CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Co-Digestion Capacity Analysis
Prepared for the California State Water Resources Control Board under Agreement #17-014-240

CO-DIGESTION CAPACITY IN CALIFORNIA

FINAL | June 2019

carollo

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Disclaimer

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Contents

Appendices

Tables

Figures

Abbreviations

AB	Assembly Bill
AD	anaerobic digestion
ADC	alternative daily cover
ADWF	average dry weather flow
AUIS	all units in service
BEAM	Biosolids Emissions Assessment Model
BioMAT	Bioenergy Market Adjusting Tariff
Board	Board of Commissioners
Btu	British thermal unit
Cal-ARP	California accidental release prevention
CalRecycle	California's Department of Resources Recycling and Recovery
CARB	California Air Resources Board
Carmel	Carmel Area Wastewater District
Carollo	Carollo Engineers, Inc.
CASA	California Association of Sanitation Agencies
CCI	construction cost index
CCR	California Code of Regulations
CCST	California Council on Science and Technology
CEC	California Energy Commission
CERF	compost emission reduction factor
cf	cubic feet
CHP	combined heat and power
CLEEN	California Lending for Energy and Environmental Needs
CMSA	Central Marin Sanitation Agency
CNG	compressed natural gas
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalence
COD	chemical oxygen demand
CORe®	Centralized Organic Recycling
CPI	consumer price index
CPUC	California Public Utilities Commission
CRF	capital recovery factor
CSE	Center for Sustainable Energy
DRU	demographic research unit
EBMUD	East Bay Municipal Utility District
EBS®	Engineered Bioslurry
ECBP	East County Bioenergy Project
EERE	Energy Efficiency & Renewable Energy
EI&C	electrical, instrumentation, and controls
ENR	engineering news record

EPA	United States Environmental Protection Agency
EREF	Environmental Research and Education Foundation
ERS	Economic Research Service
F2E	Food to Energy
FOG	fats, oil, and grease
FTE	full time equivalent
g	grams
GGE	gallon gas equivalent
GHG	greenhouse gas
Goleta	Goleta Sanitary District
gpd	gallons per day
gpm	gallons per minute
H_2S	hydrogen sulfide
Hp	horsepower
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program
IBank	California Infrastructure and Economic Development Bank
IC	internal combustion
ISO	Independent System Operator
JPA	Joint Powers Agreement or Authority
JWPCP	Joint Water Pollution Control Plant
kg	kilogram
kWh	kilowatt hour
LACSD	Sanitation Districts of Los Angeles County
lb	pound
LBNL	Lawrence Berkeley National Lab
lbs	pounds
lbs/p/week	pounds per person per week
LCFS	low carbon fuel standard
LHV	low heating value
LNG	liquefied natural gas
LUOOS	largest unit out of service
MCE	Marin Clean Energy
MDRR	Mount Diablo Resource Recovery
MG	million gallons
mg/L	milligrams per liter
mgd	million gallons per day
MJ	mega joule
mm	millimeter
MMBtu	million British thermal units
MOA	memorandum of agreement
MRF	materials recovery facility
MSS	Marin Sanitary Services
MSW	municipal solid waste

MT	metric ton
MT CO_2e	metric tons of carbon dioxide equivalent emissions
MW	megawatt
MWh	megawatt hour
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPV	net present value
NRDC	National Resource Defense Council
O&M	operations and maintenance
OCSD	Orange County Sanitation District
OREX™	Organics Extrusion Press
OSHA	Occupational Safety and Health Administration
PG&E	Pacific Gas and Electric
ppd	pounds per day
PSM	process safety management
R2	resource recovery
RCNG	renewable compressed natural gas
ReFED	Rethink Food Waste Through Economics and Data
Resolution	Comprehensive Response on Climate Change
RFS	Renewable Fuel Standard
RIN	renewable identification number
RMP	risk management plan
RNG	renewable natural gas
SB	Senate Bill
SBWMA	South Bayside Waste Management Authority
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
scf	standard cubic feet
scfd	standard cubic feet per day
scfm	standard cubic feet per minute
SCG	SoCalGas
SGIP	self-generation incentive program
SJVAPCD	San Joaquin Valley Air Pollution Control District
SOP	standard operating procedures
SRT	solids residence time
SSO	source separated organics
SVCW	Silicon Valley Clean Water
SWRCB	State Water Resources Control Board
TPY	tons per year
TS	total solids
TWAS	thickened waste activated sludge
USDA	United States Department of Agriculture
VFD	variable frequency drive

VOC	volatile organic carbon
VS	volatile solids
VSLR	volatile solids loading rate
WMA	Waste Management Agency
WWTP	wastewater treatment plant

Appendix 1A

FOOD WASTE DISPOSAL INVENTORIES

CalRecycle

The 2014 Waste Characterization study (Cascadia 2015) indicates that the commercial sector contributed about 43 percent of the total food waste disposal (2.4 out of 5.59 million short wet tons).

CalRecycle is preparing to perform a new characterization study within the next year (Carr 2018).

Lawrence Berkeley National Laboratory

Researchers at Lawrence Berkeley National Laboratory (LBNL) recently evaluated bioenergy potential from California food waste (Breunig, Jin et al. 2017). The food waste considered included high- and low-moisture solids from food processors, on-farm culls from harvest and storage, as well as the food waste mixed in with the MSW stream sent to landfills. The amount of food waste identified by LBNL for all categories is about 20 percent greater than that in the inventory done at the University of California, Davis (Williams, Jenkins et al. 2015) due to inclusion of on-farm culls and additional categories of food processing. For digestible components of MSW (i.e., food waste), LBNL uses the same data source (CalRecycle) and same methods as Williams' 2015 used in this analysis.

Additionally, LBNL used regional waste composition data from CalRecycle to estimate the total quarterly and annual food waste disposed of in 2014. Those totals were translated into regional totals as shown in Table 1A.1 (labeled "2014 LBNL") for comparison with the 2017 and 2014 food waste totals estimated in this analysis. The "2014 LBNL" data comports with the 2014 food waste data (5.53 million short wet tons statewide compared to the state estimate of 5.59 million short tons, a difference of only 2 percent). The larger values in 2017 are because total disposal was more (i.e., 37.5 million short wet tons MSW disposal in 2017 while there was 31.2 million short wet tons in 2014 [CalRecycle 2016]).

Table 1A.1 2017 and 2014 Food Waste(1) Disposal by Region Compared to LBNL Estimates (million short wet tons)

Region	2017(2)	2014(2)	2014 LBNL(3)
Southern	3.80	3.22	3.17
Central Valley	1.24	1.02	1.03
Bay Area	1.33	0.99	0.98
Coastal	0.35	0.27	0.26
Mountain	0.10	0.09	0.09
Total	**6.83**	**5.59**	**5.53**

Notes:
(1) Food waste is material currently disposed of at landfills, and does not include agricultural waste.
(2) 2014 Regional Characterization data (CalRecycle 2018) , 2017 and 2014 disposal years.
(3) Adapted from Table S17 in (Breunig, Jin et al. 2017) based on 2014 data from CalRecycle.

Appendix 1B

CALRECYCLE WASTE REGIONS

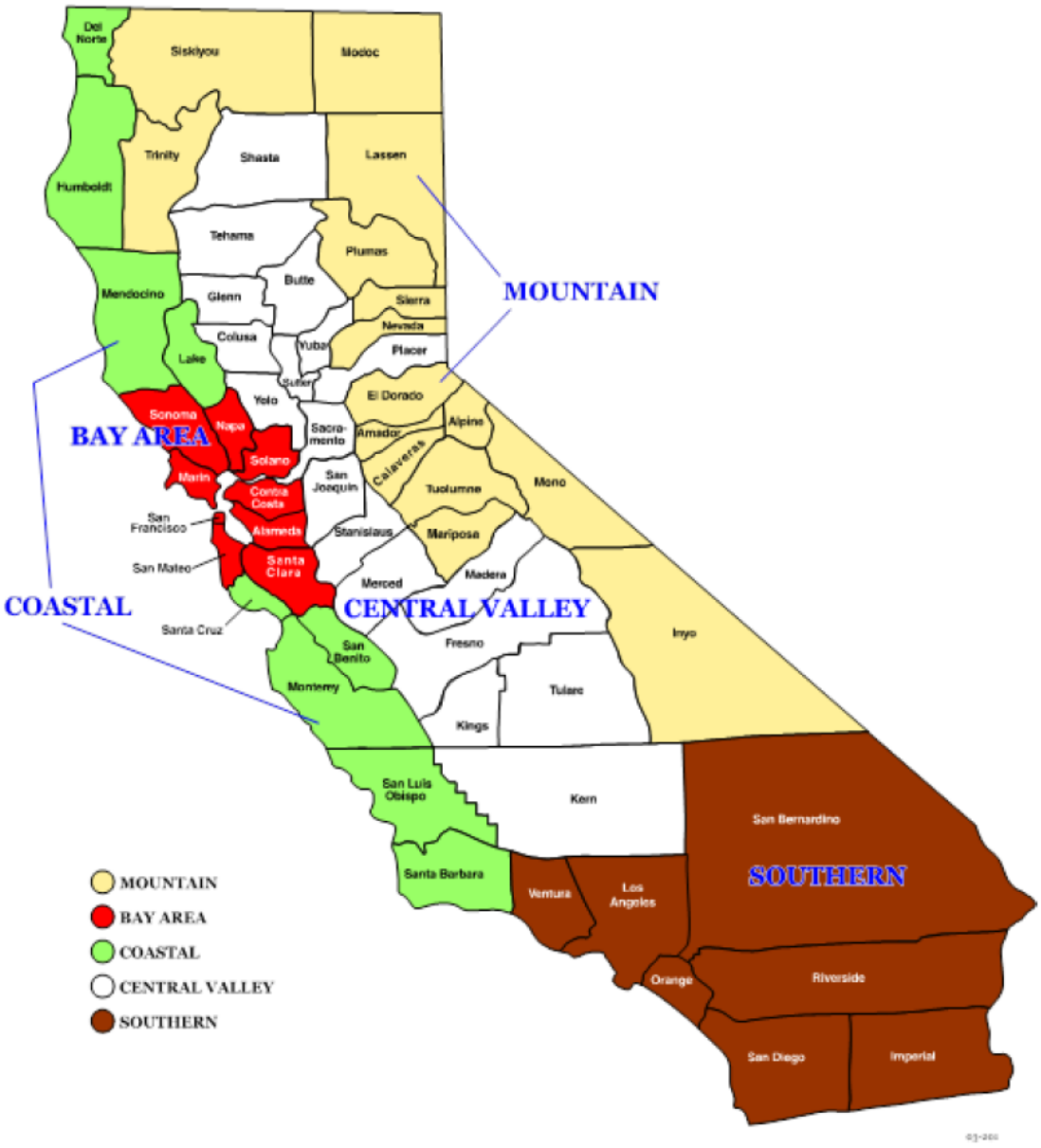

Figure 1B.1 CalRecycle Waste Regions at the County Level (Cascadia 2015)

Appendix 1C

PER CAPITA FOOD WASTE DISPOSAL ESTIMATES

Environmental Protection Agency (EPA)

The EPA has reported on solid waste generation and disposal for more than 30 years. The EPA uses a materials flow methodology for estimating waste amounts. This method uses production data (weight) of materials and products with adjustments for exports and imports, average product lifetime, diversion rates and a sampling of waste characterization studies (USEPA 2015).

The EPA estimates that US average per capita food waste is 4.4 pounds per person per week (lbs/p/week) (USEPA 2016) and has increased slowly since 1990 (Figure 1C.1). However, the EPA methodology consistently estimates much lower waste amounts than are reported in surveys and comprehensive landfill databases. The State of Garbage in America survey compiled 301 million short wet tons disposed of in the US in 2008 compared to the EPA estimate of 154 million short wet tons. A review of a comprehensive database of US landfills (with measured truck weight receipts) indicates 320 million short wet tons of MSW were landfilled in 2012, more than twice the EPA estimate. If the EPA estimates are low by half, then this suggest per capita food waste (landfilled) is more than 8 lbs/p/week, all else equal.

Environmental Research & Education Foundation (EREF)[3]

EREF, noting that the estimate of MSW in the U.S. varies by a factor of two between US EPA's estimate and The State of Garbage Report (last published 2008 data), set out to create a US inventory of MSW generation and disposal from a "bottom up" approach by gathering measured waste data from over 9,000 facilities (landfills, compost facilities, material recovery facilities, waste to energy facilities, etc.). While we did not have access to the detailed report and per capita food waste disposal data for the US, the summary reported EREF estimates of over 220 million short tons being landfilled in the US relative to 134 million short wet tons estimated by the EPA - a factor of 1.64 times larger.

United States Department of Agriculture (USDA)

The Economic Research Service (ERS) at the USDA has used a Loss-Adjusted Food Availability database to estimate the amount of food waste retail and consumer levels. ERS estimates that 31 percent, or 74 million short wet tons, of the 237 million short wet tons of the available US food supply at the retail and consumer levels in 2010 went uneaten. Based on the 2010 US population of 309 million, the USDA per capita food waste is 8.3 lbs/p/week.

Rethink Food Waste through Economics and Data (ReFED)

ReFED is a collaboration of over 30 business, nonprofit, foundation, and government leaders committed to reducing food waste in the United States. ReFED has synthesized results of food waste studies and vetted data through industry experts and academics and created a *Roadmap* of US food waste (ReFED 2016). ReFED estimates 69 million short wet tons of food waste is generated per year of which 58 million short wet tons is landfilled (6.3 lbs/p/week). The Natural Resources Defense Council (NRDC) now uses the ReFED estimate for baseline waste levels in the "Wasted" report series.

[3] https://erefdn.org/wp-content/uploads/2016/09/WasteGen-Executive-Summary.pdf

Comparison with CalRecycle

Figure 1C.1 displays per capita food waste disposal values over time from CalRecycle and EPA data and the single point data from the USDA ERS and ReFED reports. The CalRecycle values are consistently larger than EPA values, though they nearly converge around 2010 before diverging again. The USDA ERS estimate (8.3 lbs/p/week) is about 60 percent larger than the CalRecycle value for 2010. The ReFED value (6.3 lbs/p/week for 2015) is similar to the 2017 CalRecycle value of 6.6 lbs/p/week. Given the consistent methodology used by CalRecycle and the amount of data used in their analyses, this project uses CalRecycle per capita food waste estimates for its analyses.

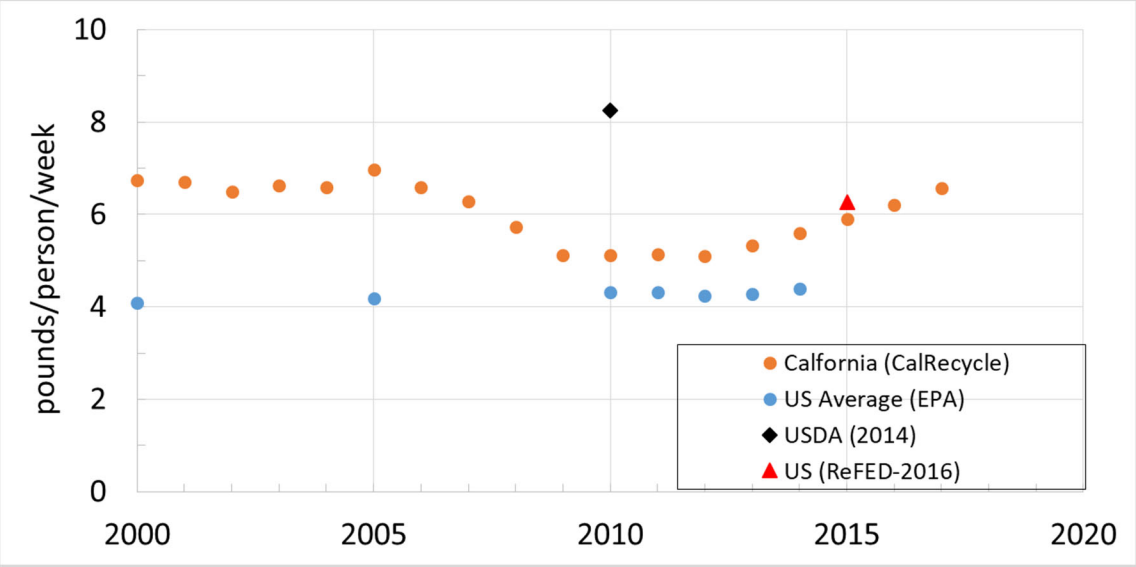

Figure 1C.1 Per Capita Food Waste Disposal Values from Literature Compared to CalRecycle Characterization Data

Note: Food waste fractions were linearly interpolated between CalRecycle Characterization Study years and held constant for 2015 -2017 based on CalRecycle's 2014 Characterization Study results.

Appendix 1D

BASELINE ORGANIC WASTE DISPOSAL INVENTORY

Table 1D.1 2017 Total MSW and Food Waste Disposal and per-capita estimates, County of Origin ("disposed by")

Region	County of Origin Disposal Tons - 2017	Total MSW Disposal, 2017 (short wet tons)	Food Waste (%)	Estimated Food Waste Disposal, 2017 (short wet tons)	Population	2017 Per capita Foodwaste Disposal, Estimated (lbs/person/week)	2025 Per capita Foodwaste Disposal - Estimated 10% Decrease (lbs/person/week)
Bay Area	Alameda	1,381,330	19.8	273,761	1,650,818	6.4	5.7
Bay Area	Contra Costa	801,293	19.8	158,805	1,138,039	5.4	4.8
Bay Area	Marin	232,012	19.8	45,982	262,545	6.7	6.1
Bay Area	Napa	180,270	19.8	35,727	141,624	9.7	8.7
Bay Area	San Francisco	626,997	19.8	124,262	880,418	5.4	4.9
Bay Area	San Mateo	612,469	19.8	121,383	772,900	6.0	5.4
Bay Area	Santa Clara	1,475,586	19.8	292,441	1,945,465	5.8	5.2
Bay Area	Solano	472,834	19.8	93,709	437,309	8.2	7.4
Bay Area	Sonoma	948,777	19.8	188,034	503,883	14.4	12.9
Coastal	Del Norte	19,445	19.8	3,859	26,858	5.5	5.0
Coastal	Humboldt	82,676	19.8	16,407	136,113	4.6	4.2
Coastal	Lake	98,387	19.8	19,525	64,979	11.6	10.4
Coastal	Mendocino	91,990	19.8	18,255	89,124	7.9	7.1
Coastal	Monterey	455,146	19.8	90,323	442,808	7.8	7.1
Coastal	San Benito	80,252	19.8	15,926	58,416	10.5	9.4
Coastal	San Luis Obispo	310,405	19.8	61,599	278,532	8.5	7.7
Coastal	Santa Barbara	417,424	19.8	82,837	450,216	7.1	6.4
Coastal	Santa Cruz	213,359	19.8	42,341	276,452	5.9	5.3
Mountain	Alpine	838	20.0	167	1,141	5.6	5.1
Mountain	Amador	37,526	20.0	7,495	37,050	7.8	7.0
Mountain	Calaveras	37,411	20.0	7,472	44,609	6.4	5.8
Mountain	El Dorado	149,358	20.0	29,831	186,123	6.2	5.5
Mountain	Inyo	21,140	20.0	4,222	18,592	8.7	7.9
Mountain	Lassen	21,093	20.0	4,213	30,652	5.3	4.8
Mountain	Mariposa	34,559	20.0	6,902	17,996	14.8	13.3
Mountain	Modoc	5,469	20.0	1,092	9,521	4.4	4.0
Mountain	Mono	24,988	20.0	4,991	13,798	13.9	12.5
Mountain	Nevada	79,316	20.0	15,842	98,433	6.2	5.6
Mountain	Plumas	22,192	20.0	4,432	19,481	8.8	7.9

Region	County of Origin Disposal Tons - 2017	Total MSW Disposal, 2017 (short wet tons)	Food Waste (%)	Estimated Food Waste Disposal, 2017 (short wet tons)	Population	2017 Per capita Foodwaste Disposal, Estimated (lbs/person/week)	2025 Per capita Foodwaste Disposal - Estimated 10% Decrease (lbs/person/week)
Mountain	Sierra	3,070	20.0	613	3,133	7.5	6.8
Mountain	Siskiyou	40,374	20.0	8,064	44,239	7.0	6.3
Mountain	Trinity	36	20.0	7	13,455	0.0	0.0
Mountain	Tuolumne	45,120	20.0	9,012	54,036	6.4	5.8
Southern	Imperial	210,827	17.1	36,096	188,650	7.4	6.6
Southern	Los Angeles	10,170,204	17.1	1,741,276	10,271,792	6.5	5.9
Southern	Orange	3,262,162	17.1	558,526	3,200,748	6.7	6.0
Southern	Riverside	2,322,651	17.1	397,669	2,389,723	6.4	5.8
Southern	San Bernardino	1,857,315	17.1	317,997	2,163,680	5.7	5.1
Southern	San Diego	3,424,307	17.1	586,288	3,320,108	6.8	6.1
Southern	Ventura	922,013	17.1	157,861	856,111	7.1	6.4
Valley	Butte	224,462	19.6	43,959	226,470	7.5	6.7
Valley	Colusa	24,521	19.6	4,802	22,580	8.2	7.4
Valley	Fresno	854,068	19.6	167,262	999,929	6.4	5.8
Valley	Glenn	20,040	19.6	3,925	29,210	5.2	4.7
Valley	Kern	985,250	19.6	192,953	898,825	8.3	7.4
Valley	Kings	107,611	19.6	21,075	150,587	5.4	4.8
Valley	Madera	136,636	19.6	26,759	157,472	6.5	5.9
Valley	Merced	268,649	19.6	52,613	276,275	7.3	6.6
Valley	Placer	316,576	19.6	61,999	381,675	6.2	5.6
Valley	Sacramento	1,396,891	19.6	273,569	1,519,381	6.9	6.2
Valley	San Joaquin	824,624	19.6	161,495	749,092	8.3	7.5
Valley	Shasta	1,394	19.6	273	178,501	0.1	0.1
Valley	Stanislaus	336,128	19.6	65,828	551,557	4.6	4.1
Valley	Sutter	96,376	19.6	18,874	98,720	7.4	6.6
Valley	Tehama	52,740	19.6	10,329	64,294	6.2	5.6
Valley	Tulare	439,237	19.6	86,021	472,748	7.0	6.3
Valley	Yolo	191,720	19.6	37,547	219,468	6.6	5.9
Valley	Yuba	74,784	19.6	14,646	76,691	7.3	6.6
STATE TOTALS		**37,544,300**	**18.1**	**6,829,200**	**39,613,000**	**6.6**	**6.0**

Table 1D.2 2017 Disposal by Facility in Short Wet Tons

Disposal Facility	SWIS No.	County	Latitude	Longitude	Total Disposal
Vasco Road Sanitary Landfill	01-AA-0010	Alameda	37.75333	-121.72333	260,708
Neal Road Recycling and Waste Facility	04-AA-0002	Butte	39.67425	-121.72929	192,106
Rock Creek Landfill	05-AA-0023	Calaveras	38.03535	-120.8418	22,156
Acme Landfill	07-AA-0002	Contra Costa	38.02532	-122.0873	13,786
Keller Canyon Landfill	07-AA-0032	Contra Costa	37.99763	-121.93623	776,152
Union Mine Disposal Site	09-AA-0003	El Dorado	38.648	-120.8298	892
City Of Clovis Landfill	10-AA-0004	Fresno	36.943	-119.685	58,034
American Avenue Disposal Site	10-AA-0009	Fresno	36.66794	-120.13232	580,094
Glenn County Landfill Site	11-AA-0001	Glenn	39.63435	-122.28264	19,759
Imperial Solid Waste Site	13-AA-0001	Imperial	32.84552	-115.68112	1,808
Calexico Solid Waste Site	13-AA-0004	Imperial	32.6764	-115.54565	1,435
Salton City Solid Waste Site	13-AA-0011	Imperial	33.22944	-115.98611	135,170
Imperial Landfill	13-AA-0019	Imperial	32.8581	-115.52332	113,626
Monofill Facility	13-AA-0022	Imperial	33.08472	-115.82444	48,214
Lone Pine Landfill	14-AA-0003	Inyo	36.59421	-118.03495	4,361
Independence Landfill	14-AA-0004	Inyo	36.7884	-118.17586	869
Bishop Sunland Solid Waste Site	14-AA-0005	Inyo	37.32961	-118.40007	16,349
Boron Sanitary Landfill	15-AA-0045	Kern	34.99028	-117.6475	4,327
Shafter-Wasco Recycling & Sanitary LF	15-AA-0057	Kern	35.51042	-119.41085	165,336
Mojave-Rosamond Sanitary Landfill	15-AA-0058	Kern	34.99336	-118.13881	25,243
Ridgecrest Recycling & Sanitary Landfill	15-AA-0059	Kern	35.60254	-117.73755	59,447
Taft Recycling & Sanitary Landfill	15-AA-0061	Kern	35.20377	-119.45314	49,517
Tehachapi Sanitary Landfill	15-AA-0062	Kern	35.12362	-118.34031	39,723
McKittrick Waste Treatment Site	15-AA-0105	Kern	35.2909	-119.63232	118,735
Main Base Sanitary Landfill, Edwards AFB	15-AA-0150	Kern	34.95605	-117.95627	3,073
Clean Harbors Buttonwillow LLC	15-AA-0257	Kern	35.40658	-119.60904	53,534
Bakersfield Metropolitan (Bena) SLF	15-AA-0273	Kern	35.34467	-118.7595	449,597
H.M. Holloway Inc.	15-AA-0308	Kern	35.63707	-119.76615	135,500
Avenal Regional Landfill	16-AA-0004	Kings	36.01195	-120.11535	111,536
CWMI, KHF (MSW Landfill B-19)	16-AA-0021	Kings	35.96561	-120.01242	100,649
Kettleman Hills - B18 Nonhaz Codisposal	16-AA-0023	Kings	35.95619	-120.00855	10,106
Chemical Waste Management, Inc. Unit B-17	16-AA-0027	Kings	35.95904	-120.01606	138,642
Eastlake Sanitary Landfill	17-AA-0001	Lake	38.9531	-122.59969	94,662
Bass Hill Landfill	18-AA-0009	Lassen	40.35281	-120.55508	20,637
Westwood Landfill	18-AA-0010	Lassen	40.318	-121.02272	69
Scholl Canyon Landfill	19-AA-0012	Los Angeles	34.1575	-118.19556	391,383
Azusa Land Reclamation Co. Landfill	19-AA-0013	Los Angeles	34.117	-117.925	423,086
Lancaster Landfill and Recycling Center	19-AA-0050	Los Angeles	34.7474	-118.1165	138,424
Chiquita Canyon Sanitary Landfill	19-AA-0052	Los Angeles	34.4295	-118.64661	1,491,522

Disposal Facility	SWIS No.	County	Latitude	Longitude	Total Disposal
Calabasas Landfill	19-AA-0056	Los Angeles	34.15125	-118.72005	352,046
Pebbly Beach (Avalon) Disposal Site	19-AA-0061	Los Angeles	33.333	-118.31	3,540
San Clemente Island Landfill	19-AA-0063	Los Angeles	32.96474	-118.53652	95
Sunshine Canyon City/County Landfill	19-AA-2000	Los Angeles	34.32731	-118.51489	2,018,390
Antelope Valley Public Landfill	19-AA-5624	Los Angeles	34.56975	-118.15208	495,833
Savage Canyon Landfill	19-AH-0001	Los Angeles	33.9799	-118.0171	88,601
Fairmead Solid Waste Disposal Site	20-AA-0002	Madera	37.06468	-120.1991	197,952
Redwood Landfill	21-AA-0001	Marin	38.16564	-122.56835	351,691
Mariposa County Sanitary Landfill	22-AA-0001	Mariposa	37.50432	-120.0058	12,466
Highway 59 Disposal Site	24-AA-0001	Merced	37.4038	-120.49826	306,719
Billy Wright Disposal Site	24-AA-0002	Merced	37.03923	-120.9731	159,342
Alturas Sanitary Landfill	25-AA-0001	Modoc	41.45861	-120.56556	1,035
Walker Landfill	26-AA-0001	Mono	38.5545	-119.4548	325
Pumice Valley Landfill	26-AA-0003	Mono	37.90694	-119.06528	357
Benton Crossing Landfill	26-AA-0004	Mono	37.68748	-118.78128	23,113
Johnson Canyon Sanitary Landfill	27-AA-0005	Monterey	36.53167	-121.40667	207,758
Monterey Peninsula Landfill	27-AA-0010	Monterey	36.70961	-121.76223	603,209
Clover Flat Resource Recovery Park	28-AA-0002	Napa	38.584	-122.534	72,187
Prima Deshecha Sanitary Landfill	30-AB-0019	Orange	33.48654	-117.62491	528,964
Olinda Alpha Sanitary Landfill	30-AB-0035	Orange	33.934	-117.841	2,135,320
Frank R. Bowerman Sanitary LF	30-AB-0360	Orange	33.71809	-117.70331	2,289,412
Western Regional Landfill	31-AA-0210	Placer	38.83583	-121.34472	283,518
Badlands Sanitary Landfill	33-AA-0006	Riverside	33.95349	-117.11758	641,708
Badlands Sanitary Landfill	33-AA-0006	Riverside	33.95349	-117.11758	641,708
Lamb Canyon Sanitary Landfill	33-AA-0007	Riverside	33.88389	-116.99722	294,006
Lamb Canyon Sanitary Landfill	33-AA-0007	Riverside	33.88389	-116.99722	294,006
Oasis Sanitary Landfill	33-AA-0015	Riverside	33.43923	-116.0818	1,094
Desert Center Landfill	33-AA-0016	Riverside	33.77754	-115.40867	33
Blythe Sanitary Landfill	33-AA-0017	Riverside	33.70478	-114.62673	12,348
Blythe Sanitary Landfill	33-AA-0017	Riverside	33.70478	-114.62673	12,348
El Sobrante Landfill	33-AA-0217	Riverside	33.79923	-117.46786	3,256,447
Sacramento County Landfill (Kiefer)	34-AA-0001	Sacramento	38.51667	-121.18667	779,315
L and D Landfill	34-AA-0020	Sacramento	38.528	-121.378	243,181
John Smith Road Landfill	35-AA-0001	San Benito	36.82476	-121.32316	290,553
California Street Landfill	36-AA-0017	San Bernardino	34.08861	-117.221	51,762
Victorville Sanitary Landfill	36-AA-0045	San Bernardino	34.59333	-117.27	302,572
Barstow Sanitary Landfill	36-AA-0046	San Bernardino	34.83617	-117.01773	76,671
Mid-Valley Sanitary Landfill	36-AA-0055	San Bernardino	34.14328	-117.42752	1,042,343
Landers Sanitary Landfill	36-AA-0057	San Bernardino	34.23776	-116.36983	53,101
USMC - 29 Palms Disposal Facility	36-AA-0067	San Bernardino	34.24833	-116.06417	7,301
Fort Irwin Sanitary Landfill	36-AA-0068	San Bernardino	35.26589	-116.66233	8,036

