Project</b>				
Site Preparation	101.10	diesel	10.21	9,902
Grading	851.33	diesel	10.21	83,382
Building Construction	484.69	diesel	10.21	47,472
Paving	111.05	diesel	10.21	10,876
Architectural Coating	44.77	diesel	10.21	4,385
<b>Program</b>				
Site Preparation	404.41	diesel	10.21	39,609
Grading	1,702.67	diesel	10.21	166,765
Building Construction	969.37	diesel	10.21	94,944
Paving	444.18	diesel	10.21	43,505
Architectural Coating	89.54	diesel	10.21	8,770
Demolition	34.24	diesel	10.21	3,353
<hr/>				
<b>Onroad</b>	<i>source:</i> EMFAC- Miramar Hotel			
	<b># Projects</b>	<b>Hauling</b>	<b>Vendor</b>	<b>Worker</b>
<b>Modeling Results</b>				
Site Preparation		0	0	461
Grading		0	0	1,324
Building Construction		0	23,469	27,194
Paving		0	0	705
Architectural Coating		0	0	4,561
Demolition		92	0	64
<b>Project</b>				
Site Preparation	1	0	0	461
Grading	2	0	0	2,649
Building Construction	2	0	46,938	54,387
Paving	1	0	0	705
Architectural Coating	2	0	0	9,122
<b>Program</b>				
Site Preparation	4	0	0	1,846
Grading	4	0	0	5,298
Building Construction	4	0	93,875	108,774
Paving	4	0	0	2,820
Architectural Coating	4	0	0	18,244
Demolition	2	183	0	128



**Energy Assumptions and Modeling**

**2. Fuel Consumption Summary**

**b. Operational**

# Castellina

## Operational Energy Summary

### Annual Operational Energy Consumption

<u>Project</u>	gallons		MMBTU/yr Natural Gas	GWh/yr Electric
	Diesel	Gas		
Unmitigated	59,602	111,485	2,919.58	1.03
% of County (2018)	0.21%	0.23%	0.0515%	0.062%
% PG&E (2018)			0.0003%	0.001%
% PG&E (2021/2022)			0.0004%	0.001%
% State	0.0016%	0.0008%		
Mitigated	57,288	107,157	2,425.24	0.99
% of County (2018)	0.20%	0.22%	0.0427%	0.059%
% PG&E (2018)			0.0003%	0.001%
% PG&E (2021/2022)			0.0003%	0.001%
% State	0.0016%	0.0008%		
 <u>Program</u>				
Unmitigated	1,095,884	1,901,430	66,605.97	24.42
% of County	3.91%	3.88%	1.1739%	1.466%
%PG&E (2018)			0.0075%	0.028%
%PG&E (2035/2030)			0.0080%	0.021%
%State	0.0300%	0.0141%		
Mitigated	1,047,168	1,816,906	55,792.23	24.20
% of County (2018)	3.74%	3.71%	0.9833%	1.453%
% PG&E (2018)			0.0063%	0.028%
%PG&E (2035/2030)			0.0067%	0.021%
%State	0.0286%	0.0135%		

# Castellina

## Natural Gas & Electricity

	kBTU	MMBTU	kWh	GWh	MWh
<b>Unmitigated</b>					
Project <sup>2</sup> (Building)	2,912,916	2,913	1,032,726	1.03	1,033
Project <sup>2</sup> (Mobile)	6,668	7			
Program <sup>2</sup> (Building)	66,330,858	66,331	24,421,718	24.42	24,422
Program <sup>2</sup> (Mobile)	275,108	275			
<b>Mitigated</b>					
Project <sup>2</sup> (Building)	2,418,835	2,419	985,088	0.99	985
Project <sup>2</sup> (Mobile)	6,409	6			
Program <sup>2</sup> (Building)	55,529,349	55,529	24,199,122	24.20	24,199
Program <sup>2</sup> (Mobile)	262,879	263			
<b>County/Utility</b>					
Madera (2018) <sup>3,4</sup>		5,674,040		1,666	1,665,573
PG&E (2018) <sup>5,7</sup>		887,872,720		87,375	87,375,000
PG&E (2021/2022) <sup>5,7</sup>		823,210,780		102,149	102,149,000
PG&E (2035/2030) <sup>5,7</sup>		828,126,600		116,897	116,897,000

