Appendix G

Greenhouse Gas Emissions Assumptions and Modeling

ESA

Greenhouse Gas Emissions, Assumptions and Modeling

Appendix G

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Greenhouse Gas Emissions, 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

	2020	**2021**	**2035**
CO intensity	625.966	610.932	255.124
% renewable	35%	36.14%	73.33%

[1] See CO_2 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
Phase 1 (Total - Modeled for Construction and Operation)				**91.90**	
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
Buildout (Total - Modeled Operation Only)					
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	
Remainder to be built after Phase 1 (Total - Not Modeled)					
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

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

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[1]
Phase 1			
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
Buildout (Worst Case Year) [2]			
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 activitiy. 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
Phase 1			
Site Preparation	18	0	0
Grading	20	0	0
Building Construction	306	116	0
Paving	15	0	0
Architectural Coating	61	0	0
Buildout			
Same as Phase 1 (per project; 4 projects per year)			
Demoliltion	15	0	23

Miles per trip

5. Construction Equipment by Phase

Phase 1

PhaseName	***OffRoadEquipmentType***	***OffRoadEquipme***	***UsageHours***	***HorsePower***	***LoadFactor***	
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	2
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	2

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

PhaseName	***OffRoadEquipmentType***	***OffRoadEquipme***	***UsageHours***	***HorsePower***	***LoadFactor***
Demolition	Concrete/Industrial Saws	1	8	81	0.73
Demolition	Excacators	3	8	158	0.38
Demolition	Rubber Tired Dozers	2	8	247	0.4

Castellina
Operational Assumptions

Mobile source emissions

Source: Project Specific Traffic Study

Project

	Trip Rate	Trips	
Single Family Residential	9.520	1,114	406,610

Buildout

	Unadjusted Units	Trip Rate	Trips		Reduction	Adjusted Trips	Trip Rate
Single Family Detached	2090	8.235	17,212			17,212	8.235
Condo/Tonwhouse	172	5.814	1,000			1,000	5.814
Midrise Apartment	469	6.652	3,120			3,120	6.652
Adult Housing	341	4.111	1,402	du		1,409	4.132
General Office	27	18.000	486	ksf	47	439	16.261
shoppint center	107	66.336	7,098	ksf	186	6,912	64.598
Neighborhood park	59	2.288	135	acre	135	0	0.000
School	520	1.985	1,032	student	849	183	0.352
Adult Center	10	33.800	338	ksf	331		
Total			31,823		1548	30,275	
						11,050,375	
					28,960		

Adjustments in CalEEMod

shoppint center 54.7

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

		Indoor		outdoor	
	DUs	**af/du/year**	**AF/yr**	**af/du/year**	**AF/yr**
Residential					
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

		Indoor		outdoor	
	DUs	**af/du/year**	**AF/yr**	**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

CO2 Intensity Factor By Utility Provider

Utility Provider: **Pacific Gas and Electric**

Year	RPS Mandate[2]	Electricity Emission Factor (lbs CO2e/MWh)	lbs/metric ton
Base	0.00%	956.71642	2204.62
2017[1]	33.00%	641.00000	

Year	RPS Mandate[2,3]	Electricity Emission Factor (lbs CO2e/MWh)	Electricity Emission Factor (MT CO2e/MWh)	Proportion Compared to Year 2024
2020	34.57%	625.966	0.284	
2021	36.14%	610.932	0.277	
2022	37.71%	595.898	0.270	
2023	39.29%	580.864	0.263	
2024	44.00%	535.761	0.243	1.00
2025	46.67%	510.249	0.231	0.95
2026	49.33%	484.736	0.220	0.90
2027	52.00%	459.224	0.208	0.86
2028	54.67%	433.711	0.197	0.81
2029	57.33%	408.199	0.185	0.76
2030	60.00%	382.687	0.174	0.71
2031	62.7%	357.174	0.162	0.67
2032	65.3%	331.662	0.150	0.62
2033	68.0%	306.149	0.139	0.57
2034	70.7%	280.637	0.127	0.52
2035	73.3%	255.124	0.116	0.48
2036	76.0%	229.612	0.104	0.43
2037	78.7%	204.100	0.093	0.38
2038	81.3%	178.587	0.081	0.33
2039	84.0%	153.075	0.069	0.29
2040	86.7%	127.562	0.058	0.24
2041	89.3%	102.050	0.046	0.19
2042	92.0%	76.537	0.035	0.14
2043	94.7%	51.025	0.023	0.10
2044	97.3%	25.512	0.012	0.05
2045	100%	0.000	0.000	0.00
2046	100%	0.000	0.000	0.00
2047	100%	0.000	0.000	0.00
2048	100%	0.000	0.000	0.00
2049	100%	0.000	0.000	0.00
2050	100%	0.000	0.000	0.00
2051	100%	0.000	0.000	0.00
2052	100%	0.000	0.000	0.00
2053	100%	0.000	0.000	0.00
2054	100%	0.000	0.000	0.00