Disposal Facility	SWIS No.	County	Latitude	Longitude	Total Disposal
San Timoteo Sanitary Landfill	36-AA-0087	San Bernardino	34.01283	-117.21477	278,286
Borrego Landfill	37-AA-0006	San Diego	33.24667	-116.29333	2,127
Otay Landfill	37-AA-0010	San Diego	32.60333	-117.005	1,509,706
West Miramar Sanitary Landfill	37-AA-0020	San Diego	32.856	-117.162	858,449
Sycamore Landfill	37-AA-0023	San Diego	32.86232	-117.02538	967,133
San Onofre Landfill	37-AA-0902	San Diego	33.39667	-117.54028	11
Las Pulgas Landfill	37-AA-0903	San Diego	33.36444	-117.41921	16,608
Foothill Sanitary Landfill	39-AA-0004	San Joaquin	38.03778	-120.93722	289,362
Forward Landfill, Inc.	39-AA-0015	San Joaquin	37.87417	-121.18828	859,530
North County Landfill & Recycling Center	39-AA-0022	San Joaquin	38.097	-121.10194	185,777
City Of Paso Robles Landfill	40-AA-0001	San Luis Obispo	35.66314	-120.53182	39,389
Camp Roberts Landfill	40-AA-0002	San Luis Obispo	35.77509	-120.7343	109
Cold Canyon Landfill, Inc.	40-AA-0004	San Luis Obispo	35.1873	-120.59579	182,546
Chicago Grade Landfill	40-AA-0008	San Luis Obispo	35.52333	-120.63028	104,480
Corinda Los Trancos Landfill (Ox Mtn)	41-AA-0002	San Mateo	37.50057	-122.41078	577,401
Vandenberg AFB Landfill	42-AA-0012	Santa Barbara	34.7197	-120.52418	69
Tajiguas Res Rec Proj & Sanitary LF	42-AA-0015	Santa Barbara	34.48151	-120.1264	213,422
Santa Maria Regional Landfill	42-AA-0016	Santa Barbara	34.95152	-120.38009	110,636
City Of Lompoc Sanitary Landfill	42-AA-0017	Santa Barbara	34.62555	-120.48298	37,662
Zanker Material Processing Facility	43-AN-0001	Santa Clara	37.43615	-121.95122	8,825
Newby Island Sanitary Landfill	43-AN-0003	Santa Clara	37.45897	-121.94108	418,646
Kirby Canyon Recycl.& Disp. Facility	43-AN-0008	Santa Clara	37.18507	-121.67109	178,407
Guadalupe Sanitary Landfill	43-AN-0015	Santa Clara	37.21481	-121.89837	192,846
City of Santa Cruz Resource Recovery Fac	44-AA-0001	Santa Cruz	36.97602	-122.10608	50,708
City Of Watsonville Landfill	44-AA-0002	Santa Cruz	36.914	-121.824	28,699
Buena Vista Drive Sanitary Landfill	44-AA-0004	Santa Cruz	36.91738	-121.81142	96,785
Anderson Landfill, Inc.	45-AA-0020	Shasta	40.41639	-122.36	114,674
West Central Landfill	45-AA-0043	Shasta	40.48156	-122.53498	140,502
Loyalton Landfill	46-AA-0001	Sierra	39.67	-120.22	933
Recology Hay Road	48-AA-0002	Solano	38.312	-121.83722	712,789
Potrero Hills Landfill	48-AA-0075	Solano	38.21188	-121.98081	999,287
Central Disposal Site	49-AA-0001	Sonoma	38.29964	-122.74951	655,861
Fink Road Landfill	50-AA-0001	Stanislaus	37.38816	-121.13633	283,334
Tehama County/Red Bluff Landfill	52-AA-0001	Tehama	40.19565	-122.2965	52,791
Teapot Dome Disposal Site	54-AA-0004	Tulare	36.02111	-119.10583	112,828
Visalia Disposal Site	54-AA-0009	Tulare	36.39222	-119.39194	311,415
Toland Road Landfill	56-AA-0005	Ventura	34.4025	-118.99806	424,678
Simi Valley Landfill & Recycling Center	56-AA-0007	Ventura	34.29454	-118.79544	1,098,158
Yolo County Central Landfill	57-AA-0001	Yolo	38.59641	-121.6824	211,027
Recology Ostrom Road LF Inc.	58-AA-0011	Yuba	39.07306	-121.3935	249,020
STATE TOTAL					**36,985,589**

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Appendix 1E

TOTAL AND PER CAPITA SOLID WASTE DISPOSAL TREND

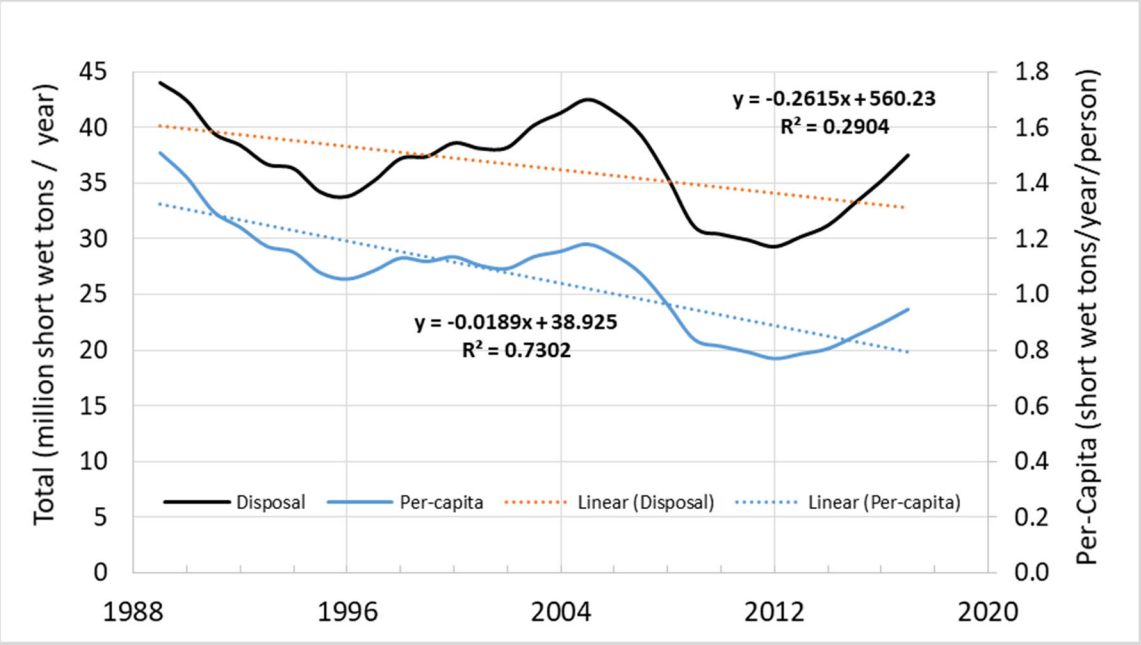

Figure 1E.1 Total and Per Capita Solid Waste Disposal Trend

Appendix 1F

PROJECTED FOOD WASTE DISPOSAL SCENARIOS BY COUNTY IN SHORT TONS, 2025 & 2030

Table 1F.1 Projected Food Waste Disposal Scenarios by County in Short Wet Tons, 2025 and 2030 (assumes no recovery or diversion)

County	Constant Per Capita		10% Decrease in Per Capita	
	2025	2030	2025	2030
Alameda	296,917	310,709	267,225	279,638
Alpine	162	166	146	150
Amador	7,841	8,075	7,057	7,267
Butte	46,301	48,008	41,671	43,207
Calaveras	7,694	7,859	6,925	7,073
Colusa	5,115	5,306	4,604	4,775
Contra Costa	173,798	182,678	156,418	164,410
Del Norte	3,917	3,961	3,525	3,565
El Dorado	31,589	33,018	28,430	29,716
Fresno	182,159	191,641	163,943	172,477
Glenn	4,113	4,246	3,702	3,821
Humboldt	16,824	16,969	15,142	15,272
Imperial	39,730	42,044	35,757	37,840
Inyo	4,303	4,342	3,873	3,907
Kern	213,922	229,426	192,530	206,484
Kings	22,699	23,827	20,429	21,444
Lake	19,920	20,293	17,928	18,264
Lassen	4,189	4,145	3,770	3,730
Los Angeles	1,809,085	1,842,449	1,628,177	1,658,204
Madera	29,624	31,766	26,662	28,589
Marin	47,091	47,703	42,382	42,933
Mariposa	6,973	7,065	6,276	6,358
Mendocino	18,832	19,142	16,949	17,228
Merced	58,301	62,258	52,470	56,032
Modoc	1,069	1,063	962	957
Mono	5,194	5,304	4,675	4,773
Monterey	96,381	99,745	86,742	89,771
Napa	37,385	38,555	33,647	34,699
Nevada	16,437	16,950	14,794	15,255
Orange	584,687	599,143	526,218	539,228
Placer	69,127	73,877	62,214	66,489
Plumas	4,378	4,339	3,940	3,905
Riverside	447,012	475,510	402,311	427,959

County	Constant Per Capita		10% Decrease in Per Capita	
	2025	2030	2025	2030
Sacramento	299,732	316,464	269,759	284,818
San Benito	17,248	18,182	15,523	16,364
San Bernardino	345,722	364,324	311,150	327,891
San Diego	621,868	641,214	559,682	577,093
San Francisco	133,598	138,690	120,238	124,821
San Joaquin	180,826	192,807	162,743	173,526
San Luis Obispo	64,739	66,354	58,265	59,719
San Mateo	128,830	132,671	115,947	119,404
Santa Barbara	87,623	90,345	78,861	81,311
Santa Clara	318,370	334,271	286,533	300,844
Santa Cruz	44,776	46,176	40,298	41,559
Shasta	282	289	254	260
Sierra	611	604	550	544
Siskiyou	8,069	8,094	7,262	7,285
Solano	103,010	108,690	92,709	97,821
Sonoma	199,744	206,996	179,769	186,296
Stanislaus	72,261	76,245	65,035	68,620
Sutter	20,327	21,251	18,294	19,126
Tehama	10,753	11,082	9,678	9,974
Trinity	7	7	6	6
Tulare	93,443	98,363	84,099	88,527
Tuolumne	9,058	9,139	8,152	8,225
Ventura	164,895	169,555	148,405	152,599
Yolo	41,949	44,774	37,754	40,297
Yuba	15,863	16,580	14,276	14,922
State Total	**7,296,373**	**7,574,751**	**6,566,736**	**6,817,276**

Appendix 1G

RECOVERABLE FOOD WASTE IN SHORT WET TONS AS DIVERTED FROM A LANDFILL

Note: "Low Projection" will be used in follow-on chapters.

Table 1G.1 Recoverable Food Waste in Short Wet Tons as Diverted from a Landfill

County	High Projection (60% recovery of the "constant per capita" scenario)		Low Projection (50% recovery of the "10% decrease per capita" scenario)	
	2025	2030	2025	2030
Alameda	178,150	186,425	133,613	139,819
Alpine	97	100	73	75
Amador	4,705	4,845	3,528	3,634
Butte	27,781	28,805	20,836	21,604
Calaveras	4,616	4,715	3,462	3,537
Colusa	3,069	3,184	2,302	2,388
Contra Costa	104,279	109,607	78,209	82,205
Del Norte	2,350	2,377	1,763	1,783
El Dorado	18,953	19,811	14,215	14,858
Fresno	109,296	114,985	81,972	86,238
Glenn	2,468	2,547	1,851	1,911
Humboldt	10,095	10,182	7,571	7,636
Imperial	23,838	25,226	17,878	18,920
Inyo	2,582	2,605	1,936	1,954
Kern	128,353	137,656	96,265	103,242
Kings	13,620	14,296	10,215	10,722
Lake	11,952	12,176	8,964	9,132
Lassen	2,513	2,487	1,885	1,865
Los Angeles	1,085,451	1,105,470	814,088	829,102
Madera	17,774	19,060	13,331	14,295
Marin	28,255	28,622	21,191	21,466
Mariposa	4,184	4,239	3,138	3,179
Mendocino	11,299	11,485	8,474	8,614
Merced	34,980	37,355	26,235	28,016
Modoc	641	638	481	478
Mono	3,116	3,182	2,337	2,387
Monterey	57,828	59,847	43,371	44,885
Napa	22,431	23,133	16,823	17,350
Nevada	9,862	10,170	7,397	7,627
Orange	350,812	359,486	263,109	269,614
Placer	41,476	44,326	31,107	33,245
Plumas	2,627	2,603	1,970	1,952
Riverside	268,207	285,306	201,156	213,980

County	High Projection (60% recovery of the "constant per capita" scenario)		Low Projection (50% recovery of the "10% decrease per capita" scenario)	
	2025	2030	2025	2030
Sacramento	179,839	189,878	134,879	142,409
San Benito	10,349	10,909	7,762	8,182
San Bernardino	207,433	218,594	155,575	163,946
San Diego	373,121	384,729	279,841	288,546
San Francisco	80,159	83,214	60,119	62,410
San Joaquin	108,495	115,684	81,372	86,763
San Luis Obispo	38,843	39,813	29,133	29,860
San Mateo	77,298	79,603	57,973	59,702
Santa Barbara	52,574	54,207	39,430	40,655
Santa Clara	191,022	200,563	143,266	150,422
Santa Cruz	26,865	27,706	20,149	20,779
Shasta	169	173	127	130
Sierra	366	362	275	272
Siskiyou	4,841	4,857	3,631	3,642
Solano	61,806	65,214	46,354	48,910
Sonoma	119,846	124,197	89,885	93,148
Stanislaus	43,357	45,747	32,518	34,310
Sutter	12,196	12,751	9,147	9,563
Tehama	6,452	6,649	4,839	4,987
Trinity	4	4	3	3
Tulare	56,066	59,018	42,050	44,264
Tuolumne	5,435	5,484	4,076	4,113
Ventura	98,937	101,733	74,203	76,300
Yolo	25,169	26,865	18,877	20,148
Yuba	9,518	9,948	7,138	7,461
State Total	**4,377,824**	**4,544,851**	**3,283,368**	**3,408,638**

Appendix 2A

SURVEY

2018 Carollo Survey Design and Distribution

The project team developed a survey focused on current solids processing systems, present-day flows and loads, solids and biogas handling practices, existing facility capacities, and planned future changes. The goal of the survey was to assess each municipal WWTP's ability to co-digest food waste now (with no modifications) and interest in doing so in the future. CASA distributed the survey to its member agencies, and the results were analyzed by Carollo.

The survey was sent to 223 permitted municipal WWTPs through CASA in late August of 2018. As of February 1, 2019, 99 facilities provided survey responses.

Municipal WWTPs That Responded to the Survey

American Valley Community Services District
Anderson Water Pollution Control Plant
Atwater Regional Wastewater Treatment Facility
Bakersfield City Wastewater Treatment Plant #2
Bakersfield City Wastewater Treatment Plant No. 3
Camarillo Sanitary District
Carmel Area Wastewater District
Carpinteria Sanitary District
Central Contra Costa Sanitary District
Central Marin Sanitation Agency
City of American Canyon
City of Auburn WWTP
City of Barstow
City of Benicia Wastewater Treatment Plant
City of Brentwood
City of Cloverdale
City of Corona, Department of Water and Power
City of Eureka
City of Hayward WPCF
City of Healdsburg
City of Holtville Wastewater Treatment Plant
City of Imperial
City of Lindsay
City of Livingston (Water Reclamation Facility)
City of Lompoc
City of Los Banos WWTP
City of Manteca
City of Millbrae
City of Needles
City of Newman WWTP
City of Palm Springs
City of Palo Alto Regional Water Quality Control Plant
City of Petaluma
City of Reedley

City of Richmond Water Pollution Control Plant
City of Rio Vista
City of Riverside Regional Water Quality Control Plant
City of San Diego
City of Sanger
City of Santa Barbara
City of Santa Rosa
City of Scotts Valley
City of Simi Valley Water Quality Control Plant
City of Stockton, Regional Wastewater Control Facility
City of Sunnyvale Water Pollution Control Plant
City of Thousand Oaks - Hill Canyon Treatment Plant
City of Ventura
City of Willits
City of Woodland
City of Grass Valley
Coachella Valley Water District
Delta Diablo
Dublin San Ramon Services District
EBMUD
El Dorado Irrigation District (Deer Creek WWTP)
El Dorado Irrigation District (El Dorado Hills WWTP)
Encina Wastewater Authority
Fairfield-Suisun Sewer District
Fresno/Clovis WWTF
Goleta Sanitary District
Hyperion Water Reclamation Plant (City of Los Angeles)
Ironhouse Sanitary District
Las Gallinas Valley Sanitary District
Las Virgenes Municipal Water District
Livermore Water Reclamation Plant
Los Angeles County Sanitation Districts - JWPCP
Los Angeles County Sanitation Districts - Lancaster
Los Angeles County Sanitation Districts - Palmdale
Los Angeles County Sanitation Districts - Valencia
Malaga County Water District
North of River Sanitary District No.1
North San Mateo County Sanitation District. (City of Daly City)
Novato Sanitary District
Orange County Sanitation District - Plant No.1 Fountain Valley
Orange County Sanitation District - Plant No.2 Huntington Beach
Oro Loma Sanitary District
Padre Dam Municipal Water District
Ramona Municipal Water District

Sacramento Regional Community Services District
Salida Sanitary District
San Elijo Joint Powers Authority
San Francisco Public Utilities Commission -SEP
Santa Rosa Water Reclamation Facility
Scotia Community Services District
SFPUC - Oceanside
Silicon Valley Clean Water
SOCWA - CTP
SOCWA - JBL
SOCWA - RTP
Sonoma County Water Agency
South San Luis Obispo County Sanitation District
Summerland Sanitary District
Terminal Island Water Reclamation Plant (City of Los Angeles)
Town of Windsor
Tuolumne Utilities District
Union Sanitary District
Valley Sanitary District
Victor Valley Wastewater Reclamation Authority
West County Wastewater District

Representativeness of Survey Responses and Capacity Extrapolation

The project team evaluated the survey responses against a number of data sources to understand what types of WWTPs responded to the survey (large vs small, with vs without digestion, etc.) as well as what proportion of California's overall flow survey respondents represented.

Based on this evaluation, we determined that the survey captured the majority of flows for large facilities and for facilities in the Bay Area, Southern, and Central Valley regions. Because the survey captured the majority of these flows in California, we extrapolated results for large facilities in the Bay Area, Southern, and Central Valley regions that did not respond to the survey.

We extrapolated capacity only for processes that scale reasonably with flow. Flow-based extrapolation is not appropriate for systems that do not scale with flow such as solid organic waste receiving stations, biogas conditioning, and biogas end use capacities. Thus we did not extrapolate capacity for those processes.

We compared four data sources in this analysis:

1. Carollo Survey (2018).
2. The SWRCB's Wastewater User Charge Survey (FY 2016-17) (SWRCB 2017).
3. The EPA's Clean Watersheds Needs Survey (2012) (EPA 2012).
4. CASA's work based on data retrieved from the CIWQS Database (2015) (CASA 2018).

Table 2A.1 summarizes these data sources. We excluded facilities smaller than 1 million gallons per day (mgd) from this comparison as it is unlikely that these facilities have anaerobic digestion.

While the CIWQS database has a much larger flow than the other two databases, based on a preliminary review of this database, it appears that the CIWQS includes duplicate facility flows, and flows from facilities that are not strictly municipal WWTPs (such as recycled water facilities and permitted outfalls). Thus, this database was not considered further in this analysis.

When compared to the EPA's and State Water Board's surveys on a "number of facilities" basis, the 2018 Carollo survey captured around 37 and 56 percent of facilities in California, respectively. However, when compared on a "design flow" basis, the Carollo survey captured 70 and 88 percent of the design flow in California, respectively.

Table 2A.1 Summary of the Four Data Sources Considered

	Carollo Survey		State Water Board's Wastewater User Charge Survey		EPA's Clean Watersheds Needs Survey			CASA (CIWQS database)	
	2017 ADWF	Design Flow	ADWF	Design Flow	ADWF	Design Flow (now)	Design Flow (future)	AD WF	Design Flow
Flow, MGD	1,617	2,930	1,728	3,328	3302	4198	4652	NA	6,008
Count(1)	64	92	167	165	252(2)	252(2)	248(2)	NA	334

Notes:
(1) Only facilities larger than 1 mgd were included in this summary.
(2) Some facilities are consolidated to match how these plants were characterized in the SWRCB's and our survey.

We also looked at the breakdown of these facilities by size and by region—for all data sources except the CIWQS data, as mentioned above. Table 2A.2 shows the average percentage of flow generated by facility size and by facility region. These percentages were similar across all three data sources. As shown in this table, the majority of design flow is from large WWTPs in the Southern region.

Table 2A.2 Breakdown of Flow by Facility Size and by Region for WWTPs in California

	Average Percentage of Total Design Flow at WWTPs in CA	Average Percentage of Total Design Flow at WWTPs with Anaerobic Digestion in CA(1)
Facility Size		
Small (<5mgd)	5%	2%
Medium (5-20 mgd)	18%	15%
Large (>20 mgd)	77%	83%
Facility Region		
Bay Area	22%	21%
Southern	58%	61%
Central Valley	16%	16%
Mountain	1%	0%
Coastal	3%	3%

Notes:
(1) Facilities with digestion were compiled based on information in the EPA survey, the 2018 Carollo survey results, and communication with the EPA's Biosolids Coordinator (Fondahl L. 2019).

We also looked at how much flow Carollo's survey accounts for when compared to both the State Water Board's and EPA's databases. Table 2A.3 shows the results of this analysis.

Table 2A.3 Percentage of Design Flow Captured in the 2018 Carollo Survey

	Percentage of Design Flow Captured in Carollo Survey When Compared to the State Water Board's Database	Percentage of Design Flow Captured in Carollo Survey When Compared to the EPA's Database
Small	37%	25%
Medium	66%	45%
Large	97%	81%
Bay Area	82%	71%
Southern	102%	74%
Central Valley	68%	64%
Mountain	40%	32%
Coastal	38%	26%

As shown in Table 2A.3, the Carollo survey captures a majority of flows at large WWTPs and flows at WWTPs in the Bay Area, Southern, and Central Valley regions. Thus, in an attempt to estimate the digestion, dewatering, and flare capacity that was not captured by the Carollo survey, we extrapolated results for large facilities in the Bay Area, Southern, and Central Valley regions.

Based on the databases considered in this study, there are 40 facilities in California that are considered large facilities (>20 mgd). Of these 40 facilities, 39 are in the Bay Area, Southern, and Central Valley regions. Of these 39 facilities, 31 have anaerobic digestion. The Carollo survey received results for 22 of these facilities, accounting for 2,357 mgd of the design flow. The remaining 9 large facilities have a combined design flow of 477 mgd. Thus, to extrapolate the Carollo results for large facilities, we added 20 percent to the Carollo results for digestion, dewatering, and flare capacity. We used similar percentages when showing the data by region. Table 2A.4 shows the percentages we used to extrapolate regional data.

Table 2A.4 Percentage Increase for Extrapolation

Category	All Facilities Captured in Survey	Large Facilities Not Captured in Survey		Percent Increase
	Flow, mgd w/ digestion	# of Facilities w/ digestion	Flow, mgd w/ digestion	
Small	30	NA	NA	0%
Medium	353	NA	NA	0%
Large	2,357	9	477	20%
Bay Area	509	1	167	48%
Southern	1,780	4	200	12%
Central Valley	408	4	111	30%
Mountain	9	NA	NA	0%
Coastal	34	NA	NA	0%

1. What is your main form of wastewater solids stabilization?

   ☐ Anaerobic digestion

   ☐ Other **If your answer is other, answer Question 2 and then skip to Question 12.**

2. **Facility Contact/Info**

   a. Name of Organization: _____

   b. Name of Respondent: _____

   c. Respondent title: _____

   d. Respondent email address: _____

   e. Respondent phone number: _____

3. **General Plant Info**

   a. What is the design Average Dry Weather Flow (ADWF) to the treatment plant?

      _____ MGD

   b. What is the 2017 actual ADWF to the treatment plant?

      _____ MGD

   c. What is the design Peak Hour Wet Weather Flow (PHWWF) to the treatment plant?

      _____ MGD

   d. What is the 2017 actual PHWWF to the treatment plant?

      _____ MGD

4. **Anaerobic Digestion - Capacity**

a. Do you digest on-site? ☐ yes ☐ no

i. If No:

1. Please name the facility that accepts your wastewater sludge.

_____

2. **Skip to Question 11.**

ii. If Yes:

1. Please provide the following information for each digester tank at your facility. Tanks can be grouped by size (e.g., if a facility has 3 tanks that are each 150,000 ft^3, fill out one row, put "3" in the "Total Number" column, and "150,000" in the "Size" column).

Total Number	Number typically in service	Size (cubic feet)	Temperature Regime (Mesophilic or Thermophilic)	Mixing Method

2. What is the design Solids Residence Time (SRT) or Mean Cell Residence Time (MCRT) for your digestion system?

_____ days ☐ SRT or ☐ MCRT

3. What is the actual SRT or MCRT for your digestion system?

_____ days ☐ SRT or ☐ MCRT

4. What is your total permitted digestion capacity volume?

_____ million gallons

5. **Anaerobic Digestion - Ancillary Equipment**

   a. Please check the boxes corresponding to the type of digester mixing system in use. You can mark all that are applicable.

   - ☐ Gas injection
   - ☐ Mechanical stirring
   - ☐ Mechanical pumping
   - ☐ Other: _____

   b. Please check the boxes corresponding to the type of heat exchanger in use for digester heating. You can mark all that are applicable.

   - ☐ Spiral
   - ☐ Tube-in-tube
   - ☐ Shell and tube
   - ☐ Other: _____

6. **Anaerobic Digestion - Feedstock**

   a. What is the 2017 average influent municipal sludge flow to the digesters?

      _____ gallons per day

   b. What is the 2017 average influent municipal sludge load to the digesters?

      _____ pounds per day

   c. What is the 2017 average influent municipal sludge percent solids or solids concentration to the digesters?

      _____ ☐ percent solids or ☐ milligrams per liter

   d. Does your facility receive other feedstocks to the digesters? ☐ yes ☐ no

      i. If No:

         1. Are you interested in accepting other feedstocks in the future?

            ☐ yes (Continue.) ☐ no **(Skip to Question 7.)**

         2. Please check the boxes corresponding to the types of feedstock you are interested in co-digesting. You can mark all that are applicable.

            ☐ Fats, oils, and grease (FOG)

            ☐ Liquid food and beverage processing waste (e.g., dairy, winery, chicken blood, etc.)

            ☐ Organic fraction of municipal solid waste (food waste)

            ☐ Source separated commercial, institutional, or residential organic waste

            ☐ Sludge from another municipal treatment plant

            ☐ Other: _____

         3. Would you be interested in dedicating a digester solely to this additional feedstock? ☐ yes ☐ no

         4. **Continue to Question 7.**

      ii. If Yes:

         1. Please fill in the table on the next page.

Feedstock type	Flow (gallons per day)	Load (pounds per day)	No. of days per week feedstock is accepted	Concentration (percent solids or milligrams per liter)
FOG				
Liquid Food and beverage processing waste				
Organic fraction of municipal solid waste (food waste)				
Source separated commercial, institutional, or residential organic waste				
Sludge from another municipal treatment plant				
Other:_____				

2. How many employees does this facility use for additional feedstock digestion? _____
3. What are the main challenges your organization faces with external feedstock processing? Please choose all that apply and prioritize your choices. Please rank, with one being the most important.