## Operational Vehicle Fuel Consumption

EMFAC2017 Castellina; Dated: 43730

	Project		Program		
	Unmitigated	Mitigated	Unmitigated	Mitigated	
Gasoline	111485.20	107157.04	1901430.33	1816905.74	gallons
Diesel	59601.84	57287.93	1095883.71	1047168.22	gallons
	0.00	0.00	0.00	0.00	
Natural Gas	6.67	6.41	275.11	262.88	MMBTU

## CalEEMod Output

	Natural Gas (KBTU)		Electricity (KWh)	
	Unmitigated	Mitigated	Unmitigated	Mitigated
<b>Phase 1 Project</b>				
Single Family Housing	2,875,350	2,387,400	1,016,850	970,297
General Light Industry	37,566	31,435	15,876	14,791
City Park	0	0	0	0
<b>Program</b>				
Apartment	5,258,710	4,542,040	1,001,240	1,894,030
Condo Town House	2,613,160	2,205,200	840,572	799,673
Single Family Housing	54,214,000	45,013,700	19,172,400	18,294,700
Retirement Community	1,885,990	1,808,120	1,937,500	1,838,440
City Park	0	0	0	0
Elementary School	1,213,920	996,820	426,712	396,481
General Light Industry	28,368	24,077	14,814	13,963
General Office	248,940	200,664	224,910	209,652
Strip Mall	867,770	738,728	803,570	752,183

# Castellina

## Natural Gas Background Information

Sales		Supply			
State (2018)	PG&E	2018	2021	2035	PG&E
		2348	2177	2190	3116 MMCF/day
2,077,516	857,020	794,605	799,350	799,350	1,137,340 MMCF/year
2,077,516,000	857,020,000	794,605,000	799,350,000	799,350,000	1,137,340,000 MCF/year
1.036	1.036	1.036	1.036	1.036	1.036 MMBTU/1mCF
2,152,306,576	887,872,720	823,210,780	828,126,600	828,126,600	1,178,284,240 MMBTU/year

Source:

State: EIA, 2020. *Natural Gas Summary*. Available: [https://www.eia.gov/dnav/ng/ng\\_sum\\_lsum\\_dcu\\_SCA\\_a.htm](https://www.eia.gov/dnav/ng/ng_sum_lsum_dcu_SCA_a.htm), Accessed March 2020.

PG&E: California Gas and Electric Utilities, 2018. *2018 California Gas Report*. Available: [https://www.socalgas.com/regulatory/documents/cgr/2018\\_California\\_Gas\\_Report.pdf](https://www.socalgas.com/regulatory/documents/cgr/2018_California_Gas_Report.pdf), Accessed: March 2020

## Transportation Fuel Background Information

	Diesel	gasoline
State (2018)	3,659,000,000	13,475,000,000
County (2018)	28,000,000	49,000,000

## Assumptions

8.78 Kg of CO <sub>2</sub> per gallon of Gasoline	
10.21 Kg of CO <sub>2</sub> per gallon of Diesel	
1040 MMBtu/MMCF	1040 MMBtu
1 MWh=	0.001 GWh
100,000 BTU/therm	
3,412 Btu/kWh <sup>8</sup>	
56,740,400 Madera (2018) Therms <sup>3</sup>	

Construction      diesel      Used for trucks (haul and vendor) and off-road equipment  
                          gasoline      worker vehicles

Operation      diesel      Majority of trucks and buses  
                          gasoline      remaining vehicle mix

LCFS & Pavley assumed for on-road vehicles after year 2011

# Castellina

## Sources:

<sup>1</sup> California Energy Commission, 2018. California Retail Fuel Outlet Annual Reporting (CEC-A15) Results.  
[http://listserver.energy.ca.gov/almanac/transportation\\_data/gasoline/piira\\_retail\\_survey.html](http://listserver.energy.ca.gov/almanac/transportation_data/gasoline/piira_retail_survey.html) Accessed, March 2020.

Diesel:	1,602 Million Gallons State	28 Million Gallons County
Gasoline:	13,475 Million Gallons State	49 Million Gallons County

<sup>2</sup> ESA, 2019 CalEEMod Output - Castellina - Buildout; Castellina - Project; Castellina Buildout - Mitigated; Castellina Project - Mitigated

<sup>3</sup> <http://www.ecdms.energy.ca.gov/gasbycounty.aspx> 56.7404 Million Therms

<sup>4</sup> <http://www.ecdms.energy.ca.gov/elecbycounty.aspx> 1665.573 GWh

<sup>5</sup> PG&E 2018. Integrated Resource Plan. August 1. Available: [https://www.pge.com/pge\\_global/common/pdfs/for-our-business-partners/energy-supply/integrated-resource-planning/2018-PGE-Integrated-Resource-Plan.pdf](https://www.pge.com/pge_global/common/pdfs/for-our-business-partners/energy-supply/integrated-resource-planning/2018-PGE-Integrated-Resource-Plan.pdf). Accessed: March 2020.