[1] CEC 2017 PG&E Power Content Label

[2] SB-100 California Renewables Portfolio Standard Program: Emissions of Greenhouse Gases, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180

Greenhouse Gas Emissions, Assumptions and Modeling

2. Emissions Summaries

a. Construction

Castellina
Construction GHG Summary

CalEEMod	2016.3.2	
Title:	Castellina - Construction	9/20/2019
	Castellina - Buildout	9/23/2019
	Castellina Buildout - Mitigated	9/27/2019
	Castellina - Project	9/27/2019
	Castellina Project - Mitigated	9/27/2019
EMFAC2017	Castellina	9/22/2019

Unmitigated Construction Emissions - Max Annual

		Annual $MTCO_2e$					
	Phases / year	**Onsite**	**Hauling**	**Vendor**	**Worker**	**Annual total MT CO_2e**	**Project Total**
			Modeled Emissions				
Site Preparation	1	101.10	0.00	0.00	3.87		
Grading	1	425.67	0.00	0.00	11.11		
Building Construction	1	242.34	0.00	255.83	228.19		
Paving	1	111.05	0.00	0.00	5.92		
Architectural Coating	1	22.38	0.00	0.00	38.27		
Demolition	1	17.12	0.93	0.00	0.54		
			Project Level				
Site Preparation	1	101.10	0.00	0.00	3.87	105	
Grading	2	851.33	0.00	0.00	22.23	874	
Building Construction	2	484.69	0.00	511.65	456.38	1,453	
Paving	1	111.05	0.00	0.00	5.92	117	
Architectural Coating	2	44.77	0.00	0.00	76.54	121	
Max Project						2,670	2,670
Amortized							89
			Program Level				
Site Preparation	4	404.41	0.00	0.00	15.49	420	
Grading	4	1702.67	0.00	0.00	44.46	1,747	
Building Construction	4	969.37	0.00	1023.31	912.76	2,905	
Paving	4	444.18	0.00	0.00	23.66	468	
Architectural Coating	4	89.54	0.00	0.00	153.09	243	
Demolition	2	34.24	1.87	0.00	1.08	37	
Sub Total - No Demo						5,783	86,744
Sub Total - Demo						37	74
Max Program						5,820	86,818
			Total Emissions				
Max Program							89,488
Amortized							2,983

*Conservately assumes Project Emissions all occur within one year.

*Conservately assumes Program has 15 years of Site Preparation, Grading, Building Cinstruction, Paving, and Architectural Coating emissions and two years of Demolition activities.

Greenhouse Gas Emissions, Assumptions and Modeling
2. Emissions Summaries
b. Operational

Castellina
Operational GHG Summary

Operational Emissions By Sector

	Unmitigated		*Mitigated*	
Sector	*Project*	*Program*	*Project*	*Program*
Area	52	1,350	1	29
Energy	444	6,531	404	5,809
Mobile	1,597	28,052	1,535	26,805
Stationary	45	43	45	43
Waste	20	421	20	421
Wastewater	829	2,487	41	124
Water	29	356	29	356
Total Operational	**3,016**	**39,241**	**2,076**	**33,588**
Amortized Const	89	2,983	89	2,983
Total	**3,105**	**42,224**	**2,165**	**36,570**
			30%	13%

GHG Emissions from Wastewater Treatment

Liters/year	Program	Project	
	0.75	0.25	mgd
	273.75	91.25	mg/year
	3.79	3.79	gallons per liters
	1,036,256,476	345,418,825	liters/year
	0.0000024	0.0000024	CO_2e/liter of wastewater[1]
	2,487.02	829.01	CO2e/year

Source: CAPCOA 2010; updated formula to include the methane GWP of 25 rather than 21 in the document.