    Operations and maintenance costs (e.g., labor, chemicals)

    Finding feedstock sources

    Quality of feedstock / contamination (e.g., grit, plastics, rags)

    Digester health / upsets

    Biogas management (e.g., quality and/or quantity)

    Public perception / relations

    Odors

    Space for facilities

    Regulatory restrictions

    Other: _____

7. **Biosolids - Dewatering**

   a. Do you dewater biosolids after digestion? ☐ yes ☐ no

      i. If No:

         1. **Skip to Question 8.**

      ii. If Yes:

         1. Please check the boxes corresponding to the type of dewatering used. You can mark all that are applicable.

            ☐ Centrifuge
            ☐ Belt filter press
            ☐ Screw press
            ☐ Indirect dryer
            ☐ Direct dryer
            ☐ Drying bed
            ☐ Other: _____

         2. What is the design capacity of your dewatering facility? Please provide units with your answer (e.g., gallons per minute, wet pounds per hour, etc.). _____ units: _____
         3. What is the excess dewatering capacity of your facility, if any? Please provide units with your answer (e.g., gallons per minute, wet pounds per hour, etc.). _____ units: _____
         4. What is the average cake concentration?

            _____ percent solids
         5. What type of polymer do you use for dewatering, if any?

            _____
         6. How much polymer do you use for dewatering, if any?

            _____ pounds per year
         7. Do you have space onsite for additional dewatering units? If so, what is the approximate available area? _____ ft^2

8. **Biosolids - Utilization**

a. Please fill in the table below to explain how biosolids were utilized in 2017. Extra rows are for duplicate end use types.

End Use Type	Amount of Biosolids (total wet tons)	Percent Solids	Hauling Distance (miles, one way)	Cost Per Ton (hauling + tipping + other fees) or flat fee, if applicable
Land application (Class B)				
Land application (Class A)				
Land application (Class A EQ)				
Third party compost				
Third party further treatment				
Landfill as alternative daily cover				
Landfill disposal				
Dedicated land disposal				
Incineration				
Other:_____				

b. What are the main challenges your organization faces with biosolids processing and end use? Please choose all that apply and prioritize your choices. Please rank, with one being the most important.

Rising costs

Public perception / relations

Hauling distance

Regulatory restrictions on using biosolids for alternative daily cover

Local restrictions on land application

Securing long term use options

Other: _____

c. What does your organization plan to do with their biosolids in 2019?

☐ Same plan/strategy as 2017.

☐ Our organization will implement changes as described below:

d. What does your organization plan to do with its biosolids in 5 years?

e. Does your organization have a plan for biosolids use beyond 2025? ☐ yes ☐ no

f. Does your organization directly market biosolids products? ☐ yes ☐ no

i. If No:

1. **Skip to Part g.**

ii. If Yes:

1. What biosolids products does your organization directly market?

☐ Class B biosolids
☐ Compost
☐ Dried biosolids
☐ Dried granules/pellets
☐ Soil blend
☐ Other: _____

2. Provide the locations where the products are sold.

_____

g. Does your organization do biosolids outreach / education? If yes, what type?

☐ Facebook
☐ Twitter
☐ YouTube
☐ Website
☐ Newspaper or paper media
☐ Radio
☐ TV
☐ Placards on trucks
☐ Other: _____
☐ No, we do not publicize our biosolids program, but we do publicize our other services
☐ No, we do not publicize any of our programs

h. Does your organization have dedicated biosolids staff? ☐ yes ☐ no

If yes, what is the full time equivalent staffing? _____ FTE

9. **Biogas - Utilization**

   a. What was your 2017 biogas production?

      _____ cubic feet per year

   b. What is your permitted biogas production limit?

      _____ cubic feet per year

   c. Please fill in the table below to explain how biogas was utilized in 2017 at your facility.

Usage	No. of Units	Permitted Design Capacity, total (include units)	Utilized Capacity, total (include units)
Flared (including pilot light, if applicable)			
Boilers			
Turbines			
Internal Combustion Engines			
Fuel Cells			
Microturbines			
Compressed Natural Gas for onsite Fueling Station			
Compressed Natural Gas for Pipeline Injection			
Other: _____			

   d. What are the main challenges your organization faces with biogas production and use? Please choose all that apply and prioritize your choices. Please rank, with one being the most important.

      Operations and maintenance costs

      Need for additional staffing

      Public perception / relations

      Space for further treatment facilities

      Securing long term pricing / market variability

      Air quality regulations: _____

      Other: _____

e. What does your organization plan to do with their biogas in 2019?

- ☐ Same plan/strategy as 2017
- ☐ Our organization will implement changes as described below:

f. What does your organization plan to do with its biogas in 5 years?

g. Does your organization sell biogas products? If yes, what products?

- ☐ Renewable electricity
- ☐ CNG for onsite fueling station
- ☐ CNG for pipeline injection
- ☐ Other: _____

h. If your organization sells biogas products, provide the locations where the products are sold: _____

i. Does your organization conduct biogas outreach / education? If yes, what type?

- ☐ Facebook
- ☐ Twitter
- ☐ Youtube
- ☐ Website
- ☐ Newspaper or paper media
- ☐ Radio
- ☐ TV
- ☐ Placards on trucks
- ☐ Other: _____
- ☐ No, we do not publicize our biosolids program, but we do publicize our other services
- ☐ No, we do not publicize any of our programs

j. Does your organization have dedicated biogas processing staff? ☐ yes ☐ no

If yes, what is the full time equivalent staffing? _____ FTE

k. We need to better estimate the amount of additional biogas generated by external feedstocks. To help with this, please fill out the table below if your facility accepts an external feedstock. If not, please **skip to Question 10.**

	Before External Feedstock was Accepted	**After External Feedstock was Accepted**
Type of External Feedstock	NA	
Volume of external feedstock processed (gallons per day)	NA	
Concentration of external feedstock processed (percent solids or milligrams per liter)	NA	
Volume of conventional wastewater sludge processed (gallons per day)		
Concentration of conventional wastewater sludge processed (percent solids or milligrams per liter)		
Average amount of biogas produced (cubic feet per day)		
Averaging period (years)		

10. **Biogas - Conditioning**

a. Do you have a biogas conditioning facility? ☐ yes ☐ no

i. If No:

1. **Skip to Question 11.**

ii. If Yes:

1. What is the design capacity of the biogas conditioning facility?

_____ cubic feet per minute

11. **Solid Food Waste Receiving Facility**

a. Do you have a solid food waste receiving facility onsite or one under construction?

☐ yes ☐ no

i. If No:

1. Do you have any plans to construct a receiving facility? ☐ yes ☐ no
2. What is the approximate available space onsite for a food waste receiving facility, if any? _____ ft^2
3. If you are interested in constructing a receiving facility, what capacity are you considering? Please provide units with your answer (e.g., pounds per day, gallons per day, wet tons per day, etc.).

_____ units: _____

ii. If Yes:

1. What is the installation year? _____ year
2. What is the design capacity? _____ pounds per day
3. If you receive food waste from an offsite pre-processing facility, what is the food waste type and the name of the facility?

Food waste type: _____

Facility name: _____

4. Does your facility qualify for a CalRecycle Exemption from solid waste permitting? ☐ yes ☐ no
5. **The survey is now complete.**

******Thank you for your time******

12. **Special Considerations for Facilities without Anaerobic Digestion**

a. How did your organization process sludge and where was it sent in 2017:

b. What are the main challenges your organization faces with sludge processing? Please choose all that apply and prioritize your choices. Please rank, with one being the most important.

Rising costs

Public perception / relations

Hauling distance

Regulatory restrictions: _____

Securing long term options

Other: _____

c. What does your organization plan to do with their sludge in 2019?

☐ Same plan/strategy as 2017.

☐ Our organization will implement changes as described below:

d. What does your organization plan to do with its sludge in 5 years?

e. Does your organization have a plan for sludge processing beyond 2025? ☐ yes ☐ no

f. Does your organization do sludge outreach / education? If yes, what type?

- ☐ Facebook
- ☐ Twitter
- ☐ YouTube
- ☐ Website
- ☐ Newspaper or paper media
- ☐ Radio
- ☐ TV
- ☐ Placards on trucks
- ☐ Other: _____
- ☐ No, we do not publicize our biosolids program, but we do publicize our other services
- ☐ No, we do not publicize any of our programs

g. Does your organization have dedicated sludge processing staff? ☐ yes ☐ no

If yes, what is the full time equivalent staffing? _____ FTE

h. **The survey is now complete.**

******Thank you for your time******

Appendix 2B

EXCESS ANAEROBIC DIGESTION AND BIOGAS CAPACITY ANALYSIS METHODS

This appendix provides additional background information about how we estimated excess anaerobic digestion capacity and increased biogas production.

Anaerobic Digestion

The second process necessary for food waste co-digestion at WWTPs is anaerobic digestion. We considered two criteria to assess anaerobic digestion capacity. The first criterion is SRT. The survey included questions requesting the current feed to the digesters, the current SRT, and the design SRT. To determine excess capacity available for food waste co-digestion, we compared the current SRT first to the design SRT and then to the minimum 15-day SRT required for Class B biosolids from mesophilic digestion. In both cases, we then converted the difference to an associated food waste slurry feed rate.

We determined SRT by dividing digestion volume by volumetric feed rate. We determined digestion volume in two ways: 1) assuming the Largest Unit Out of Service (LUOOS) to maintain operational redundancy during digester maintenance, and 2) assuming All Units In Service (AUIS) to determine the maximum capacity. We considered both SRTs (15-day and design) and both digester volumes (AUIS and LUOOS) in this analysis. To come up with the digestion capacity range, we chose the 'design SRT and the Largest Unit Out of Service' as the minimum capacity scenario and the '15-day SRT and All Units In Service' as the maximum capacity scenario.

The second criterion we considered in assessing anaerobic digestion capacity was VS loading rate. We determined the current VS loading rate to the digesters for the facilities with food waste receiving stations using data provided in the survey. Based on this assessment, we estimated the quantity of food waste that could be added to reach VS loading rate limits.

Typical VS loading rates for mesophilic digestion of municipal sludge range from 0.1 pounds of volatile solids per day per cubic foot (ppd VS/cuft) to 0.2 ppd VS/cuft (WEF, MOP 8). Thermophilic digestion can accommodate higher VS loading rates, up to 0.4 ppd VS/cf (WEF, MOP 8), but most plants in California operate under mesophilic conditions.

Non-municipal organic waste is generally more readily digestible than municipal solids, and digesters processing food waste may be able to achieve higher VS loading rates than digesters processing only municipal solids (Appleton and Rauch-Williams 2017). The industry has not yet developed standard values or specific design criteria for the maximum organic loading rate for co-digestion of food waste slurry. Of those facilities co-digesting with organic wastes, the WWTP operators have typically determined and adhered to the external organic waste loading rate needed to maintain safe and stable digester operations at their specific plant. Thus we included three VS loading rates in this analysis: 0.2 ppd VS/cuft, 0.3 ppd VS/cuft, and no VS loading rate limit.

Another way to constrain the organic loading of external feedstocks is to limit the percent of total volatile solids loading from non-municipal sources. While no specific percent has been determined, operational experience has suggested that limiting the amount of non-municipal digester feed to approximately 35 percent of total volatile solids loading can maintain stable operations for co-digestion. This value would present another capacity limit in the digesters. If this capacity limit were to govern operations, the available anaerobic digestion capacity of California WWTPs that responded to the survey would be significantly less than the values

shown in Figure 2.5. Because there are limited data regarding this parameter, we did not use this type of volatile solids loading limit to assess excess digester capacity.

Table 2B.1 shows the excess capacity at each of the seven facilities with food waste receiving stations at the three different VS loading rates considered for the design SRT / Largest Unit Out of Service scenario. Table 2B.2 shows the excess capacity at each of the facilities at the three different VS loading rates considered for the 15-day SRT / All Units In Service scenario. These six scenarios represent the range of existing excess digestion capacity at these seven facilities. Additionally, for this analysis, we also assumed that all mixing, heating, and transfer equipment was adequately sized to handle loads up to the 15-day SRT with All Units In Service and no limit on VS loading rate.

Table 2B.1 Existing Anaerobic Digestion Systems for Facilities with Existing or Planned Food Waste Receiving Stations - Excess Capacity: Design SRT Limit with Largest Unit Out of Service (LUOOS)

WWTP	Design SRT (days)	Total Digester Volume with LUOOS (gallons)	VS Digester Loading (dry ppd)[2]			VS Loading Rate w/o Additional Food Waste (ppd VS/cuft)	Excess Capacity assuming VS Loading Rate Limit of 0.2 ppd VS/cuft		Excess Capacity assuming VSLR Limit of 0.3 ppd VS/cuft		Excess Capacity assuming No VS Loading Rate Limit	
			Projected Municipal Solids Load	Food Waste	Other Feedstocks		(short wet TPY as Received at a WWTP)[3]	(short wet TPY as Diverted from a Landfill)[3]	(short wet TPY as Received at a WWTP)[3]	(short wet TPY as Diverted from a Landfill)[3]	(short wet TPY as Received at a WWTP)[3]	(short wet TPY as Diverted from a Landfill)[3]
Facility 1	15	978,000	18,100	2,100	3,400	0.18	0	0	0	0	0	0
Facility 2	16	17,999,000	171,500	7,400	114,100	0.12	267,000	134,000	605,000	303,000	605,000	303,000
Facility 3[1]	15	84,300,000	1,097,400	17,700	0	0.10	893,000	446,000	893,000	446,000	893,000	446,000
Facility 4[1]	18	2,214,000	34,000	0	4,100	0.13	30,000	15,000	47,000	24,000	47,000	24,000
Facility 5	21	9,739,000	41,900	0	8,100	0.04	299,000	150,000	422,000	211,000	422,000	211,000
Facility 6[1]	24	1,653,000	15,500	0	0	0.07	17,000	8,000	17,000	8,000	17,000	8,000
Facility 7[1]	18	20,928,000	308,200	0	0	0.11	185,000	93,000	185,000	93,000	185,000	93,000
TOTAL	**NA**	**137,811,000**	**1,686,600**	**27,200**	**129,700**	**NA**	**1,691,000**	**846,000**	**2,169,000**	**1,085,000**	**2,169,000**	**1,085,000**

Notes:
(1) Planned facility or facility expansion.
(2) It is assumed that municipal solids have a VS content of 80 percent and that food waste and other feedstocks have a VS content of 86 percent.
(3) To calculate the excess capacity, it was assumed that the digesters operate and accept feedstock 365 days per year.

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Table 2B.2 Existing Anaerobic Digestion Systems for Facilities with Existing or Planned Food Waste Receiving Stations - Excess Capacity: 15-day SRT Limit with All Units In Service (AUIS)

WWTP	Assumed SRT (days)	Total Digester Volume with AUIS (gallons)	VS Digester Loading (ppd)[2]			VS Loading Rate w/o Additional Food Waste (ppd VS/cuft)	Excess Capacity assuming VS Loading Rate Limit of 0.2 ppd VS/cuft		Excess Capacity assuming VS Loading Rate Limit of 0.3 ppd VS/cuft		Excess Capacity assuming No VS Loading Rate Limit	
			Projected Municipal Solids Load	Food Waste	Other Feedstocks		(short wet TPY as Received at a WWTP)[3]	(short wet TPY as Diverted from a Landfill)[3]	(short wet TPY as Received at a WWTP)[3]	(short wet TPY as Diverted from a Landfill)[3]	(short wet TPY as Received at a WWTP)[3]	(short wet TPY as Diverted from a Landfill)[3]
Facility 1	15	1,955,000	18,000	2,100	3,400	0.09	41,000	20,000	78,000	39,000	97,000	48,000
Facility 2	15	19,799,000	171,000	7,400	3,200	0.07	336,000	168,000	712,000	356,000	902,000	451,000
Facility 3[1]	15	87,965,000	1,097,000	17,700	0	0.09	1,265,000	632,000	1,265,000	632,000	1,265,000	632,000
Facility 4[1]	15	3,321,000	34,000	0	4,100	0.09	72,000	36,000	135,000	68,000	197,000	98,000
Facility 5	15	14,608,000	42,000	0	8,100	0.03	484,000	242,000	762,000	381,000	1,106,000	553,000
Facility 6[1]	15	2,304,000	15,000	0	0	0.05	65,000	33,000	109,000	55,000	145,000	73,000
Facility 7[1]	15	22,808,000	308,000	0	0	0.10	429,000	214,000	679,000	340,000	679,000	340,000
TOTAL	**NA**	**152,760,000**	**1,685,000**	**27,200**	**18,800**	**NA**	**2,692,000**	**1,345,000**	**3,740,000**	**1,871,000**	**4,391,000**	**2,195,000**

Notes:
(1) Planned facility or facility expansion.
(2) It is assumed that municipal solids have a VS content of 80 percent and that food waste and other feedstocks have a VS content of 86 percent.
(3) To calculate the excess capacity, it was assumed that the digesters operate and accept feedstock 365 days per year.

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Increase in Biogas Production

Increasing organic loading to the digesters is expected to increase the amount of biogas produced because the additional feedstock represents a carbon source that will be converted through methanogenesis primarily to methane and carbon dioxide. However, the quantitative increase in biogas is uncertain. To address this uncertainty, the survey asked WWTPs that already accept food waste to quantify the increase in biogas they have observed with the addition of food waste to their digesters. Of the seven facilities considered, only three had historical data on biogas production both pre- and post- external feedstock addition. Table 2B.3 summarizes the observations of these three WWTPs.

Two of the three WWTPs that accept food waste slurry also accept other types of organic wastes for co-digestion. Hence, the specific biogas yield from food waste slurry only is difficult to determine from the reported data. From the quantities of municipal sludge, external feedstock, and biogas reported, we estimated the biogas yields from digestion of municipal sludge and from digestion of the accepted organic wastes. We then used the biogas yield from digestion of external feedstock to estimate the expected increase in biogas given an increase in food waste loading to the digesters. These values may overestimate the expected biogas from co-digestion of food waste slurry because they include other external feedstocks like FOG, which are known to have very high biogas yields. Table 2B.3 lists the biogas yields for total solids associated with external feedstock, rather than food waste.

Table 2B.3 Observed Change in Biogas Production with Addition of Non-Municipal Organic Feedstock

Parameter	Facility 1	Facility 2	Facility 3
Pre-External Feedstock Addition			
Municipal TS Load (dry ppd)(1)	20,000	248,000	1,259,000
Biogas Produced (scfd)	150,000	1,300,000	7,728,000
Biogas / Municipal TS Load (scf/dry lb TS fed)(2)	7.5	5.2	6.1
Post- External Feedstock Addition			
External Feedstock Type	FOG & Food Waste	FOG, Food Waste, & HSW	Food Waste
Municipal TS Load (dry ppd)(1)	20,000	171,000(3)	1,226,000
External TS Load (dry ppd)(1)	9,000	140,000	20,600
TOTAL TS Load (dry ppd)	29,000	311,000	1,238,000
Biogas Produced (scfd)	280,000	3,200,000	7,840,000
Estimated Biogas Produced from Municipal Sludge (scfd)(4)	150,000	896,000	7,525,000
Estimated Biogas Produced from External Feedstock (scfd)(5)	130,000	2,304,000	315,000
Estimated Biogas / External TS Load (scf/dry lb TS fed) (6)	14.4	16.5	15.3

Notes:

(1) Loads were calculated from the flow and percent solids reported in the survey responses.

(2) This ratio was determined by dividing the biogas produced by the municipal TS load.

(3) Facility 2's municipal TS load is substantially lower post-external feedstock addition than it is pre-external feedstock addition. Pre-external feedstock data is from the early 2000's.

(4) The estimated biogas produced from municipal sludge was calculated using the biogas / municipal TS load ratio calculated before external feedstock was added and using the municipal TS load recorded post-external feedstock addition.

(5) The estimated biogas produced from external feedstock was calculated by subtracting the estimated biogas produced from municipal sludge from the recorded total biogas produced post-external feedstock addition.

(6) This ratio was determined by dividing the estimated biogas produced from external feedstock from the recorded external TS load.

Because it is likely that these calculated ratios may overestimate the expected biogas from co-digestion of food waste slurry, we assumed a more moderate rate of 3,968 scf biomethane potential per wet short ton of food waste (See Appendix 2C, Table 2C.2 for References) and a 60 percent conversion from biogas to biomethane (EPA 2016) to project the increases in biogas production with food waste addition. This corresponds to 11 scf biogas per dry lb food waste fed. Using this, we assessed the biogas conditioning and utilization system capacities.

There are a number of beneficial uses of biogas WWTPs employ on site. These beneficial uses include:

- Boilers
- Turbines
- Internal combustion (IC) engines
- Fuel cells
- Microturbines
- Compressed natural gas (CNG) for onsite fueling station
- Pipeline injection

For any one of these beneficial uses, biogas is usually conditioned to remove contaminants. Typically biogas is treated to remove hydrogen sulfide (H_2S), moisture, and siloxanes before use in boilers, turbines, IC engines, fuel cells, and microturbines. Additional treatment to remove carbon dioxide (CO_2) is needed for CNG and pipeline injection applications. Untreated biogas can be flared, which is not considered a beneficial use, but is necessary as an emergency measure for the WWTP to safely combust biogas rather than release it into the atmosphere. For this analysis, capacity was determined in three ways: 1) estimating the excess capacity in the biogas conditioning system, 2) estimating the excess capacity in the existing on-site beneficial utilization system, and 3) estimating the excess capacity of the flare to handle biogas in situations where all other gas systems are non-functional. The limiting capacity of these three capacities determines the overall biogas handling capacity at a WWTP.

The survey asked WWTPs to provide both the permitted design capacity and utilized capacity for both the existing beneficial uses and existing flares. The survey also asked for the biogas conditioning system design capacity. From this information, we estimated the limiting biogas flow rate, associated excess capacity, and external feedstock capacity. Table 2B.4 shows the beneficial uses estimates for the seven WWTPs that currently accept food waste for co-digestion. We divided the limiting biogas flow rate by 11 scf biogas per dry lb food waste fed (discussed above), to determine the external feedstock capacity.

Table 2B.4 Existing Biogas Handling Systems for Facilities with Existing or Planned Food Waste Receiving Stations - Excess Capacity

Parameter	Facility 1	Facility 2	Facility 3(1)	Facility 4(1)	Facility 5	Facility 6(1)	Facility 7(1)
Current Average Biogas Production (biogas scfm)	200	2,250	5,810	160	260	100	1,860
Projected Municipal Increase in Biogas Production by 2030 (biogas scfm)	10	110	500	20	30	10	140
Capacity - Biogas Conditioning System							
Total Biogas Conditioning System Capacity (biogas scfm)	*260*	*2,700*	*600*	*270*	*300*	*70*	*3,000*
Biogas Conditioning System (w/o CO_2 removal) Capacity (biogas scfm)(2)	260	2,700	-	-	300	-	3,000
Biogas Conditioning System (w/ CO_2 removal) Capacity (biogas scfm)(2)	-	-	600	270	-	70	-
Capacity - Beneficial Uses							
Total Beneficial Use Capacity (biogas scfm)	*260*	*3,150*	*10,700*	*260*	*270*	*70*	*4,010*
Cogeneration Capacity (biogas scfm)	260(3)	3,150	10,100	260	270(3)	-	4,010
CNG Fueling Station Capacity (biogas scfm)	-	-	-	-	-	70	-
Pipeline Injection Capacity (biogas scfm)	-	-	600	-	-	-	-
Capacity - Flare							
Total Flare Capacity (biogas scfm)	*320*	*3,000*	*7,200*	*330*	*Not Reported*	*Not Reported*	*2,160*
Limiting Capacity							
Limiting Excess Capacity (biogas scfm)(4)	50	340	890(5)	80	0	0	160
Excess External Feedstock Capacity (short wet TPY as received at a WWTP)(6)	**9,000**	**55,000**	**141,000**	**13,000**	**0**	**0**	**26,000**
Excess External Feedstock Capacity (short wet TPY as diverted from a Landfill)(6)	**4,000**	**28,000**	**71,000**	**6,000**	**0**	**0**	**13,000**

Notes:
(1) Planned facility or facility expansion.
(2) Both biogas conditioning systems remove H2S, moisture, and siloxanes.
(3) Facility 1 and Facility 5 recorded cogeneration capacity in kW. An engine fuel rate of 12,500 BTU/kWh and a biogas low heating value of 600 BTU/cuft were assumed.
(4) Excess capacity was determined by subtracting the sum of the current biogas average production and projected biogas increase due to municipal load by 2030 from the biogas conditioning system, biogas beneficial use, and flare capacities. The minimum of these three values is shown in the table.
(5) Iron salts are added to the sewage sludge prior to digestion to prevent H2S formation. Thus biogas produced can be beneficially used without further conditioning. So, the biogas conditioning system capacity was assumed not to be limiting.
(6) To calculate the excess external feedstock capacity it was assumed that the limiting biogas facility was running 24 hours per day, 365 days per year. Capacity was also reserved for growth in municipal biogas production.

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Appendix 2C

SUMMARY OF ASSUMPTIONS USED IN CAPACITY ANALYSIS

Table 2C.1 Assumptions

General	Value	Unit	Source
Pre-processing of food waste into a digestible form (food waste slurry) occurs at a MRF			
Liquid volume entering digester = liquid volume exiting digester			
Maintain biosolids end use / disposal for each WWTP even as biosolids increase with food waste addition			
Assumed biogas volumes reported in survey were standard cubic feet			
Assumed for facilities with only one digester that AUIS = LUOOS, so they would decrease food waste addition if they need to take their digester out of service			
Process Runtimes			
Food Waste Receiving	5	day/week	-
Digestion / biosolids processing / biosolids hauling	7	day/week	-
Composition			
Food Waste			
% VS	86	%	Average of literature values (See Table 2C.2)
% TS of Food Waste Diverted from Landfills	30	%	Within the range of literature values (See Table 2C.2)
% TS of Food Waste of Diluted Food Waste Slurry Sent to WWTPs	15	%	Waste Management Engineered BioSlurry has a specification of 12 to 18 percent solids (Ecker 2018), LACSD received an average of 14 percent solids, and CMSA receives an 18 percent solids slurry.
Density of Diluted Food Waste Slurry	8.34	lb/gal	Density of water assumed
Municipal Sludge			
% VS	80	%	(WEF, MOP 8, Table 18.11)
Density	8.34	lb/gal	Density of water assumed
Digestate			
% TS	2	%	(WEF, MOP 8, Table 18.2)
Density	8.34	lb/gal	Density of water assumed
Biosolids			
% TS	27	%	Tonnage weighted average value reported in survey
Biogas			
Biogas / Municipal TS Load	6.3	scf/lb TS fed	See Table 2B.3

General	Value	Unit	Source
Estimated Biogas / External TS Load	11	scf/lb TS fed	Based on 3,968 scf/ton biomethane potential of food waste (Table 2C.3) and 60 percent biogas to biomethane conversion (Table 3A.1)
Solid Organic Waste Receiving Station			
Size of Food Waste Truck	4000	gal/truck	-
Assumed Pump / Grinder Efficiency	60	%	-
Assumed Pump / Grinder Power Consumption vs Nameplate Capacity	85	%	-
Assumed Head Required through Food Waste Grinder	50	ft	This high value was assumed to account for losses for a thick slurry.
Assumed Head Required from Food Waste Receiving Station Pump to Digester	150	ft	-
Digestion			
VS Destruction of Food Waste and Other Organics	75%		(Gray et al. 2008) (EBMUD 2008)
VS Destruction of Municipal	55%		(WEF, MOP 8, Table 23.4)
Assumed Digester Feed Temperature	70	F	
Assumed Digester Operating Temperature	95	F	Mesophilic Temperatures Assumed
Assumed Pump Efficiency	75	%	-
Assumed Pump Power Consumption vs Nameplate Capacity	85	%	-
Assumed Head Required from Digester to Dewatering	50	ft	-
Dewatering			
Polymer usage rate	19	lb/digestate dry ton	(WEF, MOP 8, Table 20.7)
Dewatering Energy Usage	50	kWh / dry ton	mid-range energy consumption for common dewatering equipment (Section 4.1.1.2)
Large facility operations	144	hours/week	-
Medium facility operations	60	hours/week	-
Small facility operations	40	hours/week	-
Biosolids End Use			

General	Value	Unit	Source
Size of Biosolids Truck	20	tons/truck	-
Biogas Utilization			
Boiler			
Efficiency	80%		-
IC Engine			
Efficiency	39%		(DOE 2016)
Fuel Rate	8,900	BTU/kwh	(DOE 2016)
Parasitic Load	10%		-
% up time	85%		-
Turbine			
Efficiency	28%		(DOE 2016)
Fuel Rate	11,800	BTU/kwh	(DOE 2016)
Parasitic Load	13%		-
% up time	85%		-
Fuel Cell			
Efficiency	41%		(DOE 2016)
Fuel Rate	8,300	BTU/kwh	(DOE 2016)
RNG Production			
Efficiency	90%		(EPA 2016)
% Run Time	100%		-

Table 2C.2 Typical Food Waste Characteristics

Source	Percent TS	Percent VS
Borowski at al., (2018)	35%	78%
Tchobanoglous (1993)	30%	83%
Kuo (2017)	-	86%
Heo (2004)	18%	92%
Zhang (2007)	26%	87%
El-Mashad (2010)	28%	86%
Liu (2009)	24%	87%
Minimum	**18%**	**78%**
Maximum	**35%**	**92%**

Table 2C.3 Typical Biomethane Potential of Food Waste

Source	Potential (scf/wet short ton food waste)(1)
Ahuja et al. (2014)	4,476
Williams et al. (2015)	3,416
EBMUD (2008); Gray, et al. (2008)	3,600
EBMUD (2008); Gray, et al. (2008)	5,100
Kuo (2017)	3,840
Edelmann (2000)	5,459
Di Maria, F. (2017)	2,451
Di Maria, F. (2017)	4,657
Zhang (2007)	3,595
El-Mashad (2010)	2,884
Liu (2009)	4,167
Minimum	**2,451**
Maximum	**5,459**
Average	**3,968**

Notes:
(1) Biomethane potential was converted to express potential for food waste that is 30 percent solids.