87,375,000 MWh

<sup>7</sup> California Gas and Electric Utilities, 2018. 2018 California Gas Report. Available:  
[https://www.socalgas.com/regulatory/documents/cgr/2018\\_California\\_Gas\\_Report.pdf](https://www.socalgas.com/regulatory/documents/cgr/2018_California_Gas_Report.pdf), Accessed: March 2020

<sup>8</sup> <https://www.eia.gov/energyexplained/units-and-calculators/energy-conversion-calculators.php#eleccalc>

**Energy Assumptions and Modeling**

**3. EMFAC2017**

**Castellina**  
**Total On-Road Fuel Consumption**

## Castellina

### Total On-Road Fuel Consumption

	gal/mile	gal/min
2020Hauling Hauling	0.15267858	3.90344E-05
2020Vendor Vendor	0.1332438	6.46676E-05
2020Worker Worker	0.03956011	0
2021Hauling Hauling	0.15009563	3.87717E-05
2021Vendor Vendor	0.13099129	6.49809E-05
2021Worker Worker	0.0382893	0
2035Hauling Hauling	0.11104338	3.08675E-05
2035Vendor Vendor	0.10089009	5.95374E-05
2035Worker Worker	0.02819882	0

Construction Phase	Daily One-Way Trips	Haul Days per Phase (days)	Work Hours per Day (hours/day)	One-Way Trip Distance per Day (miles)	Idling per Day (minutes)
<u>Site Preparation</u>	2020				
Total Haul Trips	0				
Hauling	0	60	10	20	15
Vendor	0	60	10	7.3	15
Worker	18	60	10	10.8	0
<u>Grading</u>	2020				
Total Haul Trips	0				
Hauling	0	155	10	20	15
Vendor	0	155	10	7.3	15
Worker	20	155	10	10.8	0
<u>BC</u>	2020				
Total Haul Trips	0				
Hauling	0	208	10	20	15
Vendor	116	208	10	7.3	15
Worker	306	208	10	10.8	0
<u>Paving</u>	2020				
Total Haul Trips	0				
Hauling	0	110	10	20	15
Vendor	0	110	10	7.3	15
Worker	15	110	10	10.8	0
<u>AC</u>	2020				
Total Haul Trips	0				
Hauling	0	175	10	20	15
Vendor	0	175	10	7.3	15
Worker	61	175	10	10.8	0
<u>Demolition (Program only)</u>	2020				
Total Haul Trips	23				
Hauling	3	10	10	20	15
Vendor	0	10	10	7.3	15
Worker	15	10	10	10.8	0



## Castellina

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### Total On-Road Fuel Consumption

Construction Phase	Regional Emissions (gallons)						
	gal/mile	gal/min	gal/day	Total Gallons/yr			
<u>Site Preparation</u>							
Total Haul Trips							
Hauling	0.15	3.90E-05	0	0			
Vendor	0.13	6.47E-05	0	0			
Worker	0.04	0.00E+00	8	461			
<u>Grading</u>							
Total Haul Trips							
Hauling	0.15	3.90E-05	0	0			
Vendor	0.13	6.47E-05	0	0			
Worker	0.04	0.00E+00	9	1,324			
<u>BC</u>							
Total Haul Trips							
Hauling	0.15	3.90E-05	0	0			
Vendor	0.13	6.47E-05	113	23,469			
Worker	0.04	0.00E+00	131	27,194			
<u>Paving</u>							
Total Haul Trips							
Hauling	0.15	3.90E-05	0	0			
Vendor	0.13	6.47E-05	0	0			
Worker	0.04	0.00E+00	6	705			
<u>AC</u>							
Total Haul Trips							
Hauling	0.15	3.90E-05	0	0			
Vendor	0.13	6.47E-05	0	0			
Worker	0.04	0.00E+00	26	4,561			
<u>Demolition (Program only)</u>							
Total Haul Trips							
Hauling	0.15	3.90E-05	9	92			
Vendor	0.13	6.47E-05	0	0			
Worker	0.04	0.00E+00	6	64			

**Castellina**  
**Operational Vehicle Fuel Consumption**

## Castellina Operational Vehicle Fuel Consumption

	Existing	Op year 1	op year 2
Unmitigated CO <sub>2</sub> e (MT/year)		1,597	28,052
Mitigated CO <sub>2</sub> e (MT/year)		1,535	26,805