Greenhouse Gas Emissions, Assumptions and Modeling
2. Emissions Summaries
c. Mitigation Measures

Castellina

GHG Reductions

Mitigation Measures:	SJVAPCD BPS #	CAPCOA #
Emissions Reductioin Values		
1. Wastewater Treatment		AE-6
95% reduction in GHG emissions from Wastewater treatment plant used in analysis		
95 to 97% reduction possible based on recovery method chosen.		
2. Bicycle Parking Measure	1 & 3	SDT-6 & 7
0.63% reduction in VMT.		
3. End of Trip Facilities	2	TRT-5
0.63% reduction in VMT, Non-residential		
4. Proximity to Bike Path/Bike Lanes Measure:	4	LUT-8
0.63% reduction in VMT.		
Not applied as Class II bicycle lanes are planned along Avenue 17, but there is no concrete date of installation.		
5. Pedestrian Network Measure	5	SDT-1
0.50% reduction in VMT.		
6. Pedestrian Barriers Minimized	6	SDT-1
(reduction accounted for under measure 5 above)		
7. Traffic Calming Measure	9	SDT-2
0.25% reduction in VMT used in analysis		
up to 1 percent reduction max based on implementation.		
8. Minimize Parking	12	PDT-1
0.50% reduction in VMT used in analysis		
9. Pedestrian Pathway through Parking	14	SDT-1
Reduction accounted for as part of measure 5 above.		
10. Orientation toward "planned" transit,bikeway, or pedestrian corridor	18	NA
Reduction accounted for as part of measure 5 above.		
11. Residential Density	19	NA
3% reduction in VMT for Mixed Use and High Density Residential uses		
0% In Total VMT for project		
0.33% In Total VMT for Program		
8565280 VMT for High Density Residential and Mixed Use		
78541374 Total VMT		
12. Neighborhood Electric Vehicle Access	21	SDT-3
0.50% reduction in residential VMT		
0% in total VMT for Project		
0.38% in total VMT for Program		
59278263 Non-High Density/Mixed use Residential VMT		
78541374 Total VMT		
13. Other Mixed-Use Measure	24	NA
1% reduction in VMT from residential uses		
1% reduction in total VMT or Project		
0.86% in total VMT for Program		
67843543 Residential VMT		
78541374 Total VMT		
14. Energy Star Roof Measure	26	NA
Reduction accounted for as part of measure 16 below.		

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Mitigation Measures Continued:

15.	Onsite Renewable Energy System:	27	AE-2 & 3
2.50%	% of electricity consumption		
	Minimum reduction used.		
16.	Exceed Title 24 Measure	28	BE-1
20%	reduction in energy use (accounted for in CalEEMod)		
17.	Solar Orientation	29	NA
	reduction accounted for in measures 15 and 16 above.		
18.	Non Roof Surface Measure	30	GP-1
	reductions accounted for in measure 16 above.		
19.	Green Roof Measure	31	NA
	reductions accounted for in measure 16 above.		
20.	Electric Lawnmower Measure	33	A-1 & 3
	reductions accounted for in CalEEMod		
21.	TDM Program	NA	TRT-1, 3,
1%	reduction for Rideshar program		
0.80%	reduction for TDM Marketing		
1.80%	Total reduction in project VMT.		
22	School Bus Program	NA	TRT-12
38%	reduction in school VMT		

Implementation in CalEEMod

20%	exceedence from Title 24.
2.50%	Onsite Renewables energy offset
Varies	VMT Reductions
38%	Reduction in School VMT
8.18%	Reduction in High Density & Mixed Use Residential VMT
4.05%	Reduction in Other residential VMT
4%	Reduction in non-residential VMT

	Default			Mitigated		
	H-W/C-W	H-S/C- C	H-O/C-NW	H-W/C-W	H-S/C- C	H-O/C-NW
School	9.5	7.3	7.3	5.89	4.53	4.53
Apartments	10.8	7.3	7.5	9.92	6.70	6.89
Condo, Retirement, SFR	10.8	7.3	7.5	10.36	7.00	7.20
Non-Residential	9.5	7.3	7.3	9.17	7.04	7.04

Implementation outside of CalEEMod

Wastewater Reduction - Flate rate reduction based on percentage identified in measure 1. above.

Greenhouse Gas Emissions, Assumptions and Modeling
3. CalEEMod Output

GHG emissions are based on the same annual CalEEMod output as used in the Air Quality Analysis. Annual CalEEMod output for the Phase 1 Project and the Program is included in Appendix C-1 -5 *CalEEMod Output.*

Greenhouse Gas Emissions, Assumptions and Modeling
4. EMFAC2007

GHG emissions are based on the same annual EMFAC2017 Calculations as used in the Air Quality Analysis. EMFAC2017 output for the Phase 1 Project and the Program is included in Appendix C-1 -6 *EMFAC2007.*