Appendix 3A

SUMMARY OF ASSUMPTIONS USED IN COST ANALYSIS

Table 3A.1 summarizes the cost values and assumptions used in the planning level cost analysis, includes notes about cost source, and compares the costs we used to those used in other cost estimates. As shown in the table, the biogas-related costs developed for this analysis are sometimes higher than the unit costs developed by others. We based these higher costs on recent quotes from vendors, construction costs for facilities already constructed, engineering estimates from multiple engineering consulting firms, and contractors' guaranteed maximum prices from design/build projects.

We used the median costs within the range of values presented in Table 3A.1. The noted capital values represent project costs; they include direct and indirect costs encountered in the public bidding process and other requirements typical of municipal projects. The cost estimates cover structures, civil work, mechanical and electrical equipment, process piping, controls and instrumentation, installation, insurance and bonds, general contractor overhead and profit, and engineering/legal/administration that are all typically incurred in a municipal bid process. The other referenced analyses may or may not have included all of these costs.

Table 3A.1 Co-Digestion Cost Assumptions

Value	Capital	O&M	References and Notes
Costs			
Small Solid Organic Waste Receiving Station	$2,444,000	2%	Based on quantity takeoffs for a below grade concrete storage tank, feed and mixing pumps, rock trap grinder, paddle finisher, crane, sump pumps, and odor control system. Capital costs for existing solid organic waste receiving stations (LACSD, CMSA, Manteca, and Delta Diablo) ranged from $ 1 to $4 Million.
Medium Solid Organic Waste Receiving Station	$3,559,000	2%	
Large Solid Organic Waste Receiving Station	$6,149,000	2%	
Dewatering ($/lbs total solids [TS] digestate per hour)	$2,400	2%	To convert the cost to dewater digestate to 27% TS into $/pounds TS digestate per day we assumed large facilities operate 144 hours per week, medium facilities operate 60 hours per week, and small facilities operate 40 hours per week. Expressed this way, the unit cost is $420/lbs TS digestate per day for small, $280/lbs TS digestate per day for medium, and $117/lbs TS digestate per day for large facilities.
Biogas Conditioning (Cogeneration); No CO_2 Removal ($/scfm)	$5,900[(1)]	2%	This estimate is similar to the high end of EPA estimates for gas treatment systems for both IC engines and microturbines that range in size from 10 to 760 scfm (600-5,900 $/scfm) (EPA 2016a) and within the range of CEC estimates (4,830-10,450 $/scfm) that were originally reported on $ / MMBTU/yr. The CEC estimate used a low heating value (LHV) of 650 BTU/scf; assumptions on runtimes and parasitic loads were made per Appendix 3B (CEC 2017a).
Biogas Conditioning (Fueling Station); W/ CO_2 Removal and W/O a Thermal Oxidizer ($/scfm)	$14,800[(1)]	2%	A thermal oxidizer is needed for very low BTU tail gas.
Biogas Conditioning (Pipeline Injection); W/ CO_2 Removal and W/ a Thermal Oxidizer ($/scfm)	$17,100[(1)]	2%	
Flare ($/scfm)	$3,500[(1)]	2%	This estimate is slightly higher than the top end of EPA estimates for flares that range in size from 20 to 830 scfm (1,100-3,000 $/scfm) (EPA 2016a).

Value	Capital	O&M	References and Notes
Biogas End Use (Cogeneration) ($/scfm)	$17,100(1)	2%	Average of the median unit cost for IC Engines and Microturbines. This estimate is higher than EPA estimates for IC engines with emissions reductions that range in size from 100 to 3,000 kW (8,500-9,700 $/scfm) and for microturbines that range in size from 30 to 330 kW (7,300-9,800 $/scfm) (EPA 2016a) and DOE estimates for IC engines that range in size from 100 to 9,310 kW (7,600-15,300 $/scfm) and for microturbines that range in size from 60 to 950 kW (10,300-13,200 $/scfm) (DOE 2016). However this estimate is below the range of CEC estimates for IC engines (23,780 - 51,230 $/scfm) and mictroturbines (23,120 - 49,800 $/scfm) that were originally reported in $ / MMBTU/yr. The CEC estimate used a LHV of 650 BTU/scf; assumptions on runtimes and parasitic loads were made per Appendix 3B (CEC 2017a).
Biogas End Use (Fueling Station) ($/scfm)	$10,500(1)	2%	This estimate is within the range of CEC estimates (4,440-14,370 $/scfm) that were originally reported in $ / MMBTU/yr. The CEC estimate used a LHV of 650 BTU/scf; assumptions on runtimes and parasitic loads were made per Appendix 3B (CEC 2017a). This estimate is also within the range of EPA estimates for onsite fueling stations with thermal oxidizers (flare) that range in size from 50 to 1,600 scfm (4,400-25,400 $/scfm) (EPA 2016a).
Biogas End Use (Pipeline Injection) ($/scfm)	$12,900	2%	This cost includes unit costs for a gas monitoring system and a pipeline, but does not include a cost for interconnect. This estimate is higher than the CARB estimate (10,900 $/scfm) which is based on the assumed facility size (45,000 wet tons FW) (CARB 2017). However, this estimate is within the CEC estimates (5,880-28,750 $/scfm) that were originally reported in $ / MMBTU/yr. The CEC estimate used a LHV of 650 BTU/scf; assumptions on runtimes and parasitic loads were made per Appendix 3B (CEC 2017a). This estimate also falls within EPA estimates for pipeline injection systems that range in size from 70 to 2,070 scfm and include the cost to upgrade the installed system (1,700-13,300 $/scfm) (EPA 2016a).
Pipeline Interconnection Fee ($/facility)	$2,000,000	2%	Based on interconnection fees seen for various CA utilities. This cost is not shown as a unit cost because it represents initial capital that is not specifically dependent on processing size. This value is on the low end of the range listed by PG&E of $2 to $5 million (PGE 2019). Furthermore, this value is on the high end of values estimated for SoCalGas ($1.3 to $1.9 million) (CEC 2017b) and consistent with the cost the Point Loma WWTP incurred for interconnecting with San Diego Gas and Electric ($1.99 million) (Mazanec 2013).

Value	Capital	O&M	References and Notes
Cost of emulsion polymer ($/dry ton digestate)	-	$63	Converted from an assumed unit price for polymer and polymer dose. Assumed unit polymer cost of $3.40/lb active (EBMUD 2017, escalated to 2019 dollars) and converted to $/dry ton digestate assuming polymer dose of 19 lb active polymer/dry ton digestate (see table 2C.1).
Cost of Hauling and Tipping Biosolids ($/wet ton biosolids)	-	$51	Tonnage weighted average of costs recorded in the survey. Expressed per dry ton digestate the cost is $189. The SLCP Strategy assumes 54 $/wet ton (CARB 2017).
Labor to accommodate operation, maintenance, sampling/analysis, and administration of a food waste co-digestion program ($/year)	-	$113,000	An annual burdened labor rate was inferred from reported agency data (EDD 2018) as 1.6 times the median annual unburdened WWTP operator salary for California.
Revenues			
Electricity Price (sold or offset) ($/kWh)	-	$0.08	Low end of the range based on current MCE and PG&E rates. The 2017 IEPR assumes 0.15-0.27 $/kWh; original values were reported in $ / MMBTU/yr. Assumptions on runtimes and parasitic loads were made per Appendix 3B (CEC 2017a).
SGIP Credit ($/W)	-	$0.60	The total annual SGIP credit for all facilities in CA is capped at $25,790,250 as of March 2019 (Center for Sustainable Energy [CSE], Southern California Edison [SCE], SoCalGas [SCG], and Pacific Gas and Electric [PG&E]). The step 1 values were assumed without the biogas adder (SGIP 2017). A cap per project of $5M was also assumed and this credit was only allocated for small and medium sized plants.
Onsite Fueling CNG Price ($/GGE)	-	$2.40	Average CNG price in CA (CNG now 2019). The SLCP Strategy assumes 0.7 $/GGE for all CNG prices used (CARB 2017).
Pipeline Injection CNG Price ($/GGE)	-	$0.93	5-year average of commercial natural gas price (US EIA 2019). The SLCP Strategy assumes 0.7 $/GGE for all CNG prices used (CARB 2017). The 2017 IEPR assumes 1.5-2.5 $/GGE (CEC 2017a).
RINs, $/77,000 BTU	-	$0.47	1-year average of D5 RIN credit (EPA 2019). The 2017 IEPR assumes 0.76-1.22 $/77000 BTU (CEC 2017a). The SLCP Strategy assumes the total RIN value $1.85 (CARB 2017).
Low Carbon Fuel Standard credits ($/MT CO_2e)	-	$169	1-year average of LCFS credit (CARB 2019). The 2017 IEPR assumes 22-122 $/MT CO_2e (CEC 2017a). A carbon intensity value for Biomethane CNG of 45 g CO_2/ megajoules (MJ) and an energy density of CNG of 105.5 MG/therm was used. The 2019 Standard carbon intensity of 94.17 g CO_2/MJ was also assumed. The SLCP Strategy assumes $100/LCFS (CARB 2017).

Value	Capital	O&M	References and Notes
Food waste tipping fee at wastewater treatment facilities ($/wet ton as delivered 15% solids slurry)	-	$20	US EPA lists a range of 20-65 $/wet ton (EPA 2014). The low end of the range was used for conservative purposes. The SLCP Strategy assumes 65 $/wet ton (CARB 2017) and the 2017 IEPR assumes 35-126 $/wet ton (CEC 2017a).
Conversion Factors	**Value**		**References**
Biomethane per wet ton food waste (scf/wet ton food waste)	3968	-	Table 2C.3
Biogas per lb external load (scf/dry lb external TS load fed)	11	-	Based on 3,968 scf/ton biomethane potential of food waste (Table 2C.3) and 60 percent biogas to biomethane conversion.
Biogas to Biomethane Conversion	60%	-	(EPA 2016b)
Methane Heat Content (BTU/scf)	1,028		(CARB 2018)
MJ to BTU Conversion	0.001055	-	-
Gallon Gas Equivalent (GGE) to BTU Conversion	114000	-	-
Total Solids Content of Food Waste Diverted from Landfills (Percent)	30%	-	Within the range of literature values (Table 2C.2)
Total Solids Content of Pre-processed, Diluted Food Waste Slurry Delivered to WWTPs (Percent)	15%	-	Waste Management Engineered BioSlurry has a specification of 12 to 18 percent solids (Ecker 2018), LACSD received an average of 14 percent solids, and CMSA receives an 18 percent solids slurry.
Biosolids Produced from Food Waste Digestion (fraction of wet ton biosolids to wet ton food waste)	0.394	-	Chapter 4: one wet ton of diverted and co-digested food waste generates 0.394 wet tons biosolids (dewatered to 27% TS), or 0.1065 dry tons TS biosolids
Capital Recovery Factor	0.086	-	Borrowing cost 3.32% (CA State Treasurer, 2018) and project lifetime 15 years.

Notes:
(1) Based on unit costs developed by vendors, constructed facilities at WWTPs, engineering estimates from multiple consulting firms, and/or contractor guaranteed maximum prices.

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Appendix 3B

SUMMARY OF CAPITAL COST BASIS

We determined planning level capital cost estimates corresponding to Association for the Advancement of Cost Engineering Class 5 estimates, which can range from -50 percent to + 100 percent. The cost estimates cover structures, civil work, mechanical and electrical equipment, process piping, controls and instrumentation, installation, insurance and bonds, general contractor overhead and profit, and engineering/legal/administration that are all typically incurred in a municipal bid process. The cost estimates reflect a 20-city February 2019 Engineering News Record Construction Cost Index (ENR CCI) of 11213. We describe the specific percent allocations and cost factors used to determine these total project capital costs below.

As shown in Table 3B.1, we assumed both an inflation rate and discount rate. Since the construction projects discussed in this report would be in response to legislation to divert food waste from landfills by 2025, we assumed that the discussed projects would be online by 2025. Thus, we estimated costs by assuming a mid-point of construction in 2023. To escalate costs to this mid-point of construction, we used an inflation rate of 3 percent. We determined the escalation in construction cost index by comparing the percent change in the ENR CCI for the 20-City average in January of each year from 2008 through 2019. Table 3B.2 provides each ENR CCI for those years and the percent change from year to year. The average percent increases for the past 5 and 12 years are 3.0 and 3.0 percent, respectively. Therefore, this study used a cost escalation of 3.0 percent per year.

We also converted capital costs to 2019 dollars using an assumed discount rate of 7 percent. We determined this discount rate by using the consumer price index (CPI) as established by the U.S. Bureau of Labor and Statistics. Table 3B.3 shows historical values for the CPI as well as the percent change from year to year. The average percent increase per year for the past 10 years is 1.8 percent.

Table 3B.1 Percent Allocations and Cost Factors Used in Capital Cost Estimate

Item	Estimated Cost
Direct Cost (Equipment costs and installation based on quotes, estimate from similar project, etc.)	
Subtotal	"A"
Process Mechanical Allowance	+ 5% of A
Yard Piping and Site Civil Allowance	+ 10% of A
Electrical, Instrumentation, and Controls (EI&C) Allowance	+ 20% of A
Subtotal	"B"
Estimating Contingency	+ 30% of B
Subtotal Direct Cost	"C"
Sales Tax(1) (Applied to ½ of C)	+ 8.56% of ½C
Subtotal Cost	"D"
General Contractor Overhead, Profit, & Insurance/Bonds	+ 20% of D
Subtotal Cost	"E"
Escalation to Mid-Point (based on 3% per year inflation)	+ 12% of E
Total Estimated Construction Cost	"F"
Engineering, Legal, Administration & Construction Management Fees	+ 20% of F
Total Estimated Project Cost	"G"
Converting to 2019 Dollars (based on 1.8% per year discount)	- 7% of G
Discounted Project Cost (2019 $)	"H"

Notes:
(1) 2019 average state and local sales tax for California (Tax Foundation 2019).

Table 3B.2 Percent Change in 20-City Average ENR CCI for January of each Year from 2008 through 2019

Year	ENR CCI[(1)]	Percent Change
2008	8090	
2009	8549	5.7%
2010	8660	1.3%
2011	8938	3.2%
2012	9176	2.7%
2013	9437	2.8%
2014	9664	2.4%
2015	9972	3.2%
2016	10132	1.6%
2017	10532	3.9%
2018	10878	3.3%
2019	11206	3.0%
	5-Year Average	**3.0% per year**
	12-Year Average	**3.0% per year**

Notes:
(1) Engineering News Record Construction Cost Index, ENR CCI.

Table 3B.3 Percent Change in CPI for January of each Year from 2009 through 2019

Year	CPI[(1)]	Percent Change
2009	206	
2010	213	3.4%
2011	216	1.4%
2012	223	3.2%
2013	227	1.8%
2014	230	1.3%
2015	228	-0.9%
2016	231	1.3%
2017	237	2.6%
2018	242	2.1%
2019	245	1.2%
10-Year Average		**1.8% per year**

Notes:
(1) U.S. Department of Labor, Bureau of Labor Statistics, Consumer Price Index, U.S. Cities Average.

Appendix 3C

BREAKDOWN OF UNIT CAPITAL COST COMPONENTS USED FOR BIOGAS BENEFICIAL USE SYSTEMS

Table 3C.1 Breakdown of Unit Cost Components for Biogas Beneficial Use Systems

Component	Biogas Beneficial Use System		
	Fueling Station ($/scfm)	Pipeline Injection ($/scfm)	Cogeneration[1] ($/scfm)
Median Costs by Component			
Biogas Conditioning	$14,800	$14,800[2]	$5,900
Thermal Oxidizer		$2,300[2]	-
Gas Monitoring	-	$10,200	-
Fueling Station w/ storage	$10,500	-	-
Pipeline	-	$2,700	-
Interconnection[3]	-	-	-
Cogeneration[1]	-	-	$17,100
TOTAL UNIT COST OF SYSTEM	$25,300	$30,000	$23,000
EXAMPLE: Total capital cost for 565 scfm system	*$14.3 M*	*$17.0 M[4]*	*$13.0 M*

Notes:
(1) Cogeneration includes both IC engines and microturbines.
(2) Biogas conditioning for pipeline injection, as shown in Figure 3.4 is the sum of the thermal oxidizer and biogas conditioning values in this table.
(3) $2 M must be added to each pipeline injection project to account for the interconnection costs. This cost is not shown as a unit cost because it represents an initial capital that is not dependent on processing size.
(4) Includes pipeline interconnection fee.

Appendix 3D

SUMMARY OF O&M COSTS AND REVENUE BASIS

We show the O&M costs in 2019 dollars. We assumed no inflation or discount rate for O&M costs / revenue, as these values will fluctuate, as the price of power / polymer / labor / etc. change with time. An analysis of long-term fluctuations in these operating costs was beyond the scope of this study. However, the annual change in the CPI, described in Appendix 3B at 1.8 percent, may be a good estimate of expected inflation for some O&M costs.

A detailed description of the operations and maintenance considerations for co-digestion systems include the following:

- ***Energy (power and heat):*** We assumed that the additional biogas produced from food waste co-digestion would first be used to produce the electricity and heat required to offset the additional energy requirements to process the additional food waste accepted. The remaining biogas would then be used to produce either electricity or renewable CNG to sell. Thus, we assumed no O&M costs for the increased power and heat needed to co-digest food waste. We assumed that biogas would be converted to electricity via cogeneration (included in the required capital costs) and would be converted to heat via the cogeneration system or supplemental boiler (assumed to be in place, and of sufficient capacity for additional load; hence, not included in the required capital costs).
- ***Chemicals (primarily polymer):*** We assumed emulsion polymer for dewatering. Using an East Bay Municipal Utility District (EBMUD) report, we escalated the historical average price for emulsion polymer to 2019 dollars (2017).
- ***Hauling/Tipping for Residuals:*** We used the weighted average cost by wet ton for biosolids hauling and tipping reported by survey respondents to determine costs for this O&M item.
- ***Labor (O&M and administration):*** We inferred an annual burdened labor rate from reported agency data (EDD 2018). We estimated labor costs by assuming additional FTEs for each facility. We assumed that, as the amount of food waste accepted ramps up, there could be the creation of 1 (at small and medium facilities) to 2 (at large facilities) FTE jobs to handle contracts, samples/analysis, records, operation, and maintenance. This additional labor cost is conservative (i.e., high), as the small number of WWTPs that currently process food waste have not yet seen the need for additional staffing, per the survey results.
- ***Maintenance (for equipment):*** It was assumed that the cost of maintenance would be around 2 percent of the capital equipment cost per year.

We also estimated potential revenue that can offset O&M costs. Many of these revenue sources can vary. To account for this variability, we completed a sensitivity analysis for some of these parameters, as summarized in the Illustrative Facility section. However, the base evaluation conducted in this analysis used the following assumptions:

- ***Sale of power produced from biogas:*** Of the biogas available after WWTPs dedicate a portion to offset onsite power and heat requirements, we assumed that all electricity produced from biogas generated from food waste would have a value of $0.08/kWh (either to offset electricity use onsite or to sell back to the grid). We based the revenue generated from this electricity on current rates offered for electricity purchase through the Marin Clean Energy (MCE) Program and Pacific Gas and Electric (PG&E) BioMAT program. We assumed the lower value of the two. We did not include the value of heat

generated from the production of electricity from biogas when determining available revenue.

- ***Sale of biogas for renewable CNG:*** We assumed that renewable CNG produced from biogas generated from food waste could be used in two ways: 1) onsite fueling station, or 2) pipeline injection. For onsite fueling, we assumed that renewable CNG would be sold at a price comparable to the current consumer price for CNG. For pipeline injection, we assumed that renewable CNG would be sold at a price comparable to the wholesale, or citygate, price for CNG.
- ***Tipping fees for acceptance of food waste:*** Tipping fees for food waste vary greatly. We used the lower end of the range for California facilities, as documented in an EPA report (2014).
- ***Self-Generation Incentive Program (SGIP) credit:*** We assumed 2019 SGIP credit rates. Furthermore, these credits are capped at a total of $25.8 M across California in 2019[7]. We used both the 2019 credit rate and cap in this report. While SGIP credit is limited to facilities smaller than 3 MW, a cursory review of each facility's data indicated that almost no facility would produce sufficient biogas from food waste to merit installation of a unit larger than 3 MW. Furthermore, the biogas adder is not included, because, in 2020, the minimum renewable fuel blending requirement is 100 percent (SGIP 2017). We also assumed that no facility would generate more than 125 percent of the electricity used onsite.
- ***Renewable Identification Number (RIN) credit:*** The EPA's current classification of D3 vs D5 RIN credits has caused substantial discussion and uncertainty. The current reading reduces the RINs for co-digestion substantially. Recently, biogas generated from food waste has only qualified as Advanced Biofuel and eligible for a D5 RIN credit. In the past, biogas generated from food waste has qualified as Cellulosic Biofuel and eligible for D3 RIN credit. We assumed a D5 RIN credit, and used the value equal to the average D5 credit value reported over the past year (Feb. 2018 to Feb 2019) (EPA 2019).
- ***Low Carbon Fuel Standard (LCFS) credit:*** The LCFS credits assumed reflect the average credit value over the past year (March 2018 to March 2019) (CARB, 2019).

[7] As of March 2019, the generation cap for Center for Sustainable Energy was $4,612,305.12, for Southern California Edison was $6,480,041.91, for SoCalGas was $837,660.39, and for Pacific Gas & Electric was $18,010,242.15 per https://www.selfgenca.com/home/program_metrics/.

Appendix 3E

CAPITAL RECOVERY FACTOR

We express the cost or revenue associated with each scenario as a 'normalized' cost or revenue. This normalized value is the amount of money that would be needed to be expended (if negative) or will be seen as revenue (if positive) every year over a project's lifetime. Thus the 'normalized' cost is:

$$Normalized\ Cost = Annual\ Revenue - Annual\ O\&M\ Cost - Total\ Capital\ Cost * CRF$$

The CRF, or capital recovery factor, spreads the upfront capital cost over the project lifetime and is calculated as follows:

$$CRF = \frac{i * (1+i)^n}{(1+i)^n - 1}$$

Where i is the borrowing cost of 3.32 percent (CA State Treasurer 2018), and n is the expected project lifetime of 15 years.

By using a 'normalized' cost, instead of a net present value, we avoid making assumptions about inflation rates and discount rates that would otherwise be used to calculate the annual revenues or annual costs associated with maximizing co-digestion potential statewide. Instead, we are only assuming the capital cost will be paid back over time, as is typical for municipal WWTP capital projects. We used the California borrowing cost this analysis, thus converting the capital cost to an expected annual cost.

Appendix 3F

OPTIMIZATION OF STATEWIDE CO-DIGESTION IMPLEMENTATION TO DECREASE COSTS

The goal of Scenario 2, as described in Chapter 3, is to maximize existing anaerobic digestion (AD) capacity across the State to accept all of the divertible and digestible food waste projected for 2030. In order to co-digest food waste at a WWTP, sufficient capacity is needed in both the anaerobic digestion process as well as all other key processes (as described in Chapter 2). Thus, while this report does not assume the construction of additional anaerobic digestion capacity, this report does assume that additional capacity will be constructed in other key processes to match the needed anaerobic digestion capacity on a facility-by-facility basis. The estimated capital cost associated with this construction for Scenario 2 is $1.43 billion dollars.

To develop these Scenario 2 capital costs, it was assumed that each WWTP would use a portion of their existing excess anaerobic digestion capacity for co-digestion, without optimizing for existing infrastructure at individual WWTPs. For example, assume Facility A and Facility B each have the same excess AD capacity and are both located in the same Cal Recycle region. With the method described above, both Facility A and B would be allocated the same amount of food waste to co-digest. However, Facility A may have existing excess capacity in all other processes needed for co-digestion while Facility B may not. To minimize the needed capital investment, it would make sense to allocate more food waste to Facility A for co-digestion than to Facility B. This appendix summarizes an additional analysis conducted to minimize the needed capital investment associated with Scenario 2.

A number of methods were considered for optimizing the allocation of food waste across WWTPs. These methods include:

1. **Method A (Count of Key Processes):** Allocate food waste at 100 percent of an AD's excess capacity at WWTPs with excess capacity in at least two other processes required for co-digestion. Allocate food waste at around 25 percent of an AD's excess capacity at WWTPs with excess capacity in only one other process required for co-digestion.
2. **Method B (Unit Cost-Weighted Average):** Take a unit capital cost-weighted average of the required additional capacity in each key process at a WWTP to utilize almost 100 percent of an AD's excess capacity. Allocate food waste at 100 percent of an AD's excess capacity to facilities with the lowest unit capital cost-weighted average of the required additional capacity in each key process until the 2030 food waste amount is reached.
3. **Method C (Key Process Maximum Excess Capacity):** Allocate food waste at each WWTP to an amount equal to 200 percent of the largest excess capacity of the non-AD key processes, or to an amount equal to the AD excess capacity, whichever is less.
4. **Method D (Net Required Additional Key Process Excess Capacity):** Sum the required additional capacity at each WWTP across all non-AD processes and allocate food waste at almost 100 percent of an AD's excess capacity to WWTPs with the lowest net required additional excess capacity until the 2030 food waste amount is reached.
5. **Method E (Percentage of Excess AD Capacity):** Determine if the maximum existing excess capacity in a non-AD process is less than 60 percent of the excess AD capacity. If true, allocate food waste at 60 percent of an AD's excess capacity at that WWTP. If false, allocate food waste at either 100 percent of the AD's excess capacity or at the maximum excess capacity in the non-AD process, whichever is less.

Table 3F.1 summarizes the estimated capital costs for each of these methods. As shown in this table, the minimum investment scenario is Method B: Unit Cost-Weighted Average. This method results in in an estimated capital cost of around $1.30 billion, or around $130 million less than the capital cost estimated with Scenario 2.

The spatial and WWTP size distribution for the five methods considered are shown in Figure 3F.1 and 3F.2, respectively. As shown in these figures, the lowest cost method (Method B) allocates the most food waste to large WWTPs and the least food waste to WWTPs in the Coastal and Mountain CalRecycle Regions.

Table 3F.1 Summary of Food Waste Allocation Methods to Minimize Estimated Capital Costs while Co-Digesting the Divertible and Digestible Food Waste Projected for 2030

Method	Estimated Capital Cost ($ Billions)
A: Count of Key Processes	$1.383
B: Unit Cost-Weighted Average	$1.305
C: Key Process Maximum Excess Capacity	$1.374
D: Net Required Additional Key Process Excess Capacity	$1.439
E: Percentage of Excess AD Capacity	$1.396

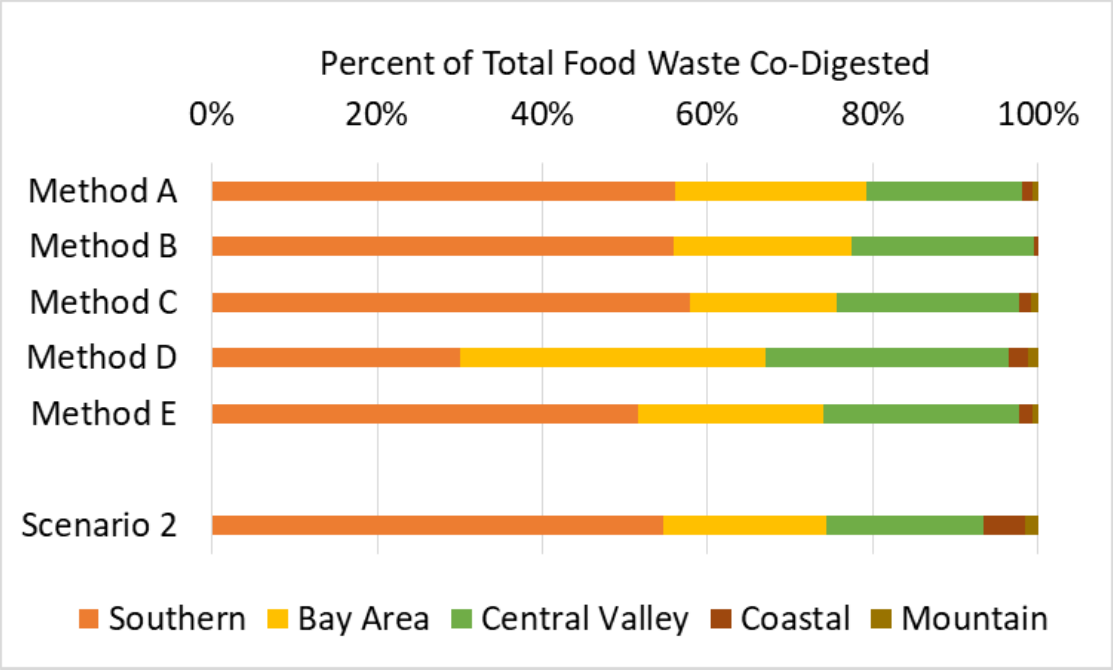


Figure 3F.1 Percent Breakdown of Food Waste Co-Digested by Location

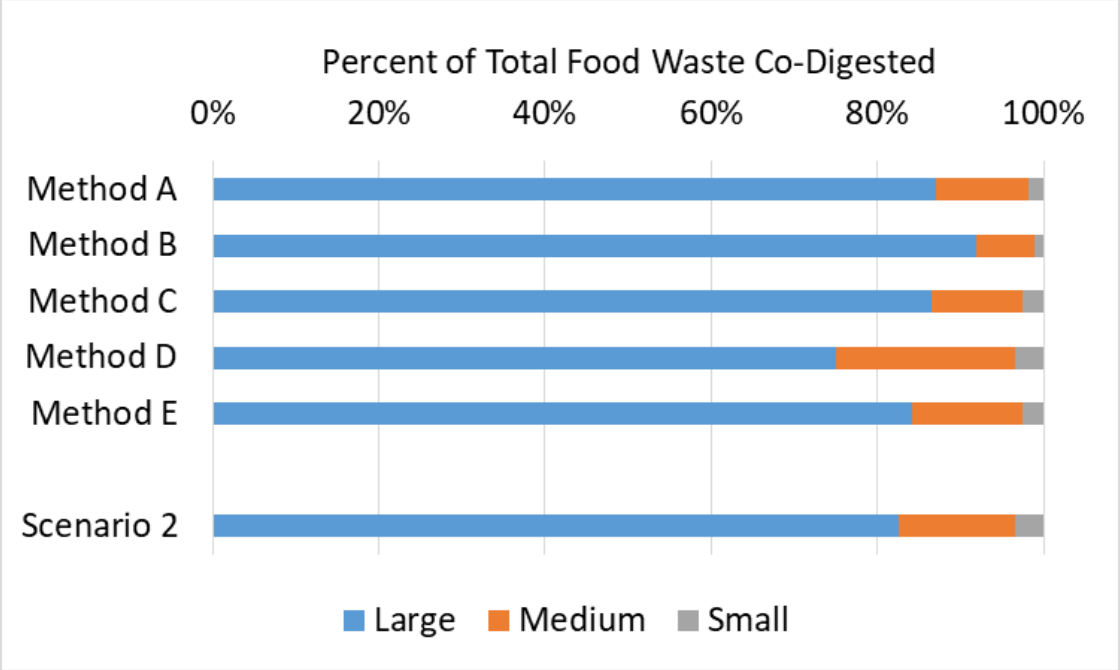


Figure 3F.2 Percent Breakdown of Food Waste Co-Digested by WWTP Size

Based on the level of accuracy for cost estimates in this analysis, this optimization effort does not indicate a significant difference in costs from the base cost analysis. However, such optimization efforts taken on a more localized scale may result in savings, and should be studied further to assess ways to reduce overall implementation costs.