Summary		Op year 1		Op year 2		
		Unmitigated	Mitigated	Unmitigated	Mitigated	
	Gasoline	111485.20	107157.04	1901430.33	1816905.74	gallons
	Diesel	59601.84	57287.93	1095883.71	1047168.22	gallons
	Electric	0.00	0.00	0.00	0.00	GWh
	Natural Gas	6.67	6.41	275.11	262.88	MBTU

Operational Year 1 2021

### Unmitigated Calculations

	% Emissions	CO <sub>2</sub> e (MT)	CO <sub>2</sub> e (kg)	CO <sub>2</sub> e (lbs)	kg CO2/gallon	Gallons	Mcf	MBTU	GWh
Gasoline	0.620603294	991.1034611	991,103	NA	8.89	111,485	NA	NA	NA
Diesel	0.379182628	605.5546569	605,555	NA	10.16	59,602	NA	NA	NA
Electric	0	0	NA	0	NA	NA	NA	NA	0.00
Natural Gas	0.000214078	0.341882087	342	NA	NA	NA	6.44	6.67	NA

### Mitigated Calculations

	% Emissions	CO <sub>2</sub> e (MT)	CO <sub>2</sub> e (kg)	CO <sub>2</sub> e (lbs)	kg CO2/gallon	Gallons	Mcf	MBTU	GWh
Gasoline	0.620603294	952.6260568	952,626	NA	8.89	107,157	NA	NA	NA
Diesel	0.379182628	582.0453339	582,045	NA	10.16	57,288	NA	NA	NA
Electric	0	0	NA	0	NA	NA	NA	NA	0.00
Natural Gas	0.000214078	0.328609269	329	NA	NA	NA	6.19	6.41	NA

Operational Year 2 2035

### Unmitigated Calculations

	% Emissions	CO <sub>2</sub> e (MT)	CO <sub>2</sub> e (kg)	CO <sub>2</sub> e (lbs)	kg CO2/gallon	Gallons	Mcf	MBTU	GWh
Gasoline	0.602585042	16903.71561	16,903,716	NA	8.89	1,901,430	NA	NA	NA
Diesel	0.396912108	11134.17846	11,134,178	NA	10.16	1,095,884	NA	NA	NA
Electric	0	0	NA	0	NA	NA	NA	NA	0.00
Natural Gas	0.000502849	14.10592849	14,106	NA	NA	NA	265.55	275.11	NA

### Mitigated Calculations

	% Emissions	CO <sub>2</sub> e (MT)	CO <sub>2</sub> e (kg)	CO <sub>2</sub> e (lbs)	kg CO2/gallon	Gallons	Mcf	MBTU	GWh
Gasoline	0.602585042	16152.29206	16,152,292	NA	8.89	1,816,906	NA	NA	NA
Diesel	0.396912108	10639.22907	10,639,229	NA	10.16	1,047,168	NA	NA	NA
Electric	0	0	NA	0	NA	NA	NA	NA	0.00
Natural Gas	0.000502849	13.47887542	13,479	NA	NA	NA	253.74	262.88	NA

## Castellina Operational Vehicle Fuel Consumption

### Emissions Percentage

	<b>2021</b>	<b>2035</b>
Gasoline	0.620603294	0.602585042
Diesel	0.379182628	0.396912108
Electric	0	0
Natural Gas	0.000214078	0.000502849

### Conversion Factors:

1000 kg/MT			
8.89 kg CO <sub>2</sub> /gallon gasoline		<a href="https://www.eia.gov/environment/emissions/co2_vol_mass.php">https://www.eia.gov/environment/emissions/co2_vol_mass.php</a>	Feb. 2016
10.16 kg CO <sub>2</sub> /gallon diesel		<a href="https://www.eia.gov/environment/emissions/co2_vol_mass.php">https://www.eia.gov/environment/emissions/co2_vol_mass.php</a>	Feb. 2016
53.12 kg CO <sub>2</sub> / thousand cubic feet		<a href="https://www.eia.gov/environment/emissions/co2_vol_mass.php">https://www.eia.gov/environment/emissions/co2_vol_mass.php</a>	Feb. 2016
1036 btu/cubic foot			
610.932 CO <sub>2</sub> lbs/MWh	Project Specific Op Year 1	2021	
255.124 CO <sub>2</sub> lbs/MWh	Project Specific Op Year 2	2035	
0.907185 MT/ton			
2000 lbs/ton			