Appendix 3G

FUNDING OPPORTUNITIES FOR BIOENERGY AND GHG REDUCING PROJECTS

This appendix is a summary of information on various federal and California state funding options for projects related to co-digestion. We recognize that funding programs continually change so this appendix provides a snapshot in time.

Prospective grant applicants can search the Funding Wizard website (https://fundingwizard.arb.ca.gov/) to identify the grants, rebates and incentives that can help pay for sustainable projects.

The Water Environment Federation (2017) has also compiled information on funding opportunities for bioenergy and greenhouse gas (GHG) reducing projects: https://www.wef.org/globalassets/assets-wef/3---resources/topics/a-n/biosolids/technical-resources/intro-to-funding-opportunities-fact-sheet.pdf

Table 3G.1 Programs that have Offered Funding for Co-digestion Related Projects

Federal Programs	
Department of Energy	Energy Efficiency & Renewable Energy (EERE): https://eere-exchange.energy.gov • Funding for projects to make clean energy technologies and services more available and reliable while lowering the direct and indirect costs, both to energy users and society as a whole. The EERE investment approach is designed to address specific gaps in the technology development pathway–areas where the private sector or other non-government stakeholders are unable to make the required investments to the scale or in the timeframe required for clean energy technologies to be commercialized.
USEPA	Renewable Fuel Standard (RFS): https://www.epa.gov/renewable-fuel-standard-program • The EPA's RFS program allows digester biogas from municipal WWTP digesters to be used as a transportation fuel feedstock. For credits, the fuel must be in the form of CNG or liquefied natural gas (LNG), or it must be used to produce electricity used to power electric vehicles.
United States Department of Agriculture	The Energy Efficiency and Conservation Loan Program: https://www.rd.usda.gov/programs-services/energy-efficiency-and-conservation-loan-program • Funding for distributed generation for on- or off-grid renewable energy systems. High Energy Cost Grant Program: https://www.rd.usda.gov/programs-services/high-energy-cost-grants • Competitive grants for community energy facilities, including renewable energy systems and energy efficiency projects serving extremely high energy cost rural communities.
State Programs	
State Water Resources Control Board	Clean Water State Revolving Fund: https://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/ • Low interest financing, with a portion reserved for projects that address green infrastructure, water efficiency, energy efficiency, or other environmentally innovative activities, referred to as the Green Project Reserve fund.

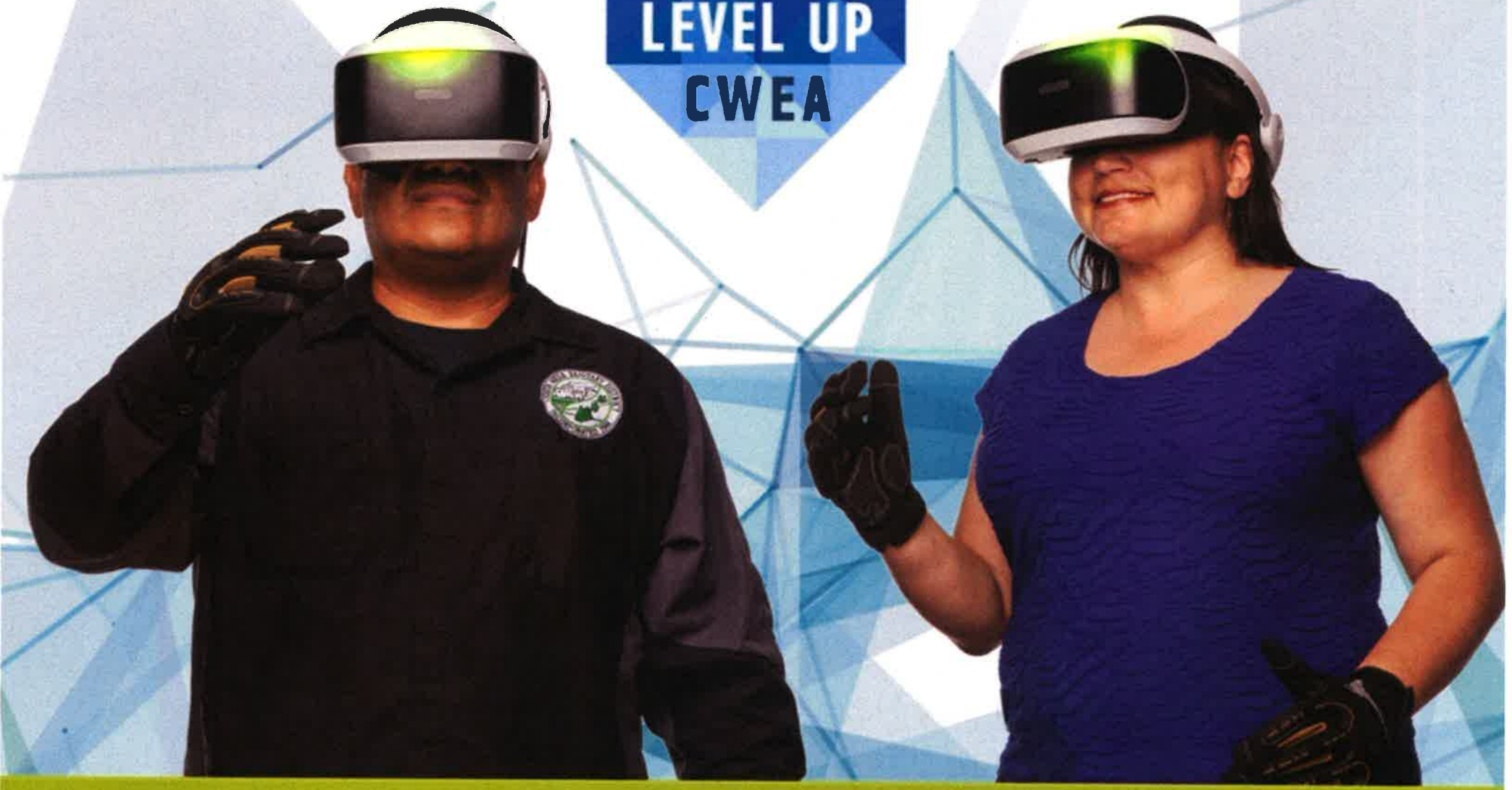
California Energy Commission	Energy Conservation Assistance Act Program: http://www.energy.ca.gov/efficiency/financing/ • Low interest loan program (1 percent interest rate for cities, counties, special districts, and public schools) for cities and schools to implement energy efficiency and renewable energy projects. The maximum loan amount available is $3 million per application.
	Alternative and Renewable Fuel and Vehicle Technology Program: https://www.energy.ca.gov/transportation/arfvtp/ • Grants to accelerate development and deployment of advanced transportation and fuel technologies.
California Public Utilities Commission	Self-Generation Incentive Program: http://www.cpuc.ca.gov/sgip/ • Incentives to support existing, new, and emerging distributed energy resources. Qualifying technologies include wind turbines, waste heat to power technologies, pressure reduction turbines, internal combustion engines, microturbines, gas turbines, fuel cells, and advanced energy storage systems.
California Air Resources Board	Air Quality Improvement Program: http://www.arb.ca.gov/msprog/aqip/aqip.htm • An incentive program to fund clean vehicle and equipment projects, research on biofuels production and the air quality impacts of alternative fuels, and workforce training.
	Carl Moyer Memorial Air Quality Standards Attainment Program http://www.arb.ca.gov/msprog/moyer/moyer.htm • Grants for cleaner-than-required engines and equipment to achieve reductions in emissions of key pollutants. Eligible projects include cleaner on-road trucks, school and transit buses, off-road equipment, marine vessels, locomotives, agricultural equipment, light duty vehicle scrap, and lawn mowers. Grants are administered by local air districts.
	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP): https://www.californiahvip.org/ • The HVIP is a voucher incentive that provides point-of-sale discounts to purchasers of low NO_x trucks and buses. Districts wanting to replace diesel refuse trucks with CNG vehicles under this program would be eligible for a voucher.
	Low Carbon Fuel Standard: https://arb.ca.gov/fuels/lcfs/lcfs.htm
California Department of Resources Recycling and Recovery (CalRecycle)	Greenhouse Gas Reduction Grant & Loan Program: https://www.calrecycle.ca.gov/climate/grantsloans/GHGLoans/ • Projects that implement or expand organics processing (e.g., composting or anaerobic digestion).
	Organics Grant Program: https://www.calrecycle.ca.gov/Climate/GrantsLoans/Organics
California Infrastructure and Economic Development Bank	California Lending for Energy and Environmental Needs : www.ibank.ca.gov/cleen-center/ • Projects that involve comprehensive energy efficiency improvements to new and existing facilities.

Appendix 5A

CMSA PRESENTATION FOR CWEA 2019 ANNUAL CONFERENCE

WELCOME TO AC19

GAME ON
LEVEL UP
CWEA



CWEA | PALM SPRINGS, CA 2019

MANAGING CENTRAL MARIN SANITATION AGENCY'S ORGANIC WASTE RECEIVING FACILITY

CWEA Annual Conference
April 11, 2019

PRESENTATION OUTLINE

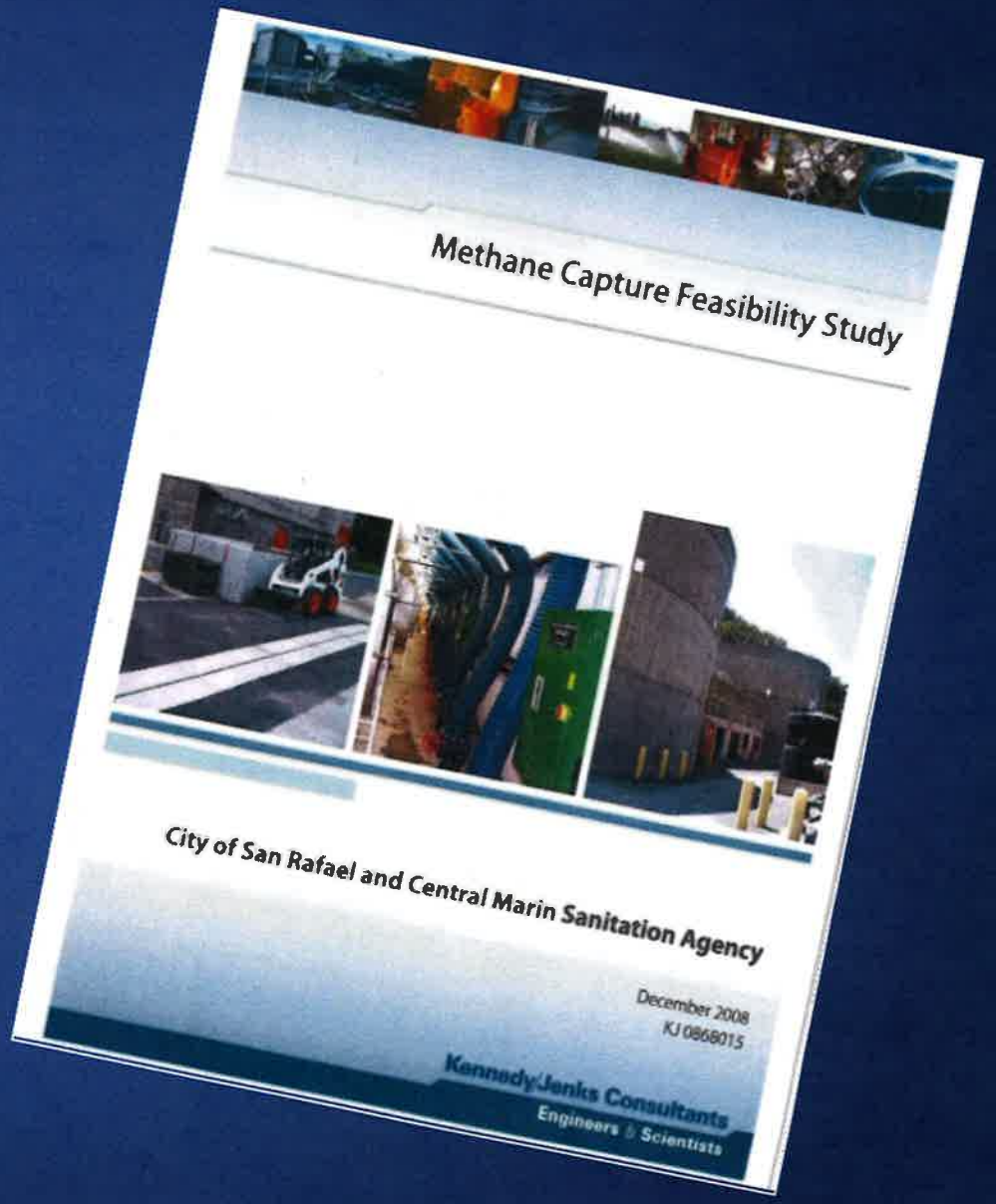
- CMSA Organic Waste Program History
- Facility Design Considerations
- Operating an Organic Waste Receiving Station
- Maintaining an Organic Waste Receiving Station
- Lessons Learned and Key Takeaways
- On the Horizon
- Questions?

CMSA Organic Waste Program History

- 2008-2009
  - Local Utility Grants for Green House Gas Emission Reduction Studies/Projects
- 2009-2010
  - Incorporated Organic Waste Receiving Facility into Planned Digester Improvements
  - Public Outreach
- 2011
  - Public/Private Partnership between Marin Sanitary Service and CMSA
- 2013
  - CMSA and MSS constructed F2E facilities
  - Delivery of FOG and food waste began in late 2013/early 2014

Facility Design Considerations

- FW quantity and characterization
- MSS Service Area--15 tons/day
- Digester capacity to accept FOG and food wastes
- Cogenerator capacity to utilize additional biogas
- Digester improvements to receive FOG/FW

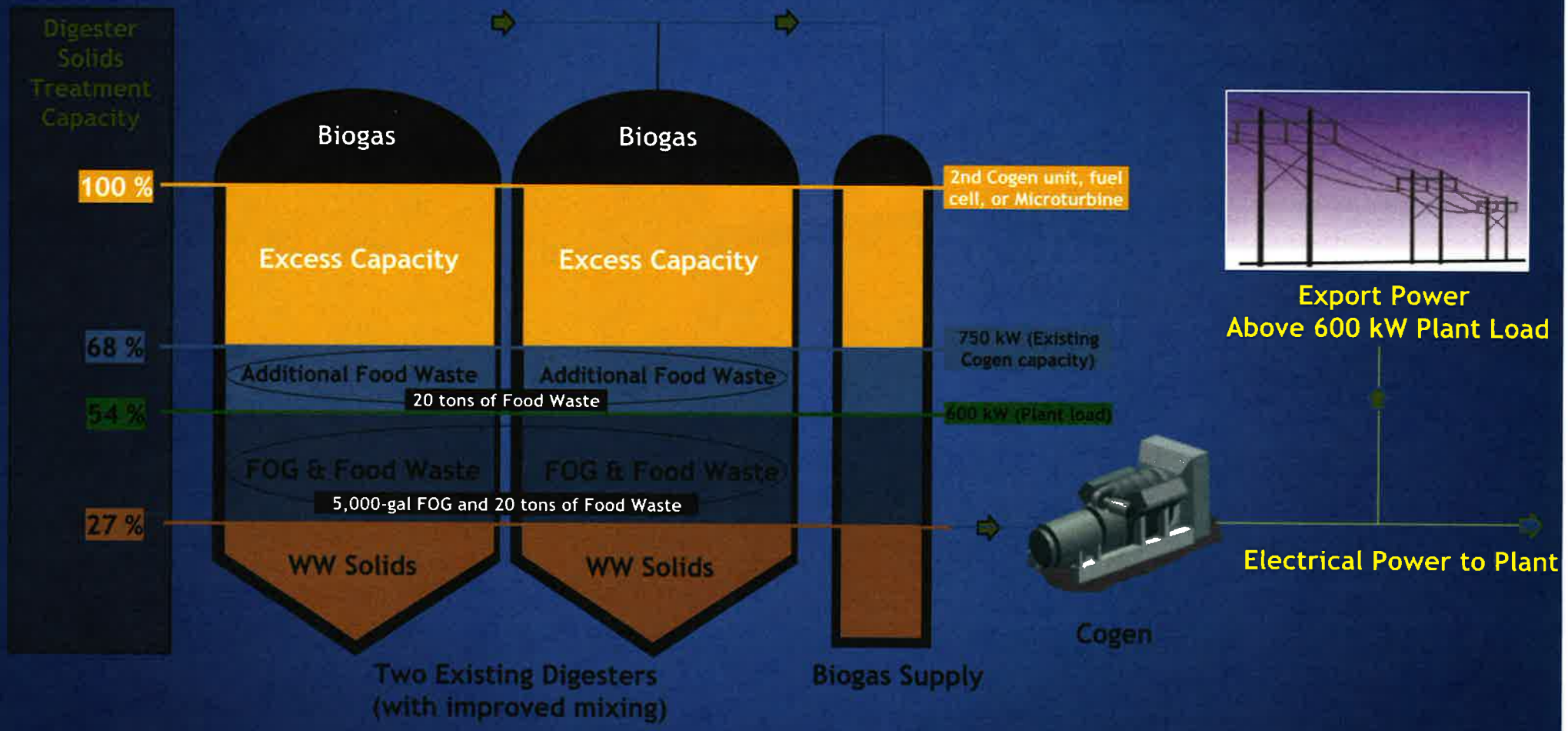


Why Look at Food Waste

- Food is the largest single source of waste in California
- In Marin Sanitary Service's (MSS) Service Area, 27.1% of the solid waste sent to Redwood Landfill is food waste.

- There are over 250 food waste generators (restaurants, delis, grocery stores) in the MSS service area.
- AB 1383 – Cal. Global Warming Solutions Act of 2006

CMSA FOG and Food Waste Capacity



2013 Digester Improvements Project

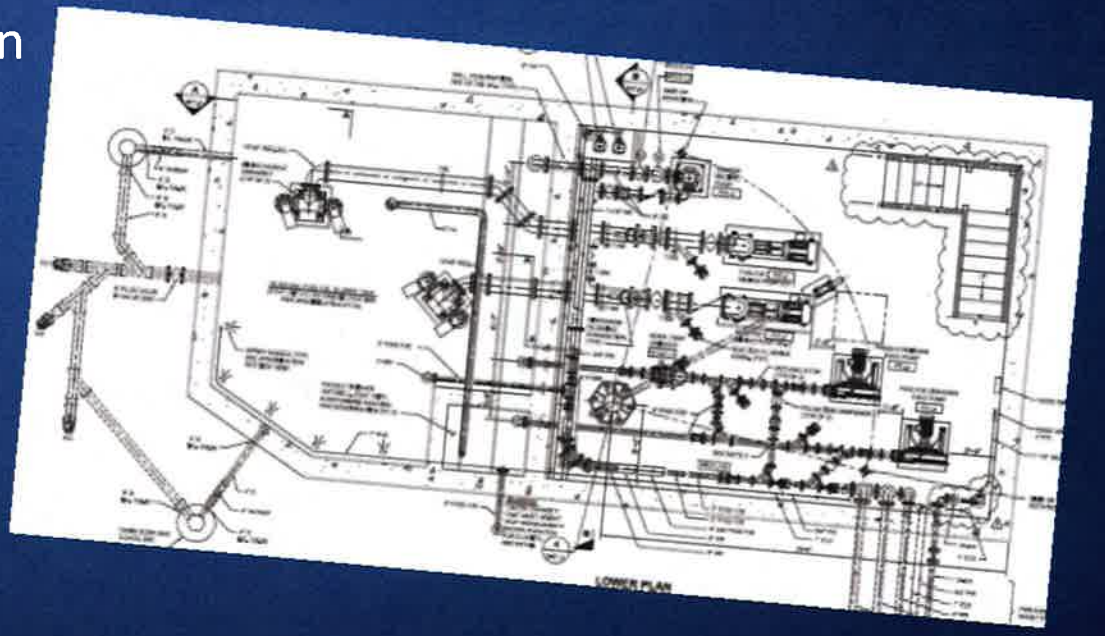
Replaced Digester Covers

- Original Floating Covers at 130,700 ft3
- New Membrane Covers at 374,400 ft3

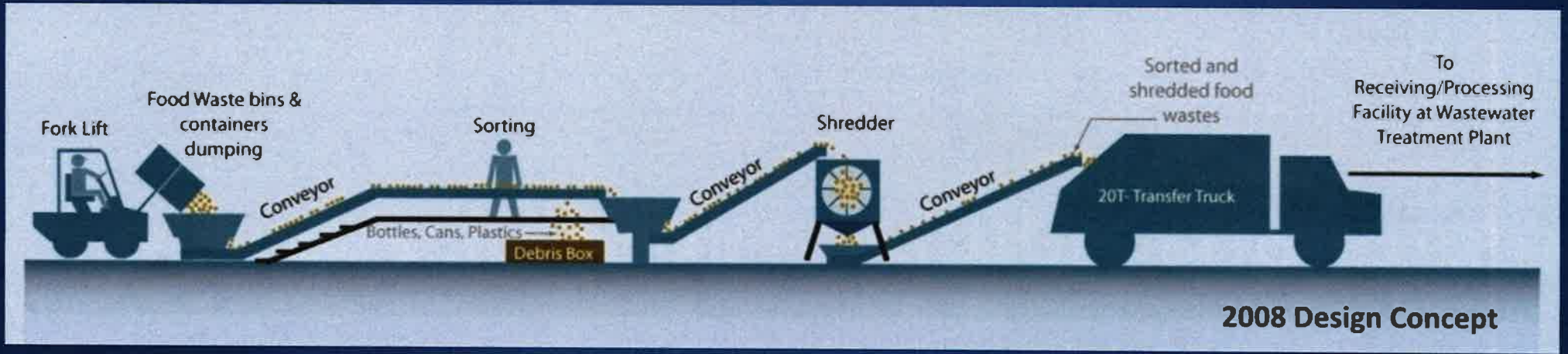
New Sulfatreat Adsorption H2S Scrubbers

New External Pump Mixing System

Organic Waste Receiving Station



2013 Marin Sanitary Improvements



2013 Marin Sanitary Improvements

Food 2 Energy

CMSA - Conventional Advanced Secondary Treatment Plant

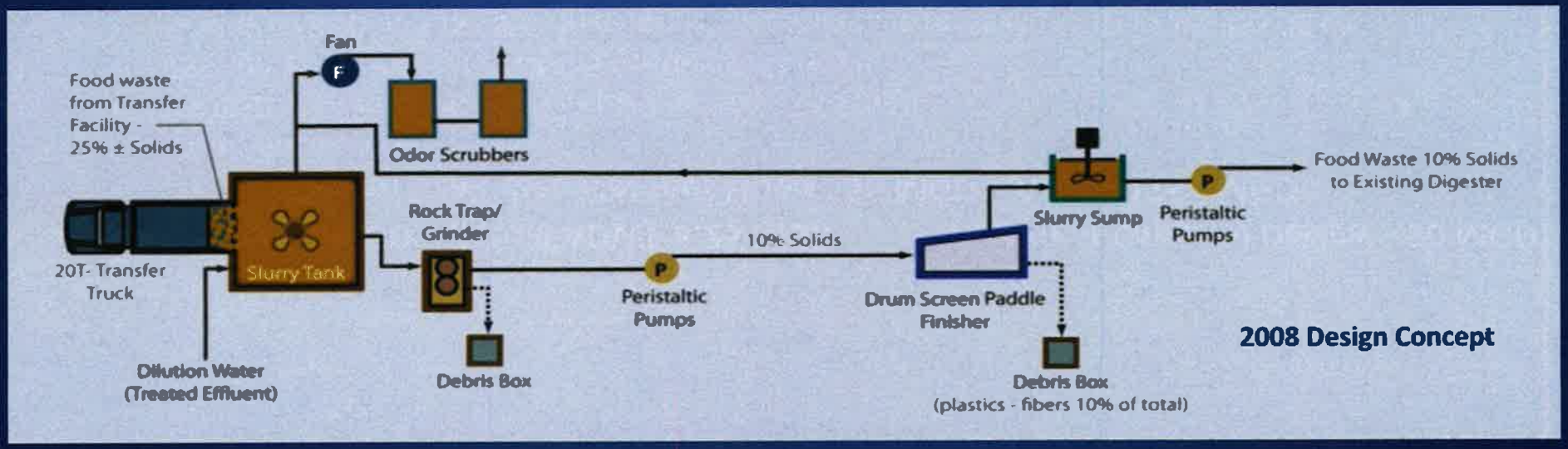
ADWF Design 10 MGD – Actual ADWF 8.25 MGD Treatment Capacity Design – 30 MGD

Design Peak Wet Weather Flows 155 MGD – Actual 125+ MGD

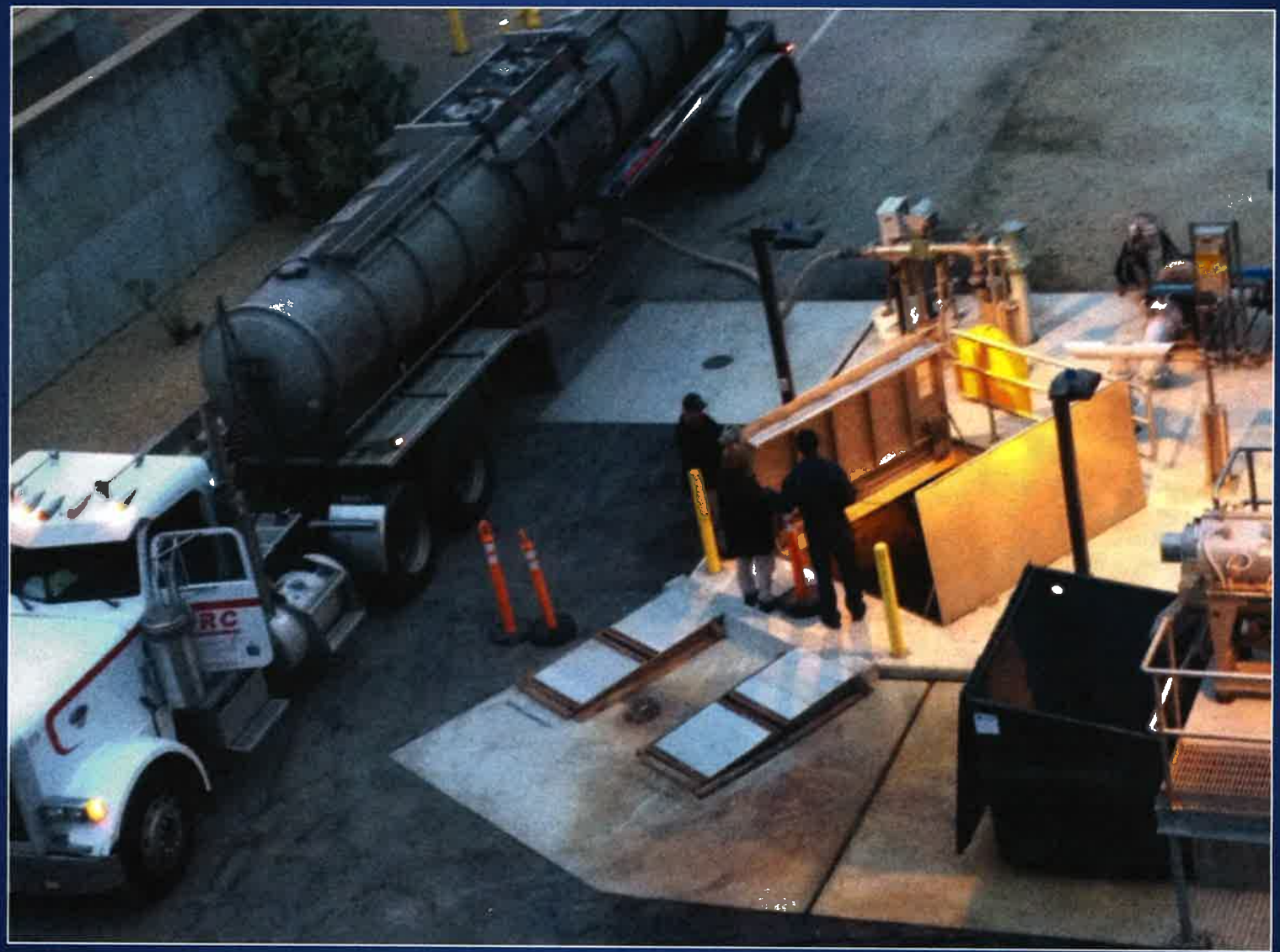
Permitted Discharges to SF Bay:

- cBOD 25mg/l monthly – 2018 cBOD Average 5.18 mg/l
- TSS 30mg/l monthly - 2018 TSS Average 4.63 mg/l
- Removal cBOD and TSS 85% minimum – 2018 Average removal cBOD 97.8% TSS 98.6%
- Total Ammonia, as N 60mg/l monthly - 2018 average 27.2 mg/l

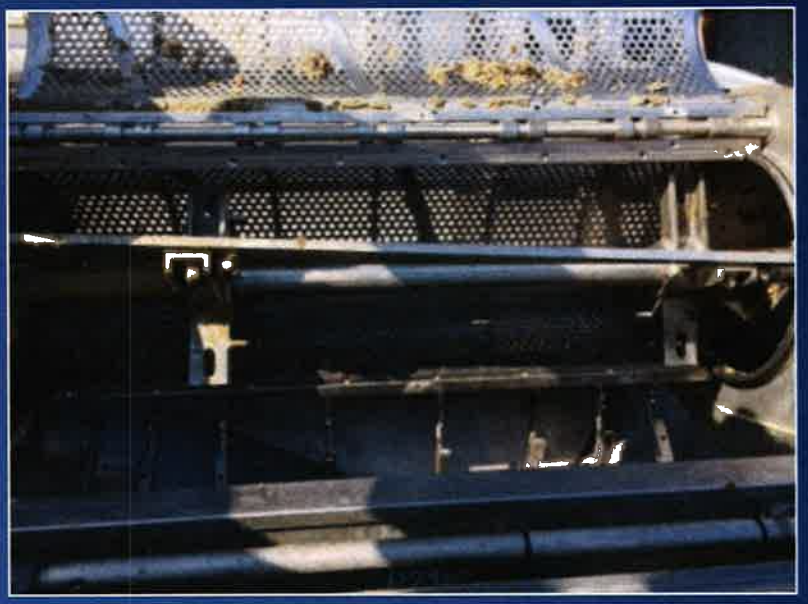
Organic Waste Receiving Facility



Receiving First FOG Load – Nov. 2013



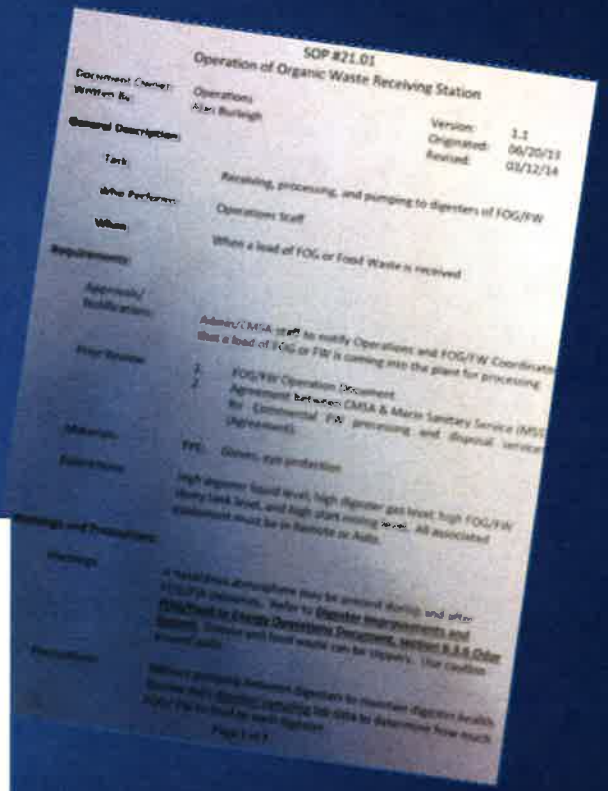
Facility Equipment



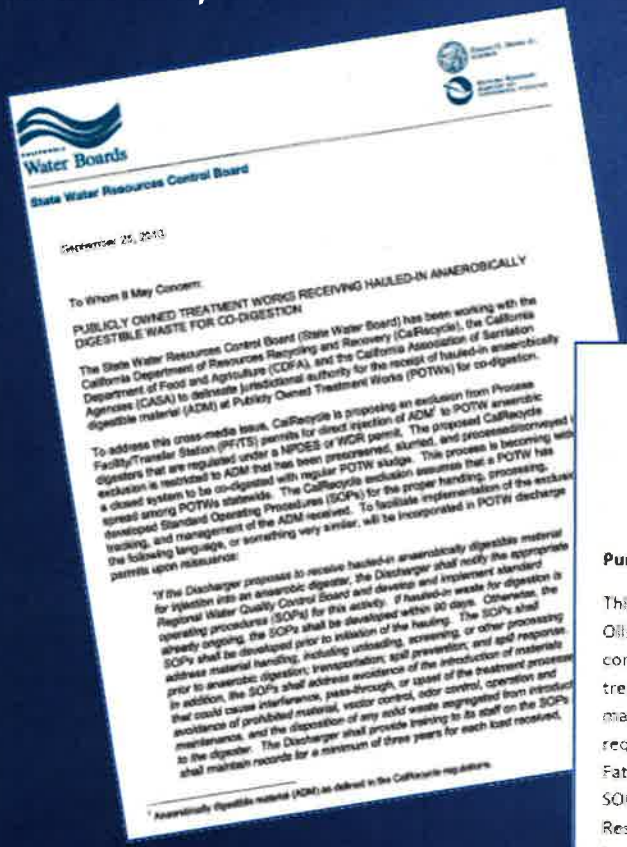
Operating an OWRF

SWRCB Executive Order for Co-digestion of FW with FOG/OW

Detailed Operations and Maintenance Procedures


SOP #21.01
Operation of Organic Waste Receiving Station

CMSA Regulated Under NPDES Permit


Water Boards
State Water Resources Control Board

September 25, 2013

To Whom It May Concern:

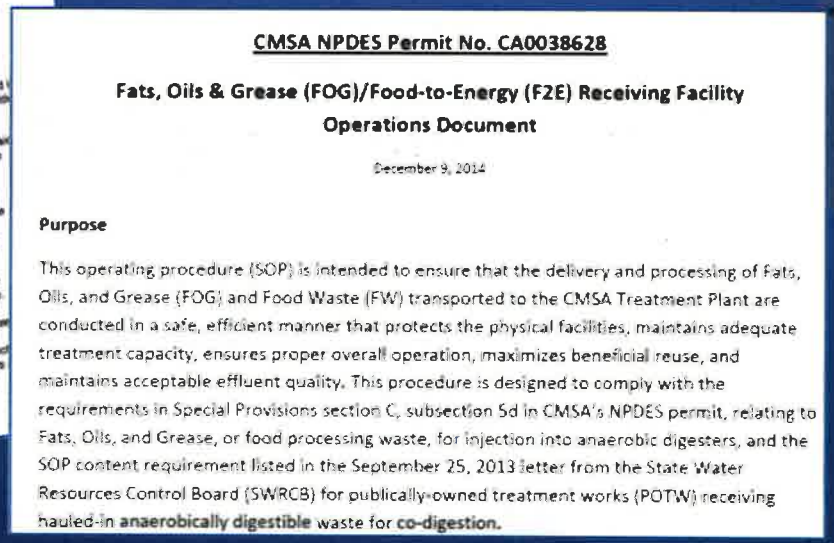
PUBLICLY OWNED TREATMENT WORKS RECEIVING HAULED-IN ANAEROBICALLY DIGESTIBLE WASTE FOR CO-DIGESTION

The State Water Resources Control Board (State Water Board) has been working with the California Department of Resources Recycling and Recovery (CalRecycle), the California Department of Food and Agriculture (CDFA), and the California Association of Sanitation Agencies (CASA) to delineate jurisdictional authority for the receipt of hauled-in anaerobically digestible material (ADM) at Publicly Owned Treatment Works (POTWs) for co-digestion.

To address this cross-media issue, CalRecycle is proposing an exclusion from Process Facility/Transfer Station (PF/TS) permits for direct injection of ADM[1] to POTW anaerobic digesters that are regulated under a NPDES or WDR permit. The proposed CalRecycle exclusion is restricted to ADM that has been prescreened, slurried, and processed/conveyed in a closed system to be co-digested with regular POTW sludge. This process is becoming widespread among POTWs statewide. The CalRecycle exclusion assumes that a POTW has developed Standard Operating Procedures (SOPs) for the proper handling, processing, tracking, and management of the ADM received. To facilitate implementation of the exclusion the following language, or something very similar, will be incorporated in POTW discharge permits upon reissuance:

"If the Discharger proposes to receive hauled-in anaerobically digestible material for injection into an anaerobic digester, the Discharger shall notify the appropriate Regional Water Quality Control Board and develop and implement standard operating procedures (SOPs) for this activity. If hauled-in waste for digestion is already ongoing, the SOPs shall be developed prior to initiation of the hauling. The SOPs shall address material handling, including unloading, screening, or other processing prior to anaerobic digestion; transportation; spill prevention; and spill response. In addition, the SOPs shall address avoidance of the introduction of materials that could cause interference, pass-through, or upset of the treatment process; avoidance of prohibited material; vector control, odor control, operation and maintenance, and the disposition of any solid waste segregated from introduction to the digester. The Discharger shall provide training to its staff on the SOPs and shall maintain records for a minimum of three years for each load received.

[1] Anaerobically digestible material (ADM) as defined in the CalRecycle regulations.


CMSA NPDES Permit No. CA0038628

Fats, Oils & Grease (FOG)/Food-to-Energy (F2E) Receiving Facility Operations Document

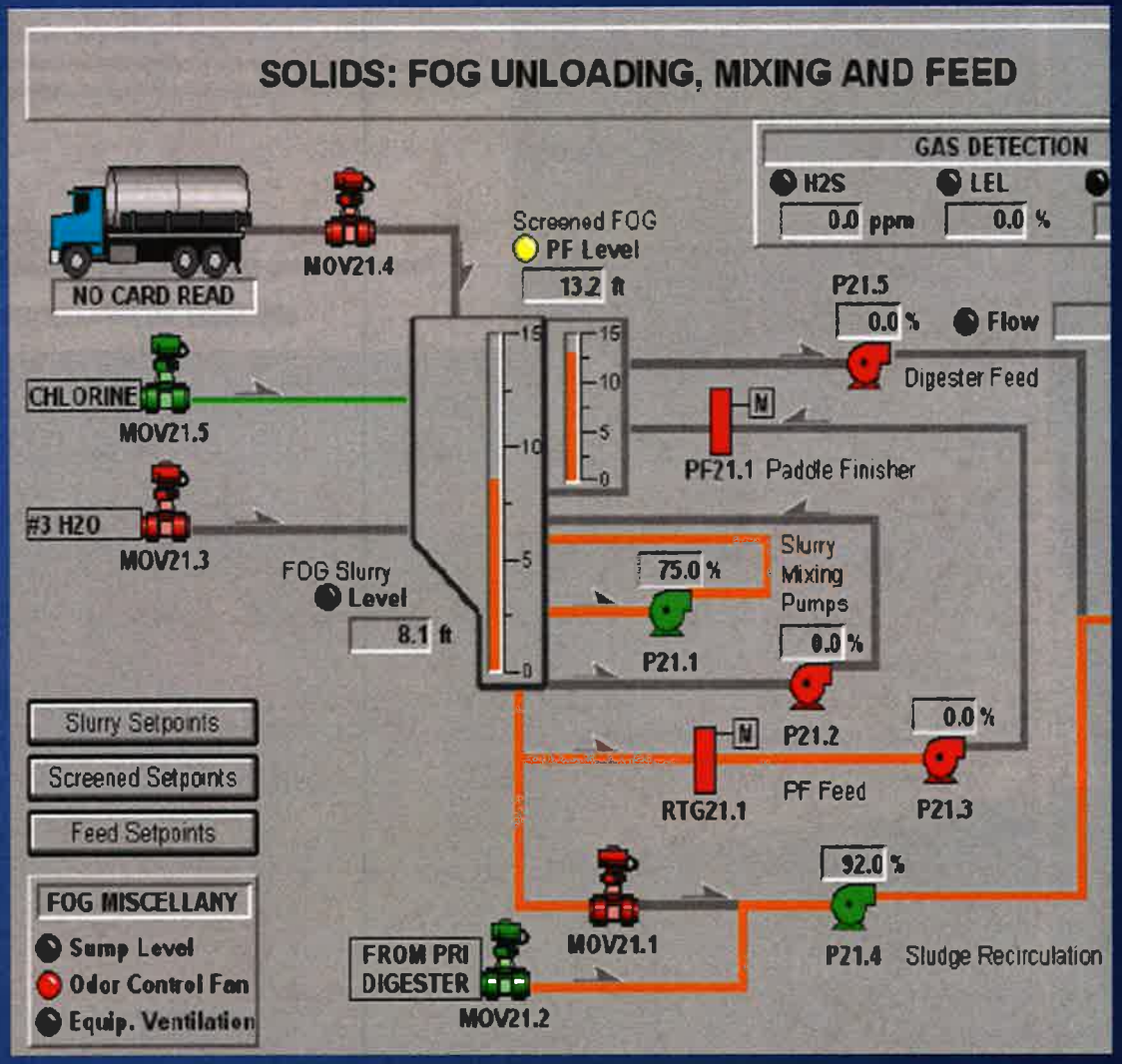
December 9, 2014

Purpose

This operating procedure (SOP) is intended to ensure that the delivery and processing of Fats, Oils, and Grease (FOG) and Food Waste (FW) transported to the CMSA Treatment Plant are conducted in a safe, efficient manner that protects the physical facilities, maintains adequate treatment capacity, ensures proper overall operation, maximizes beneficial reuse, and maintains acceptable effluent quality. This procedure is designed to comply with the requirements in Special Provisions section C, subsection 5d in CMSA's NPDES permit, relating to Fats, Oils, and Grease, or food processing waste, for injection into anaerobic digesters, and the SOP content requirement listed in the September 25, 2013 letter from the State Water Resources Control Board (SWRCB) for publically-owned treatment works (POTW) receiving hauled-in **anaerobically digestible** waste for **co-digestion.**

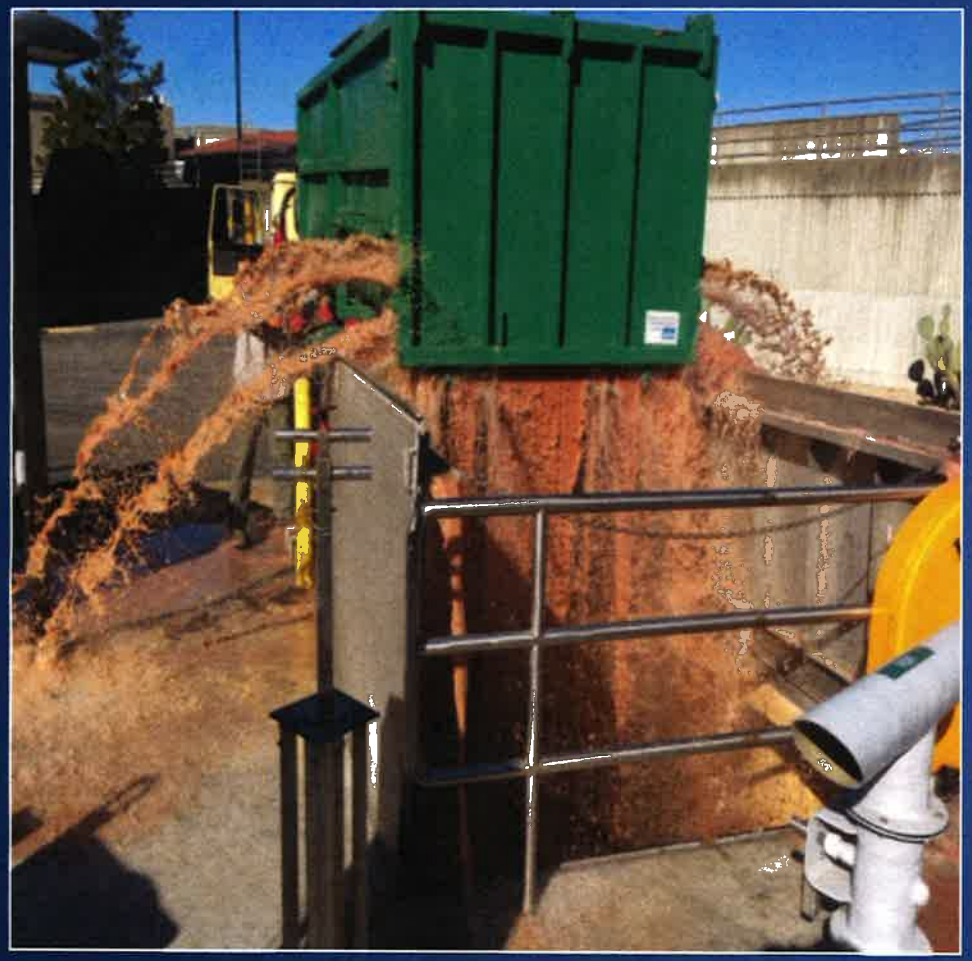
Equipment Start-up

- FOG delivery testing period started November 2013
- Began receiving January 2014
  10,000 gallons per day
- Now ~16,000 gpd
- Food waste delivery began February 2014
  4.2 tons per day
- Now ~6.8 tons/day



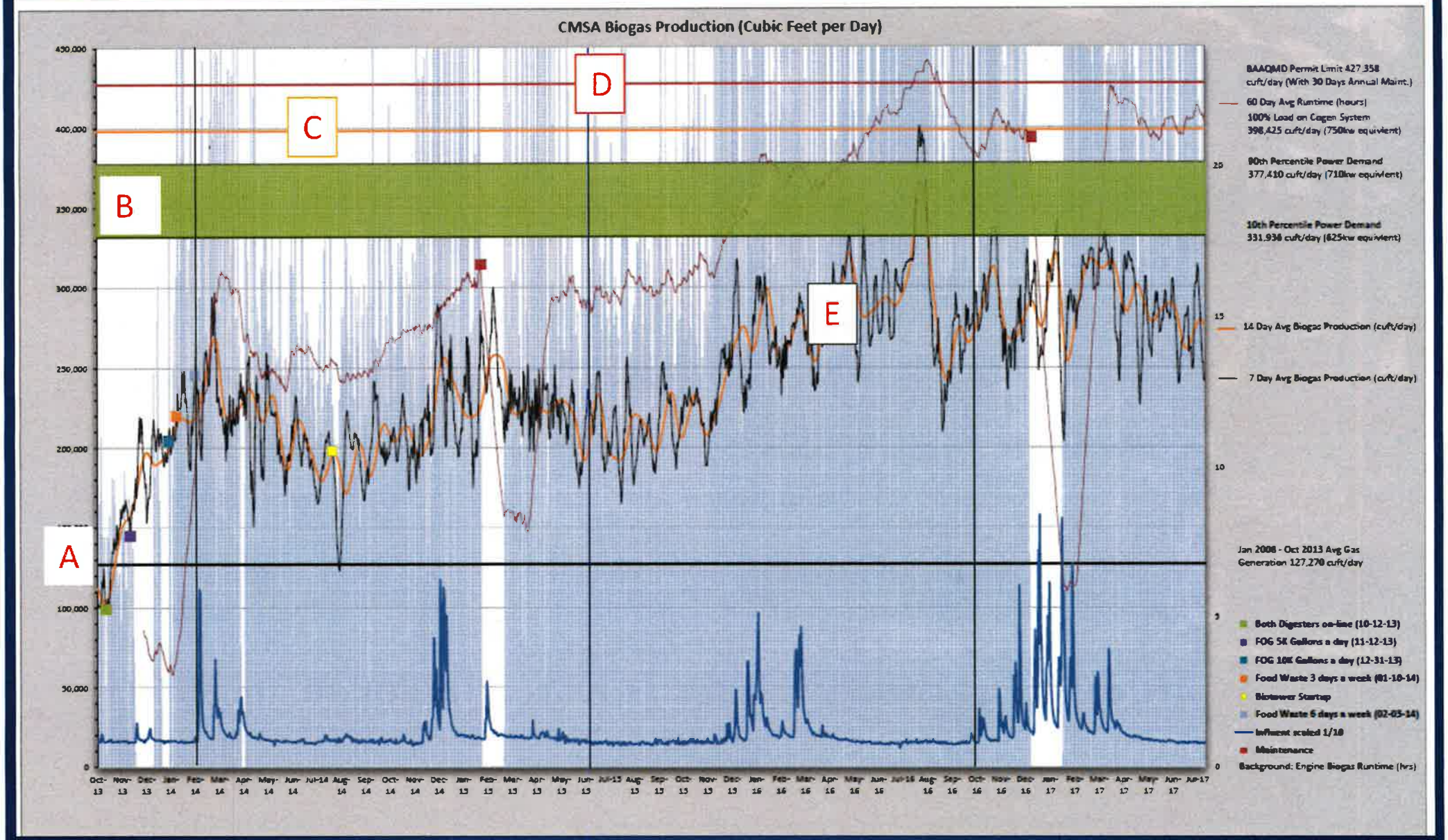
SCADA Overview Screen of the FOG/OW Station

First Delivery in January 2014



First Official Delivery in February 2014

Baseline Data

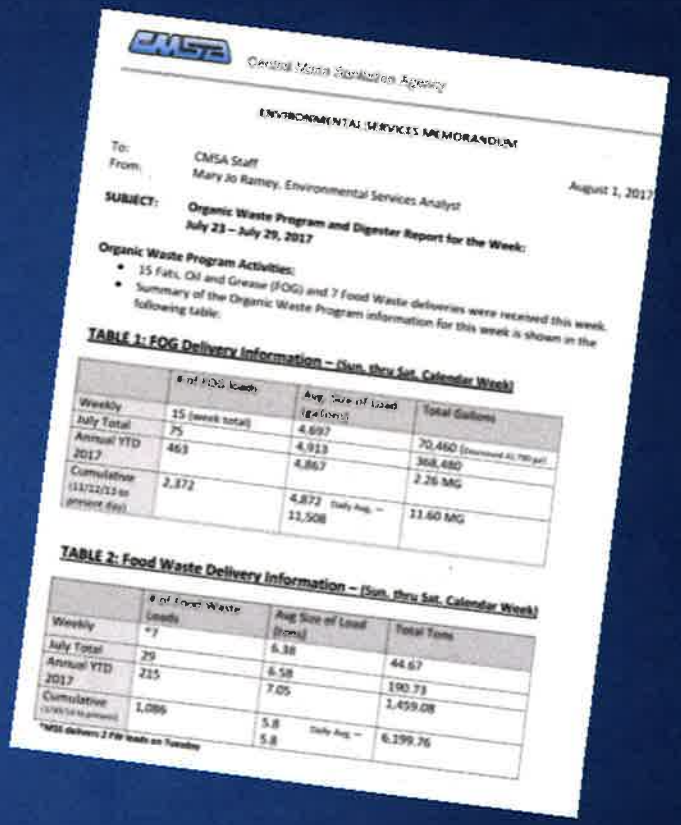


2018 Data Collection and Performance Measurements

FOG/ FW Delivery Information	**FOG**	**Foodwaste**
• Number of Loads on Avg.	**66 mo.**	**30 mo.**
• Avg. Size of Load	**4,716 Gal.**	**6.75 Tons**
• Pomace Bins and Reject Material	**14 Bins or 6.7% of Total Loading**	
Participants in the Program	**209 FSE's Currently**	
FOG/FW Slurry Feed to Digesters	**%TS 7.2 %VS 93.7**	

Digester health has remained stable and has not been affected by the addition of FW

• Total Dig. Loading	**% of Total VS Loading**
• Primary Sludge	**41%**
• TWAS	**36%**
• Organic Slurry	**23%**
• Digester HRT / days	**45.8**



CMSA

Central Marin Sanitation Agency

ENVIRONMENTAL SERVICES MEMORANDUM

To: CMSA Staff

From: Mary Jo Ramey, Environmental Services Analyst

August 1, 2017

SUBJECT: **Organic Waste Program and Digester Report for the Week: July 23 – July 29, 2017**

Organic Waste Program Activities:

- 15 Fats, Oil and Grease (FOG) and 7 Food Waste deliveries were received this week.
- Summary of the Organic Waste Program information for this week is shown in the following table:

TABLE 1: FOG Delivery Information – (Sun. thru Sat. Calendar Week)

	# of FOG Loads	Avg. Size of Load (gallons)	Total Gallons
Weekly	15 (week total)	4,697	
July Total	75	4,913	70,460
Annual YTD 2017	463	4,867	368,480
Cumulative (11/12/13 to present day)	2,372		2.26 MG
		4,873 Daily Avg. – 11,508	11.60 MG

TABLE 2: Food Waste Delivery Information – (Sun. thru Sat. Calendar Week)

	# of Food Waste Loads	Avg Size of Load (tons)	Total Tons
Weekly	*7	6.38	
July Total	29	6.58	44.67
Annual YTD 2017	215	7.05	190.73
Cumulative	1,086		1,459.08
		5.8 Daily Avg. – 5.8	6,199.76

*CMSA delivers 2 FW loads on Tuesday

PROCESS LAB DATA METRICS

		Digester #1	range	Digester #2	
DIGESTER SAMPLING	Total Solids (%)	2.2	1.7 – 2.8	2.5	Sample Date: 7/28/17
	Volatile Solids (%)	72	65-72	71	Sample Date: 7/28/17
	Volatile Solids Reduction (%) Land App >38%	72.1	>45	72.1	
	Total Alkalinity (mg/L)	5800	4300 – 5500	5800	Sample Date: 7/31/17
	Volatile Acids (mg/L)	86	85 - 129	86	Sample Date: 7/31/17
	Ratio: VA/TA	0.0148	0.018 – 0.029	0.0148	Sample Date: 7/31/17

Facility Processes Control When Operating an OWRF

Primary Sedimentation

- Blanket Depths

Secondary System

- MLSS Inventory

Digester Feeding

- Fill and mix slurry during the day
- Feeding in afternoon
- Empty and clean in late evening

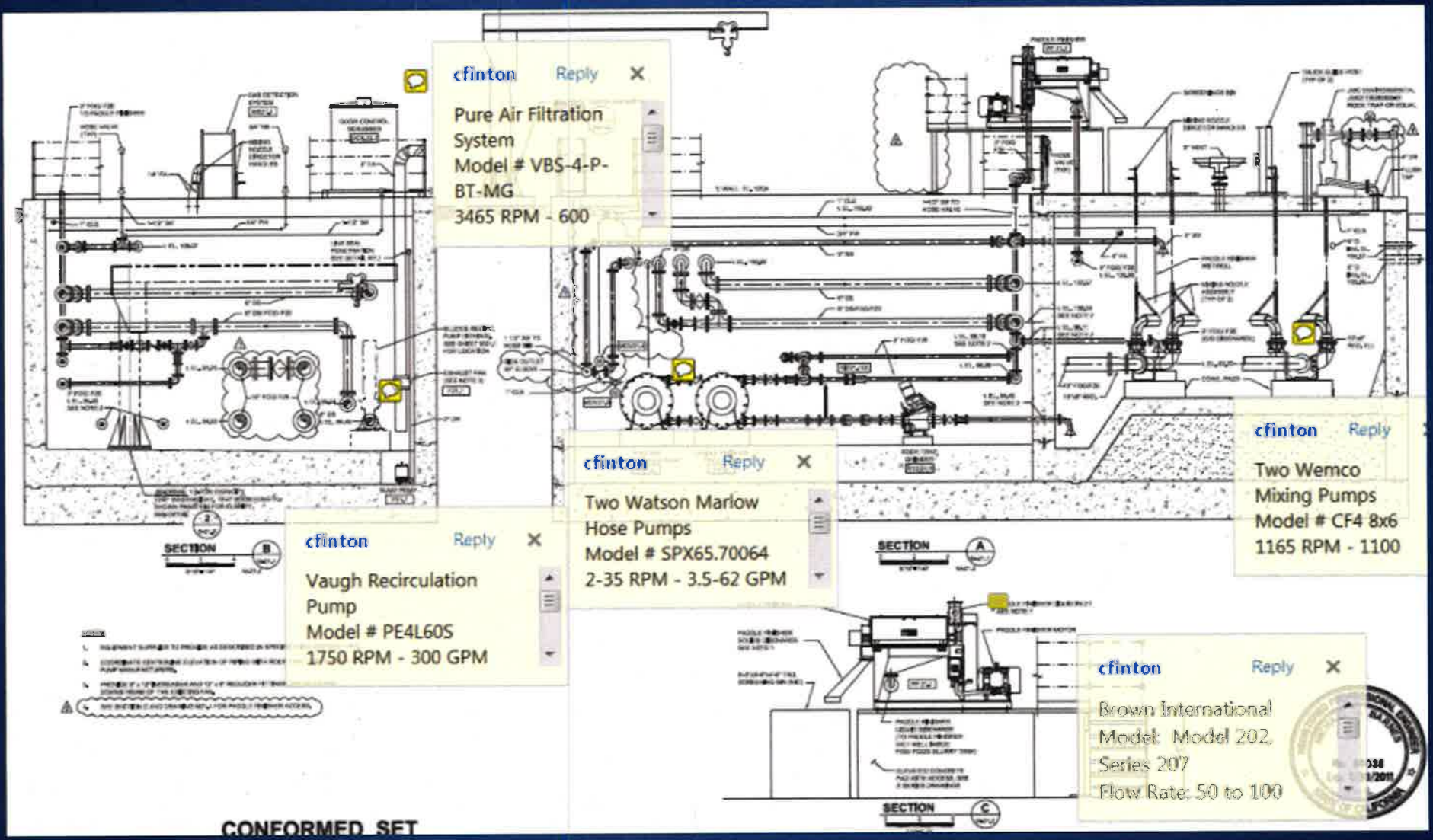
Solids Handling

- No Significant Increase in Biosolids
- Dewatering Operations
- Managing Biogas

CENTRIFUGE SAMPLING	Unit # / Date	#1-7/24	#1-7/25	#3-7/26	#1-7/27			
	Feed (%)	2.5	2.4	2.4	2.8			
	Centrate (TSS mg/L)	124	148	308	188			
	Cake (%)	28.1	27	26.8	25.9			
	Capture Rate (%)	99.5	99.4	98.8	99.4			

Maintaining an OWRF

Facility Equipment



Preventative Maintenance

Daily

- Hose Down Equipment and Receiving Station
- Rinse out Pumps and Piping
- Cleanout Heavy Object Trap (FOG Screen)

Preventative Maintenance

Weekly

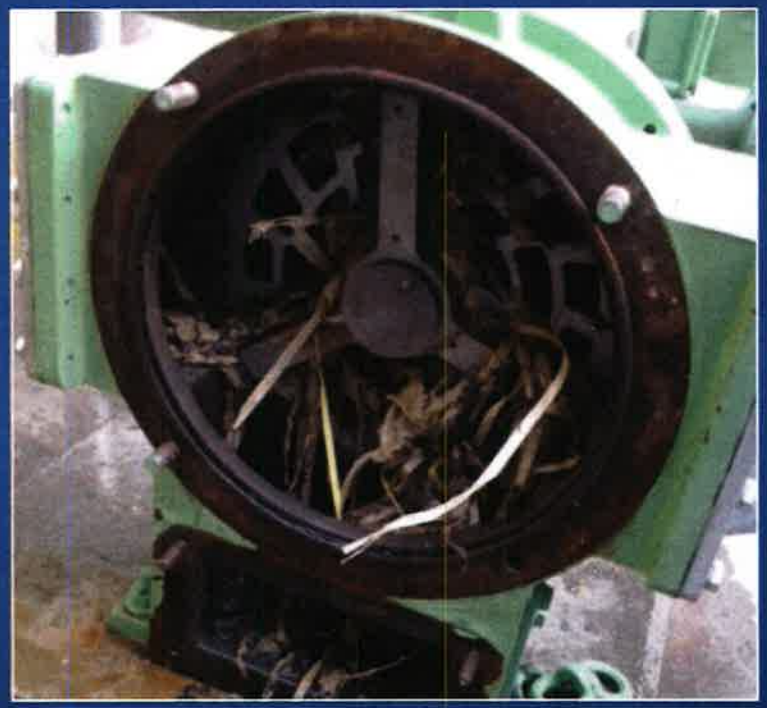
- Pomace Bins
- Rock Trap Grinder
- Equipment Area

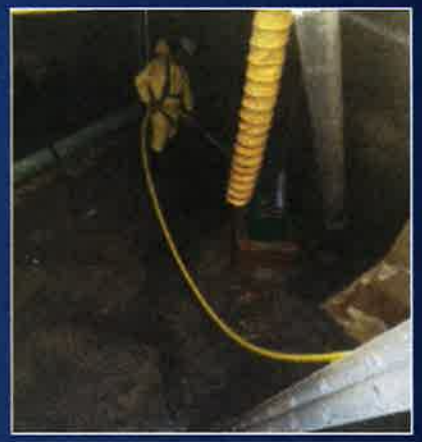
Monthly

- Pumps
- Paddle Finisher

Quarterly

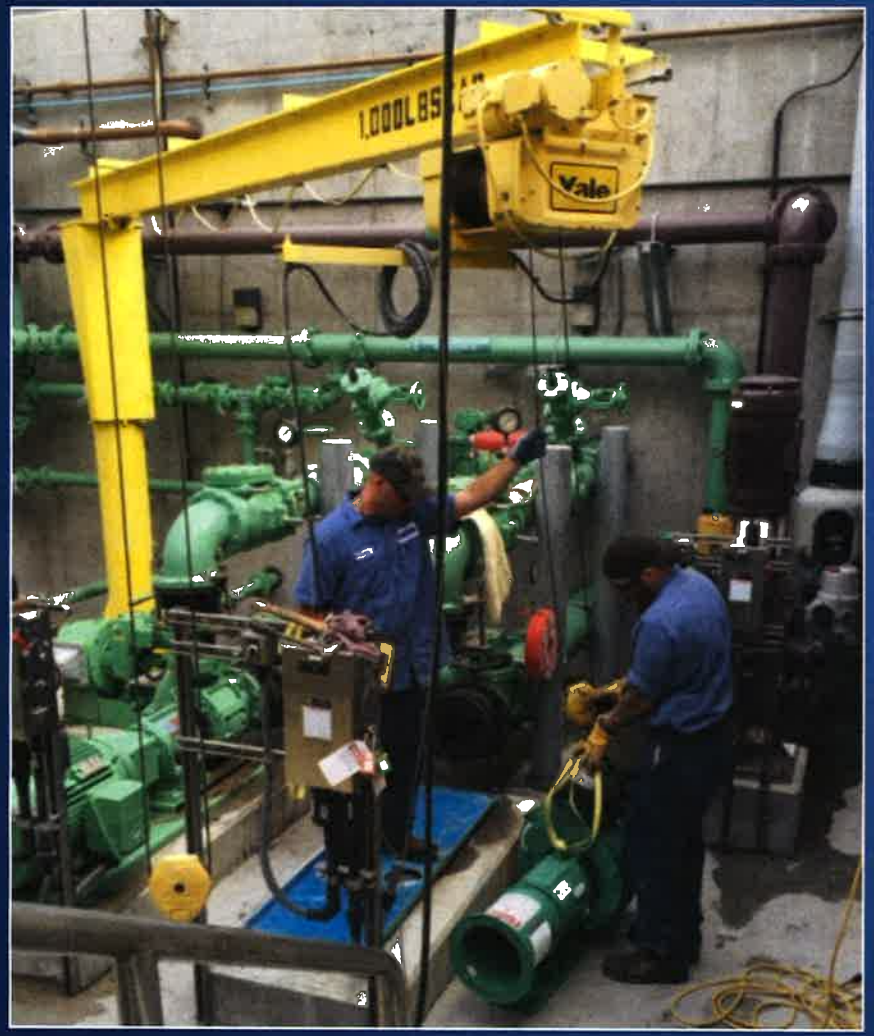
- Receiving Tank Cleaning and Coating Inspection





Corrective Maintenance

Mixing Pumps

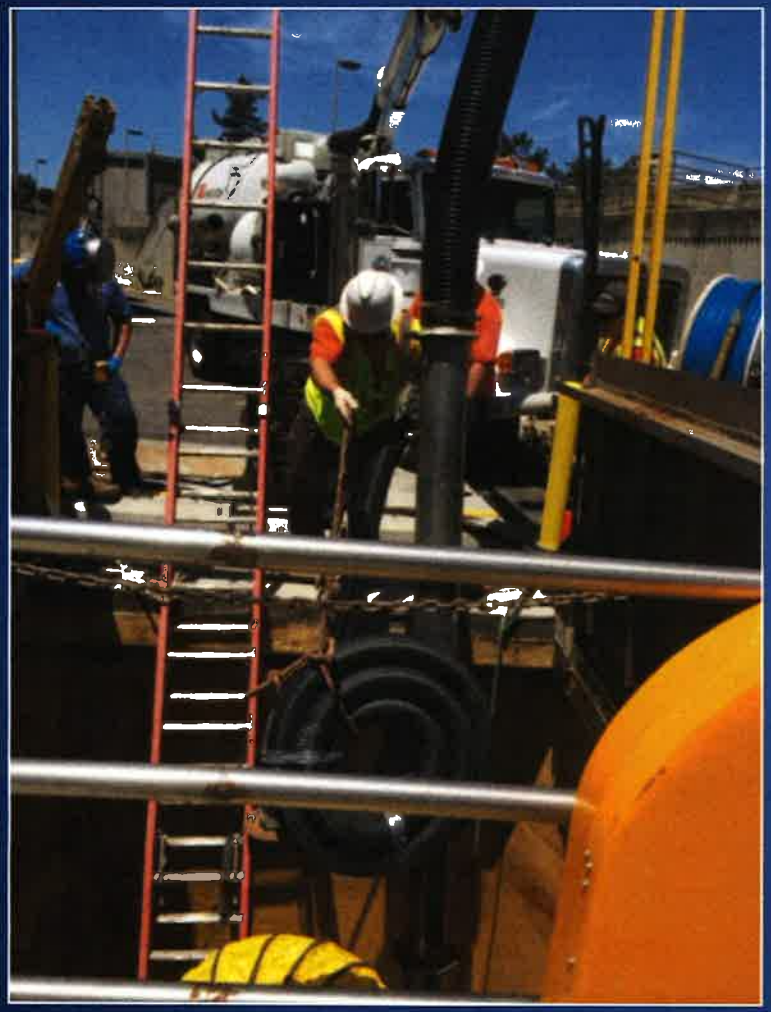


Corrective Maintenance

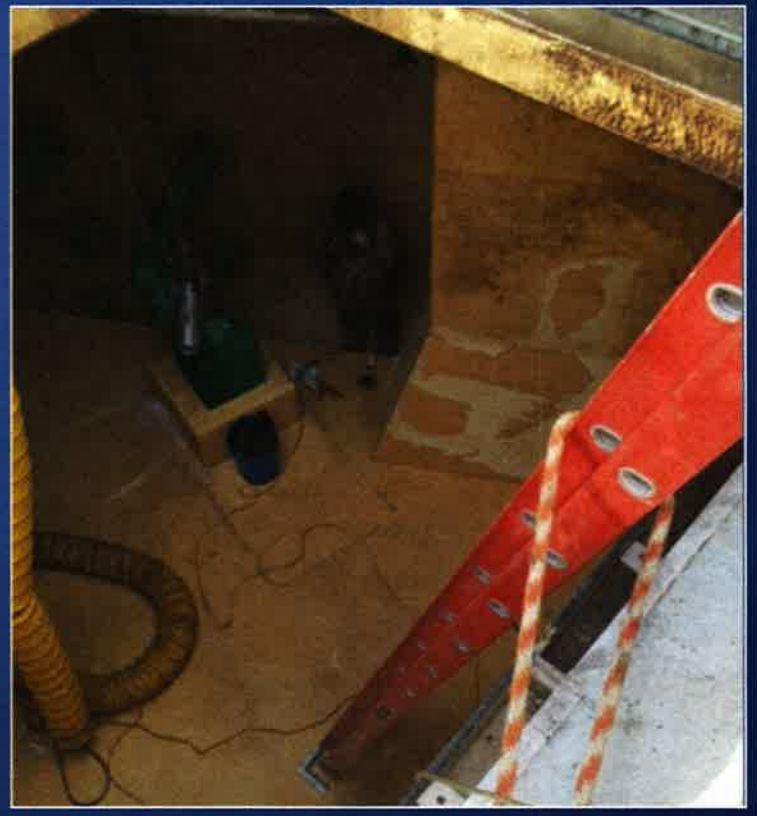
Tank Coating Failure

Corrective Maintenance

Quarterly Cleaning



Quarterly Cleaning



Unplanned Corrective Maintenance

Feed Pump Hoses

- Most unpredictable failure regardless of hose material
  - $2,118 per hose labor/material
  - Average 6 hose replacements per year
  - Paddle Finisher Feed Pump Leads Hose Replacements
  - Two Hoses and Five Gallons of Glycerin - Critical Inventory

Critical Spare Inventory – Risk Analysis

- Equipment Name and Function
- Options Available if Equipment was Out of Service (OOS)
- Can we Operate the Station w/o Equipment for 72 hours
- Consequences if Equipment is OOS
- Recommendation for Spare in Inventory (Yes / No)
- List of Spare Parts Onsite
- Estimated Equipment Delivery time for purchase to shipment

FOG/FZE STATION EQUIPMENT FUNCTION AND RISK ANALYSIS

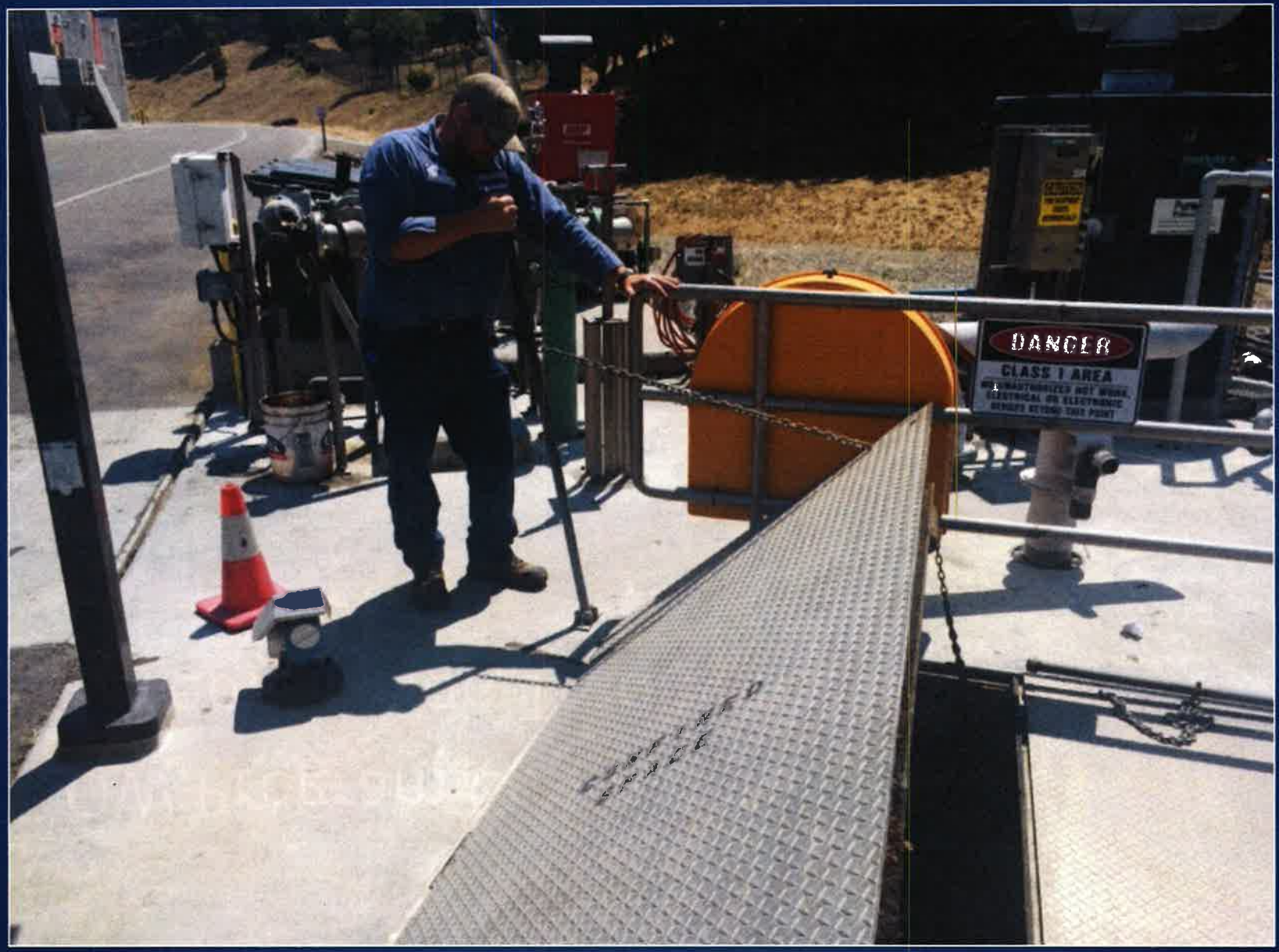
Equipment name:	Equipment function:	Possible options if equipment is out of service. CMSA Operation Department still review and refer RMI to WSP.	Can CMSA staff operate the FOG station without this equipment for 72 hours (YES / NO) Please explain why. Comments from team:	Consequences if equipment is out of service (other than increased staff time to operate)	Recommend having spare parts onsite? And why?	List of spare parts CMSA already have onsite	Recommended for additional spare parts onsite	Estimate equipment delivery time from purchase to shipment
Equipment Area Exhaust Fan	The exhaust fan is to minimize the potential harmful gases accumulating in the lower equipment area.	Use portable fan if the exhaust fan is out of service.	Yes Use portable exhaust fan if the permanent exhaust fan is out of service.	None.	No There is little to no impact if equipment is out of service, with the temporary solution in place.	None	No	
FOG/FZE Mixing Pumps	The mixing system was designed with the corner nozzles and waste mixing nozzles to avoid collecting the material in dead zones. These pumps are designed to chop as it pumps, keeping oversized solids and stringy material from clogging downstream process.	Use one mixing pump to mix the slurry tank in longer period for flow circulation. CMSA operation staff can either common the mixing nozzle or adjust the nozzle location to avoid collecting the slurry waste material in dead zones.	Yes Lead operator reported that the texture of the recently received food waste is watery and will able to mix well with only one pump in service.	Potentially decrease the slurry tank's mixing performance.	No. FOG or waste slurry will able to mix using one pump.	1 complete spare pumps, CMSA assembled 1 impeller with cutter bar and cutter nut 1 set of bearing 1 set of mechanical seals 1 set of o-rings 1 set of shims	No	
Rock Trap Grinder RTG21.1	Rock Trap Grinder will let rocks and gravel drop out, and will use the grinder cutter to shred any larger size solids. RTG21.1 will start and stop based on the operation parameters of Paddle Finisher Feed Pump FZ21.3.	Increase the slurry tank mixing duration, using the FOG/FZE Mixing Pumps. These pumps are designed to chop as it pumps, keeping oversized solids and stringy material from clogging downstream process.	Mixing waste slurry longer will shred the waste in smaller size, and the paddle finisher may capture the remaining unwanted waste.	There is a risk of damaging the paddle finisher feed pump (FZ1.3) and the paddle finisher, if the rock trap grinder is not in service.	Yes Protect downstream equipment. The cutting surface is a normal wear and tear item, and may need replacement frequently. It is recommended to have the normal wear and tear parts onsite.	2 seal assemblies 2 bearing assemblies 4 gaskets 2 complete cutter head tensioning devices 2 complete cutting surfaces	No	
Paddle Finisher Feed Pump (Hose Pump) FZ1.3	Paddle Finisher Feed Pump FZ1.3 will take in the waste slurry material from the slurry tank, feed it to the Paddle Finisher, and discharge it back to the paddle finisher wet well.	Option 1: Operator can open the manual (normally closed) isolation valve so that the FOG/FZE feed pump (Hose Pump FZ1.3) can take the waste slurry from the slurry tank to the paddle finisher. When the paddle finisher wet well is full, it will spill over back to slurry tank. Operator can shut off the paddle finisher, and close the manual isolation valve, and serve it as an FOG/FZE feed pump. The paddle finisher wet well volume is approximately 1100 gallon (size 8'x4'x5'), assuming the hose pump feed rate is 60	Options seem to be available to bypass the out of service pump, however, it will be too troublesome to operate the system if the pump is out of service	Option 1: Require almost a full time operator staff to be staged at the FOG Station during the period when the slurry tank is being emptied. Option 2: Unable to screen the unwanted materials from the food waste slurry. Potential slurry waste material with size	Yes Team discussed this believed that it will be too troublesome to operate if the pump is out of service, as replacing normally wear parts such as hose, coolant, and wear shoes can be done in few hours.	4 spare hoses 4 gallons of lubricant refills	No	

Lessons Learned and Key Takeaways

- OW Program Coordinator a Must
- Accepting Non-Traditional Wastes

Operator demonstrating Safe Access Gates

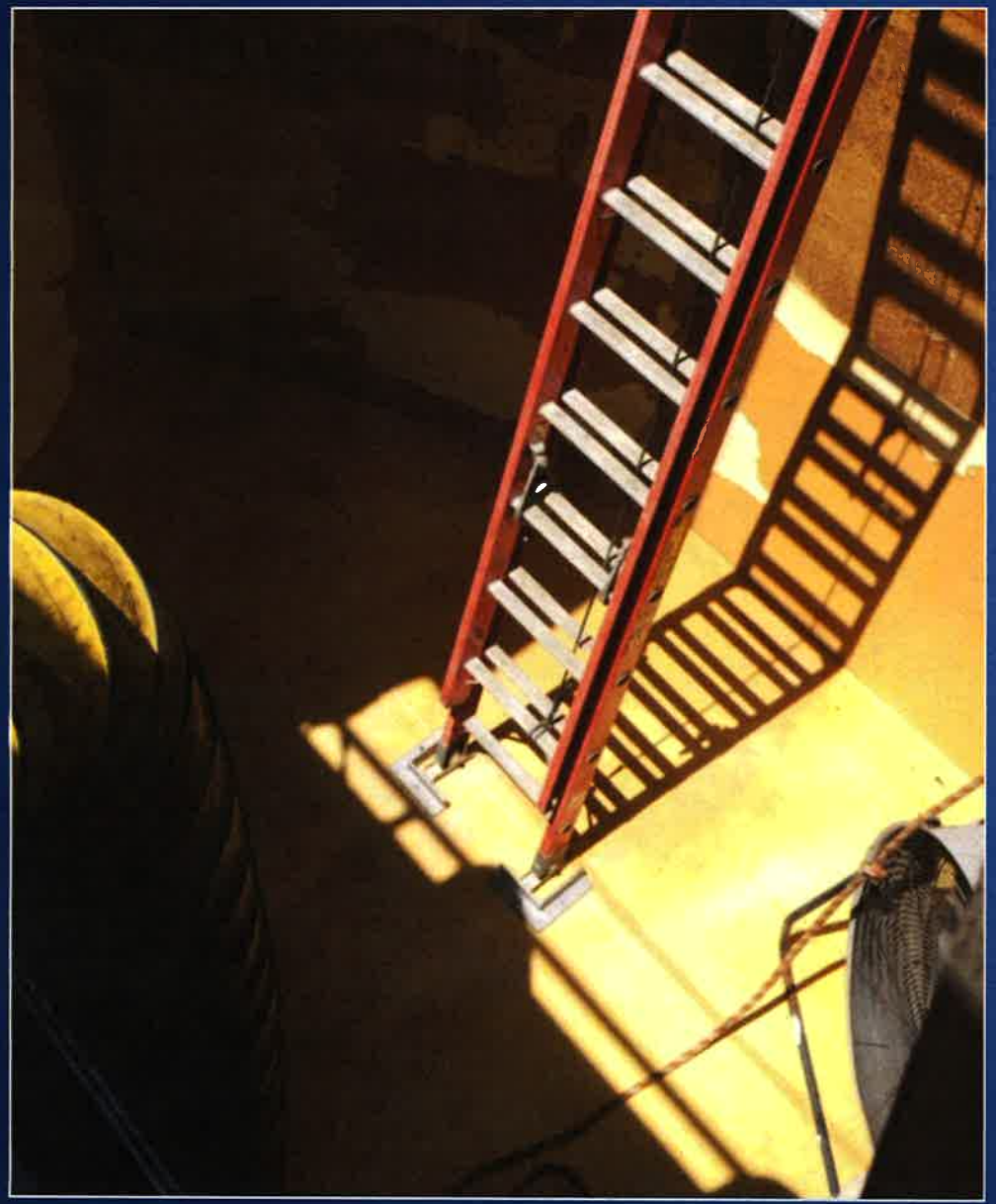
- Leaver and Chain

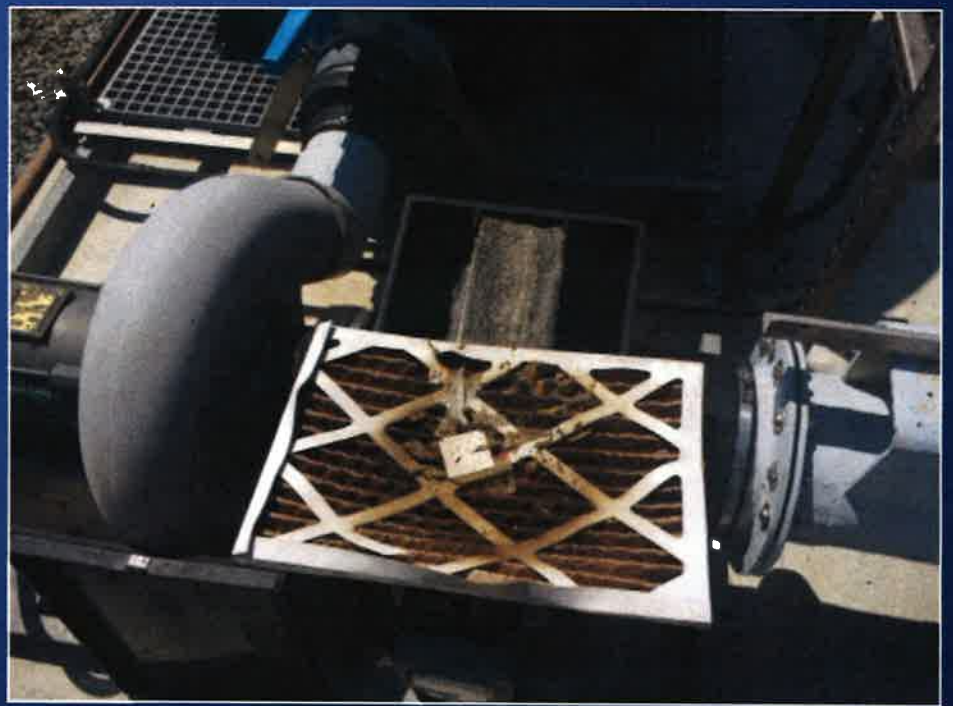


- Paddle Finisher Chute

- Hazardous Atmosphere Monitoring

- Ladder Cleats and Scrubber Fan





Budget Considerations

OWRF Maintenance Consumables Budget

- 2014 = $20,000
- 2019 = $40,000 or 50.0% increase

Biogas Conditioning Media

OW Program Staff Levels 1.6 FTE

Breaking Even on Revenue versus Expenses

Cost Information

OWRF Construction Cost = $1.9 million

2018 Tipping Fee Revenue: $152,825

– FOG / Foodwaste / Soy-Whey / Brewery Waste

2018 Biogas Energy Value (NG =) $315,253

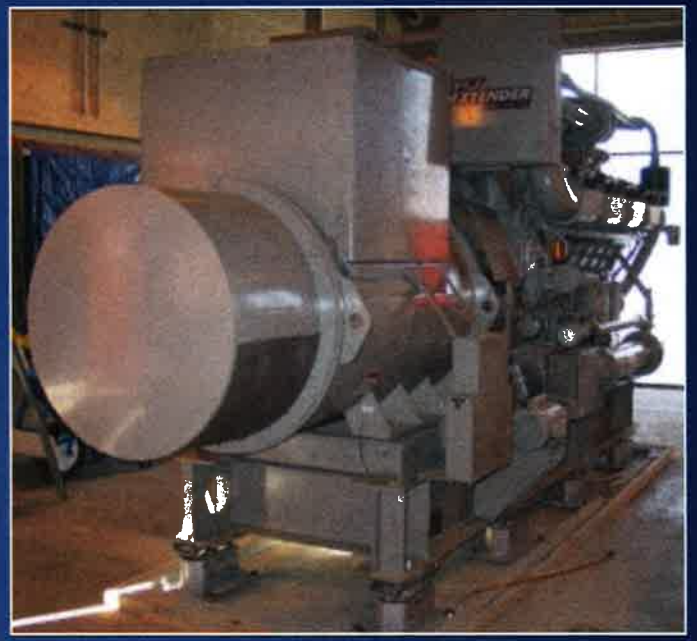
82% Reduction in Natural Gas Procurement*

Self-Sustainable Biogas Production

95.4% of Agency Power Produced in March by Cogenerator

94.0% Produced w/ Biogas

Methane Content 64%



CMSA CY18 PERFORMANCE METRICS – May 2018

TABLE I - TREATMENT/PROCESS METRICS

Metric	Definition	Measurement	Range/Target/Goal
1) Wastewater Treated	Volume of wastewater influent treated and disposed, in million gallons (Mg)	281.9 Mg	165 – 820 Mg
2) Biosolids Reuse	Alternate Daily Cover (ADC) at the Redwood Landfill, in wet tons (wt) Fertilizer and soil amendment at land application sites, in wet tons (wt) Bio-Fertilizer production at the Lystek facility, in wet tons (wt)	wt wt	360 – 665 wt
3) Conventional Pollutant Removal	Removal of the conventional NPDES pollutants - Total Suspended Solids (TSS) and Biological Oxygen Demand (BOD) a. tons of TSS removed; % TSS removal b. tons of organics removed (BOD); % BOD removal	 0; 0% 0; 0%	 > 85% > 85%
4) Priority Pollutants Removal	Diversion of priority NPDES metals from discharge to the S.F. Bay a. % Mercury b. % Copper	 0.0% 0.0%	 88 – 99% 84 – 98%
5) Biogas Production	Biogas generated in our anaerobic digesters, in million cubic feet (MM^3) Natural gas (methane) equivalent of the biogas, in million cubic feet (MM^3)	9.16 MM^3 5.86 MM^3	6.0 to 9.5 MM^3 3.8 to 6.1 MM^3
6) Energy Produced	Energy produced from cogeneration of generated biogas and purchased natural gas - in kilowatt hours Cogeneration system runtime on biogas , in hours (hrs.); % time during month Biogas value (natural gas cost equivalent)	441,538 kWh 694.9 hrs; 93.4% $24,973	380 to 480,000 kWh 540 hrs.; 75% $7,000 to $24,000
7) Efficiency	The cost to operate and maintain the treatment plant per million gallons of wastewater treated, in dollars per million gallons Energy used, kilowatt hours, per million gallons treated	$1,276 /Mg 2,627 kWh/Mg	$451-$1,830/Mg (wet - dry) 670 - 2,400 kWh/Mg

On the Horizon

Achieve Energy Self-Sufficiency

Deliver Power to Local Utility

- Interconnection Agreement
- Improvements to Export Power
- Power Sale Agreements

Expand Program

- Find Additional Sources of OW
- Produce More Biogas

Questions?

Chris Finton – Treatment Plant Manager

cfinton@cmsa.us

David Ernst – Operations Department

dernst@cmsa.us

MaryJo Ramey – OW Program Coordinator

mramey@cmsa.us

Appendix 5B

CMSA MSS FEEDSTOCK AGREEMENT

AGREEMENT BETWEEN

THE CENTRAL MARIN SANITATION AGENCY

AND

MARIN SANITARY SERVICE, INC.

FOR

COMMERICAL FOOD WASTE PROCESSING AND DISPOSAL SERVICES

MAY 2013

TABLE OF CONTENTS

EXHIBITS

AGREEMENT BETWEEN
THE CENTRAL MARIN SANITATION AGENCY
AND
MARIN SANITARY SERVICE, INC.
FOR
COMMERCIAL FOOD WASTE PROCESSING AND DISPOSAL SERVICES

This Agreement is entered into and executed as of the ___ day of ___, 2013 (the "Effective Date"), by and between the Central Marin Sanitation Agency ("CMSA") a joint powers authority, and Marin Sanitary Service, Inc. ("MSS"), a corporation formed under the laws in the State of California, (together referred to as the "Parties" or "Party").

RECITALS

WHEREAS, the State of California ("State") through enactment of the California Integrated Waste Management Act of 1989, has directed all local agencies to promote recycling and to maximize the use of feasible source reduction, recycling and composting options in order to reduce the amount of municipal solid waste that must be disposed of by landfill; and

WHEREAS, organic food waste is one of the largest components of landfilled material; and

WHEREAS, CMSA is a regional wastewater treatment agency located in San Rafael that provides wastewater and biosolids treatment and other environmental services to the residents in San Rafael, Larkspur, Corte Madera, Ross, Fairfax, San Anselmo, and unincorporated areas in the Central Marin County, including San Quentin State Prison; and

WHEREAS, MSS is the solid waste company that serves many residents and businesses in Central Marin County, and has a similar service area as CMSA; and

WHEREAS, CMSA has two existing anaerobic digesters that produce biogas for use as renewable fuel and a cogeneration engine to produce electricity to power CMSA's facilities and treatment plant; and

WHEREAS, CMSA and MSS partnered with the City of San Rafael in 2008 to conduct a Methane Capture Feasibility Study that showed MSS can collect up to 15 tons of commercial food waste per day in its Service Area (as defined below), and that food waste can be processed in the CMSA digesters to produce additional biogas; and

WHEREAS, CMSA completed a Food-to-Energy (F2E) predesign study in 2009 that indicated that its digesters have unutilized capacity to treat over 100 tons/day of food waste, and its cogeneration engine has the capacity to generate additional energy from biogas produced by 57 tons of food waste; and

WHEREAS, CMSA and MSS have identified many benefits of a commercial F2E program for their organizations, customers, and the environment, including reduced greenhouse gas emissions, reduced use of landfill volume, and saving electricity and natural gas resources within Central Marin County; and

WHEREAS, CMSA wishes to accept, and CMSA's Facility has the capacity to accept, up to 15 tons of commercially generated food waste a day from MSS' service area; and

WHEREAS, MSS wishes to deliver up to 15 tons of commercially generated food waste a day from its service area to CMSA's Facility and engage CMSA's food waste processing and disposal services; and

WHEREAS, the Parties agree that a number of the terms and conditions of this Agreement may have to be modified over time based on new information learned as a result of the evolution of the Central Marin Commercial Food Waste Program; and

WHEREAS, the Parties agree to cooperate with each other in good faith to implement or amend this Agreement.

NOW, THEREFORE, in consideration of the mutual promises, covenants, guarantees and conditions contained in this Agreement and for other good and valuable consideration, CMSA and MSS agree as follows:

ARTICLE 1. DEFINITIONS

Accept (or **Acceptance** or other variations thereof) is the transfer of ownership of Food Waste from MSS to CMSA.

Agreement means this Agreement, including all exhibits and attachments that are incorporated herein by reference. This Agreement may be amended and supplemented pursuant to Section 12.06.

Applicable Law means all statutes, rules, regulations, permits, orders, or requirements of the Federal, State, County, and local government authorities and agencies having applicable jurisdiction, that apply to or govern the Facility, the Site or the performance of the Parties' respective obligations hereunder in effect as of the Execution Date and as amended and/or enacted hereinafter.

Collectors means MSS and those business entities engaged by MSS to collect Food Waste from commercial food waste generators.

Change in Law means the occurrence of any event or change in Applicable Law as follows:

(1) the adoption, promulgation, amendment, modification, rescission, revision or revocation of any Applicable Law or change in judicial or administrative interpretation thereof occurring after the Execution Date hereof; or

(2) any order or judgment of any Federal, State or local court, administrative agency or governmental body issued after the Execution Date hereof if:

(i) such order or judgment is not the result of the willful misconduct or negligent action or inaction of the Party relying thereon or of any third party for whom the Party relying thereon is directly responsible; and

(ii) the Party relying thereon, unless excused in writing from so doing by the other Party, shall make or have made, or shall cause or have caused to be made, Reasonable Business Efforts in good faith to contest such order or judgment (it being understood that the contesting in good faith of such an order or judgment shall not constitute or be construed as willful misconduct or negligent action of such Party); or

(3) the imposition by a governmental authority or agency of any new or different material conditions in connection with the issuance, renewal, or modification of any permit or approval after the Execution Date; or

(4) the failure of a governmental authority or agency to issue, or the suspension, termination or rejection of, any permit or approval after the Execution Date hereof.

Commercial Food Waste Generator means those restaurants and food processing businesses participating in MSS' Food Waste program.
Contract Year means CMSA's fiscal year of July 1 of one year to June 30 of the following year.

Delivery (**Deliver** or **Delivered** or other variations thereof) means arrival of MSS at the Site entrance during Facility Receiving Hours for the purposes of delivering Food Waste to CMSA.

Disposal means depositing of Pomace or Residual of Digested Food Solids for beneficial use such as compost, land application, or alternative daily cover at authorized landfills, or dumping at an authorized landfill.
Facility means the CMSA's wastewater treatment plant located at 1301 Andersen Drive, San Rafael, California.

Facility Receiving Hours are hours when the CMSA will be open to Accept Food Waste at the Facility as defined in Section 6.03.

Food Waste means organic consumer food materials acceptable for Pre-processing that is collected from Commercial Food Waste Generators within MSS' Service Area, or within the respective service areas of other Marin County solid waste haulers that contract with MSS for Food Waste Pre-processing services. Food Waste includes fruits, vegetables, meat, seafood, small bones, dairy, eggs, breads, pastas, sauces, cooking oil, grease, tea bags, coffee grounds and filters, and other related food waste materials.

Force Majeure event includes but is not limited to floods, earthquakes, other extraordinary acts of nature, war or insurrection, riots, or other similar catastrophic events, not caused or maintained by the Party seeking relief, which event is not reasonably within the ability of that Party to intervene in or control to the extent that such event has a materially adverse effect on the ability of that Party to perform its obligations hereunder. No event, the effects of which could have been prevented by reasonable precautions, including compliance with Applicable Laws, shall be a Force Majeure event. No failure of performance by CMSA, MSS, their respective contractors or other Collectors shall be a Force Majeure event unless such failure is itself caused by a Force Majeure event as to CMSA, MSS, their respective contractors and/or other Collectors.

Hazardous Waste means materials that are hazardous, including but not limited to:
(1) "Hazardous Waste" pursuant to Section 40141 of the California Public Resources Code; all substances defined as Hazardous Waste, acutely Hazardous Waste, or extremely Hazardous Waste by Sections 25110.02, 25115, and 25117 of the California Health and Safety Code (the California Hazardous Waste Control Act), California Health and Safety Code Section 25100 et seq., and future amendments to or recodification of such statutes or regulations

promulgated thereunder, including 23 California Code of Regulations Sections 2521 and 2522; and

(2) materials regulated under the Resource Conservation and Recovery Act, 42 U.S.C. Section 6901 et seq., as amended (including, but not limited to, amendments thereto made by the Solid Waste Disposal Act Amendments of 1980), and related Federal, State and local laws and regulations;

(3) materials regulated under the Toxic Substances Control Act, 15 U.S.C. Section 2601 et seq., as amended, and related Federal, State of California, and local laws and regulations, including the California Toxic Substances Account Act, California Health and Safety Code Section 25300 et seq.;

(4) materials regulated under the Comprehensive Environmental Response, Compensation and Liability Act, 42 USC 9601, et seq., as amended, and regulations promulgated thereunder; and

(5) materials regulated under any future additional or substitute Federal, State or local laws and regulations pertaining to the identification, transportation, treatment, storage or disposal of toxic substances or Hazardous Waste; with the exception that Hazardous Waste, for the purpose of this Agreement, shall specifically exclude Household Hazardous Waste.

If two or more governmental agencies having concurrent or overlapping jurisdiction over Hazardous Waste adopt conflicting definitions of "Hazardous Waste," for purposes of collection, transportation, processing and/or disposal, the more restrictive definition shall be employed for purposes of this Agreement.

Holidays are New Year's Day, Martin Luther King's Birthday, President's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the day after Thanksgiving Day, and Christmas Day or any other day that CMSA gives MSS seventy-two (72) hours prior written notice that the Facility will not be in operation that day.

Household Hazardous Waste are those wastes resulting from products used by the general public for household purposes which, because of their quantity, concentration, or physical or chemical characteristics, may pose a substantial known or potential hazard to human health or the environment when improperly treated, disposed, or otherwise managed.

Labor Action means labor unrest, including strike, work stoppage, lock-out, slowdown, sick-out, picketing, industrial disturbance and any other concerted job action.

Notice (or **Notify** or other variation thereof) means written notice given by one Party to the other Party in relation to the execution of the various obligations of both Parties under this Agreement.

Permits means all Federal, State and local, statutory or regulatory approvals, or other measures or mechanisms necessary for either Party to be in full legal compliance in the performance of all their obligations, as renewed or amended from time to time.

Person includes any individual, firm, association, organization, partnership, corporation, trust, joint venture, the United States, the State, a county, a municipality or special district or any other entity whatsoever.

Pomace means rejected material resulting from processing the Food Waste through the Facility's paddle finisher, after acceptance and prior to digestion, that requires recycling or Disposal.

Pre-process means the handling, removal of Unacceptable Materials, and grinding of the Food Waste by MSS at its Transfer Station prior to delivery to the Facility.

Process (or **Processing** or any other variation thereof) means the handling, digestion and Disposal of Food Waste and Pomace and Residual of Digested Food Solids by CMSA at the Facility after Acceptance.

Reasonable Business Efforts means those efforts a reasonably prudent business Person would expend under the same or similar circumstances in the exercise of such Person's business judgment, intending in good faith to take steps calculated to satisfy the obligation that such Person has undertaken to satisfy.

Residual of Digested Food Solids means material remaining after digestion and dewatering of Food Waste that requires recycling or Disposal.

Service Area means the geographical area where the residents and businesses that MSS serves are located as of the date this Agreement is executed by CMSA as set forth on Exhibit C attached hereto.

Site means the parcel of land on which the Facility is situated.

Ton means a unit of measure for weight equivalent to two thousand (2,000) standard pounds (where each pound contains 16 ounces).

Transfer Station means MSS' transfer station at 1050 Andersen Drive, San Rafael, at which the Food Waste is Pre-processed before it is transported to the Facility.

Unacceptable Material(s) means wastes or other materials that CMSA cannot Process as part of the Food Waste and is considered contamination, including but not limited to plastic,

styrofoam, glass, metal, paper, cardboard, wood, yard waste, cans, straps, ropes, cords, wires, bottles or any other material in quantities that would impact CMSA's ability to process Food Waste or meet regulatory compliance. De minimis quantities of these wastes which under typical operating circumstances would not disrupt Facility operations (e.g., by clogging pipelines or damaging equipment) will not be considered Unacceptable Materials. This definition may evolve over time by mutual agreement of the Parties to reflect new methods that allow processing of additional materials.

Uncontrollable Circumstance(s) means any act, event, or condition outside either Party's control and not the result of willful or negligent action or inaction on the part of such Party, whether affecting the Facility, the Transfer Station or either Party, which materially and adversely affects the ability of either Party to perform any of its obligations under this Agreement, including:

(1) The failure of any appropriate Federal, State, or local public agency or private utility having operational jurisdiction in the area in which the Facility or the Transfer Station is located, to provide and maintain utilities, services, water, sewer or power transmission lines to the Facility or the Transfer Station which are required for Facility operations or Transfer Station operations; or

(2) A Change in Law; or

(3) The suspension or interruption of either Party's operations as a result of any release, spill, power outage, contamination, migration or presence of any Hazardous Waste, petroleum and petroleum products or as a result of any release, spill, contamination of toxic materials where the Party is not liable for the release, spill or contamination, or a potentially responsible party. The suspension of operations due to a release, spill or contamination where the Party's liability for the release, spill or contamination arises solely from Party's status as the operator of the facility or owner of the property will be considered an Uncontrollable Circumstance; or

(4) A process upset to the Facility or the Transfer Station due to a toxic load or similar event not related to Food Waste processing and that prevents the use of the digesters; or

(5) A Force Majeure event that temporarily or permanently interrupts Facility operations or Transfer Station operations; or

(6) A Facility equipment or control system failure that constitutes a Force Majeure event and that interrupts the ability of the Facility to receive and process, the Food Waste; or

(7) A Transfer Station equipment failure that constitutes a Force Majeure event and that interrupts the ability of the Transfer Station to receive, preprocess, or transport Food Waste; or

The following are excluded from Uncontrollable Circumstances, without limitation, unless caused by an Uncontrollable Circumstance listed above:

(1) Adverse changes in the financial condition of either Party or any Change in Law with respect to any taxes based on or measured by net income, or any unincorporated business, payroll, franchise or employment taxes;

(2) The consequences of errors on the part of either Party, its employees, agents, subcontractors or affiliates, including errors in plans and specifications that should reasonably have been identified;

(3) The failure of either Party to secure patents, technical licenses, trademarks, and the like necessary for delivery and processing of Food Waste;

(4) The lack of fitness for use, or the failure to comply with the plans and specifications, of any materials, equipment or parts constituting any portion of the Facility or the Transfer Station; and

(5) Labor Actions of or affecting the employees or contractors (including, in the case of MSS, other Collectors) of the Party that is asserting Uncontrollable Circumstances.

ARTICLE 2. REPRESENTATIONS AND WARRANTIES

2.01 Of CMSA. CMSA represents and warrants as of the date hereof:

a. Status. CMSA is a publicly owned utility formed under the California Joint Exercise of Powers Act

b. Authority and Authorization. CMSA has full legal right, power and authority to Execute this Agreement and perform its obligations hereunder. This Agreement has been duly Executed by CMSA and constitutes a legal, valid and binding obligation of CMSA enforceable against CMSA in accordance with its terms.

c. No Conflicts. The execution by the CMSA of this Agreement, the performance by the CMSA of its obligations under, and the fulfillment by the CMSA of the terms and conditions of, this Agreement does not knowingly (1) conflict with, violate or result in a breach of any Applicable Law; or (2) conflict with, violate or result in a breach of any term or condition of any judgment, order or decree of any court, administrative agency or other governmental authority, or any agreement or instrument to which CMSA is a Party or by which CMSA or any of its properties or assets are bound, or constitute a Default thereunder.

d. No Approvals. CMSA warrants that all legally required Permits, qualifications and approvals of whatsoever nature will be secured for CMSA to provide services hereunder and meet CMSA's obligations, and CMSA further warrants that it shall, at its sole cost and expense, keep in effect or obtain at all times during the Term all permits, and approvals which are legally required for CMSA to provide such services and meet its obligations.

e. No Litigation. There is no action, suit, proceeding or investigation, at law or in equity, before or by any court or governmental authority, commission, board, agency or instrumentality pending or, to the best of CMSA's knowledge, threatened, against CMSA wherein an unfavorable decision, ruling or finding, in any single case or in the aggregate, would materially adversely affect the performance by CMSA of its obligations hereunder or in connection with the transactions contemplated hereby, or which, in any way, would adversely affect the validity of, or the ability to enforce, this Agreement or any other agreement or instrument entered into by CMSA in connection with the transactions contemplated hereby.

f. Public Works. The services requested by CMSA under this Agreement do not constitute a "public work" and are not subject to any of the provisions of the Public Works law, Labor Code Sections 1720-1901, nor of the regulations promulgated thereunder.

2.02 Of MSS. MSS represents and warrants as of the date hereof:

a. Status. MSS is a corporation, duly organized and validly existing under the laws of the State of California.

b. Authority and Authorization. MSS has full legal right, power and authority to Execute this Agreement, and perform its obligations hereunder. This Agreement has been duly executed by MSS and upon execution constitutes a legal, valid and binding obligation of MSS enforceable against MSS in accordance with its terms and in accordance with MSS' corporate resolution, which is attached hereto as Exhibit B. MSS has complied with Applicable Law in entering into this Agreement. Notwithstanding the foregoing, MSS does not have the authority to act for, or to waive any rights of, any of the jurisdictions in its Service Area with respect to the Food Waste delivered to the Facility.

c. No Conflicts. Neither the execution by MSS of this Agreement, the performance by MSS of its obligations hereunder, nor the fulfillment by MSS of the terms and conditions hereof: (1) conflicts with, violates or results in a breach of Applicable Law; or (2) conflicts with, violates or results in a breach of any term or condition of any judgment, order or decree of any court, administrative agency or other governmental authority, or any agreement or instrument to which MSS is a Party or by which MSS or any of its properties or assets are bound, or constitutes a Default thereunder.

d. No Approvals. No approval, authorization, license, permit, order or consent of, or declaration, registration or filing with any governmental or administrative authority, commission, board, agency or instrumentality is required for the valid execution and delivery of this Agreement by MSS.

f. No Litigation. There is no action, suit, proceeding or investigation, at law or in equity, before or by any court or governmental authority, commission, board, agency or instrumentality pending or, to the best of MSS's knowledge, threatened, against MSS that would materially adversely affect the performance by MSS of its obligations hereunder or in connection with the transactions contemplated hereby, or which, in any way, would adversely affect the validity of, or the ability to enforce this Agreement or any other agreement or instrument entered into by MSS in connection with the transactions contemplated hereby.

ARTICLE 3. THE PARTIES

3.01 Independent Contractor.

The Parties intend that each will perform its obligations as an independent contractor and neither as a partner of or joint venturer with the other. No agents, employees, contractors, consultants, licensees, agents or invitees of a Party will be deemed to be employees, contractors, licensees, agents or invitees or agents of the other Party.

3.02 Parties in Interest.

Nothing in this Agreement, whether express or implied, is intended to confer any rights on any Persons other than the Parties and their respective representatives, successors and permitted assigns.

3.03 Binding on Successors.

Subject to Section 12.03 below, the provisions of this Agreement shall inure to the benefit of and be binding on the successors and permitted assigns of the Parties.

3.04 Confidentiality of Information.

The Parties acknowledge and agree that information submitted by either Party pursuant to this Agreement may be subject to compulsory disclosure upon request from a member of the public under the California Public Records Act, Government Code Section 6250 *et seq.*

3.05 Sole Responsibility.

Each Party shall be solely responsible for the acts and omissions of its officers, employees, subcontractors and agents.

ARTICLE 4. TERM OF AGREEMENT

4.01 Term.

This Agreement shall become effective on the Effective Date and continue in effect for three (3) years thereafter unless terminated earlier by either Party in accordance with Article 7 or 11. The first year of this Agreement will begin on the Effective Date and the third year of this Agreement will end on _____ , 2016.

4.02 Term Extensions.

a. Agreement to Extend. The Parties may mutually agree in writing to extend this Agreement after the end of the first 3-year term. Each extension will be of at least 12 months in duration. The Parties shall endeavor to commit to an extension at least ninety (90) days before the expiration of the then-current term.

b. Agreement in Full Effect.

All provisions of this Agreement shall remain in effect during any extension.

4.03 Survival of Certain Provisions.

All indemnifications provided for herein and any other rights and obligations of the Parties expressly stated to survive the termination of this Agreement, shall survive such termination including, but not limited to, the following provisions: Section 6.05 (Records and Reports), Article 8 (Insurance) and Article 9 (Indemnity).

ARTICLE 5. PREPARATION, DELIVERY AND ACCEPTANCE OF FOOD WASTE

5.01 Delivered Food Waste.

MSS will use Reasonable Business Efforts and will employ specified procedures to ensure that all Food Waste Delivered to CMSA's Facility has been Pre-processed, is free of Unacceptable Materials and is acceptable based on CMSA's requirements for its Food Waste processes and its Facility processes as set forth in this Agreement.

a. Grinding of Food Waste. Before Delivery, the Food Waste must be ground into pieces approximately one inch square in size or smaller, through a hammermill or like equipment.

b. Preventing Contamination of Loads. MSS will use Reasonable Business Efforts to prevent Unacceptable Materials from being included in Food Waste Delivered to CMSA, including but not limited to the education of those Collectors and Commercial Food Waste Generators who utilize MSS' services to the termination of the Delivery to the Facility of Food Waste collected from Commercial Food Waste Generators who fail to comply with the Unacceptable Waste requirements of this Agreement. MSS will require its Commercial Food Waste Generators to sign a Food Waste Program Participation Agreement (Exhibit B) that acknowledges both the requirements of this Agreement, as well as the Participant Assessment and Contamination Controls procedures which are attached to this Agreement as Exhibit A.

5.02 Acceptance of Food Waste.

a. **Acceptance and Ownership of Food Waste**. CMSA shall accept an aggregate of up to 15 tons per day, or 75 tons per week, of Food Waste from MSS during the term of this Agreement. CMSA and MSS agree to discuss adjusting these maximum amounts based on actual program performance as the Food Waste program matures.

Notwithstanding the above, CMSA shall have the right but not the obligation to inspect each and every load of Food Waste to confirm that no Unacceptable Materials are contained therein. Food Waste will be deemed Accepted unless CMSA rejects the materials as they are being dumped or immediately after dumping at the Facility. If the Food Waste is contaminated in a manner that could not be ascertained upon visual inspection during dumping but CMSA Notifies MSS prior to completion of processing that the Food Waste contains Unacceptable Materials, it shall have the right to reject that load or loads of Food Waste.

b. Rejection of Unacceptable Material.

(1) Inspection. CMSA may use Reasonable Business Efforts to detect and discover Unacceptable Material.

(2) Rejection of Contaminated Loads. CMSA may reject any loads containing Unacceptable Materials, if a qualified CMSA representative observes Unacceptable Materials discharged into the Food Waste receiving tank and believes, using his/her professional judgment, that the Unacceptable Materials are of a type or quantity that will disrupt Facility operations (e.g., by clogging pipelines or damaging equipment). Prior to receiving Food Waste at the Facility, CMSA will develop a standard operating procedure for receiving MSS deliveries that provides guidance to CMSA and MSS staff on the types and quantities of Unacceptable Materials that have the potential to disrupt Facility operations.

Should the CMSA reject any Delivered loads of Food Waste at the Facility due to the presence of Unacceptable Materials, CMSA shall immediately upon discovery notify the delivery truck driver and the MSS designated representative verbally, identifying CMSA's reason for rejection of the Delivered Food Waste and identifying the specific MSS truck that Delivered the rejected Food Waste, if possible. If CMSA rejects Food Waste Delivered to the Facility per Section 5.02.a, MSS will promptly remove the rejected Food Waste from the Facility at its own expense.

ARTICLE 6. OTHER PROGRAM COMMITMENTS

6.01 Facility Operations.

a. Operating Throughput Commitment. CMSA acknowledges that MSS will need approximately *3* years, beginning in the Spring of 2013, to complete the process of identifying and contracting with Commercial Food Waste Generators, who qualify for inclusion in the Food Waste program. MSS estimates a maximum of fifteen (15) tons of Food Waste per day or seventy-five (75) tons of Food Waste per week (after the required pre-process) once the Food Waste program has been fully implemented.

b. Vehicle Turnaround. CMSA will use Reasonable Best Efforts to allow MSS' vehicles to enter, position their vehicles for dumping, dump their load of Food Waste (including Facility clean up), turnaround and exit the Facility within an average of sixty (60) minutes or less after arriving at the Facility absent vehicle breakdown, driver negligence, lack of cooperation on the part of the driver, or driver parking to use restrooms, telephone or other driver or truck-related issues, and provided that the truck arrives at the Facility during Facility Receiving Hours.

c. Facility Clean-up. MSS will clean and wash down the Facility's Food Waste receiving area after each load of Food Waste is dumped into its underground receiving tank. Upon completion of the dumping and cleaning, all debris and liquid waste that may have spilled during the dumping operation shall be removed and the area left in a clean and orderly state. Washdown water, hoses, brooms, and a dumpster are located at the Facility's Food Waste receiving area and may be used by MSS for Facility clean-up. If MSS fails to clean up its debris and/or liquid waste, CMSA shall be entitled to charge MSS the sum of Fifty Dollars ($50.00) for each delivery that MSS fails to clean-up.

6.02 MSS Program Guarantee.

a. Quantity. MSS shall make Reasonable Business Efforts to deliver to CMSA one hundred percent (100%) of the Food Waste collected from Collectors and Commercial Food Waste Generators, not including loads which may have to be rejected due to the presence of Unacceptable Materials. MSS will not materially reduce the scope of the Food Waste program without the prior written agreement of CMSA, which agreement shall not be unreasonably withheld. The Parties acknowledge that some restaurants or food processors in MSS' Service Area will not participate in the Food Waste program because they are either not interested in participating or are unable to provide Food Waste that meets the required quality specifications.

b. Expansion of Program. MSS further commits to expand its Food Waste collection program by encouraging other Marin County solid waste haulers to collect commercial food waste from their service areas, sharing education materials, and offering to Pre-process their collected Food Waste at the Transfer Station for MSS' Pre-processing and Delivery to the Facility.

c. Permits. MSS will be responsible at its own expense for any and all permits required for the collection, Pre-processing, and delivery of Food Waste to the Facility as well as the disposal of rejected Food Waste and debris and liquid waste spilled during loading into the vehicles, transportation to and dumping at the Facility.

6.03 General Operations.

a. Facility Receiving Hours. Unless otherwise agreed upon by the Parties in advance, CMSA shall receive Food Waste from MSS at the Facility between the hours of 6:00 a.m. and 4:00 p.m. each Monday through Friday, and between the hours of 9:00 a.m. and 12:00 p.m. on Saturdays, excluding Holidays.

b. Notification in Emergency. It is the responsibility of MSS to Notify CMSA of emergencies, and changes in scheduling of the delivery of Food Waste.

c. Scale Operation. The MSS Transfer Station operator will weigh each Food Waste delivery vehicle before and after loading (1) for CMSA billing purposes and (2) to determine the amount of materials received. The scale weight information for each delivery vehicle will be provided to CMSA at the time of each Delivery to the Facility. Upon request, MSS will provide verification that the scales are routinely calibrated and certified by Marin County.

d. Continuous Operations. CMSA shall keep open and operate the Facility continuously and uninterruptedly, during Facility Receiving Hours, except when CMSA is prevented from doing so by any Uncontrollable Circumstance, rejection of Unacceptable Material, performing scheduled maintenance of the Food Waste processing equipment, or if a CMSA digester is out-of-service or has a processing disruption.

e. Traffic Flow. CMSA shall direct traffic upon entry to the Site so that MSS' vehicles travel, queue, unload and exit in a safe manner.

6.04 Pomace and Residual of Digested Food Solids.

a. Pomace. So long as MSS is the only supplier of Food Waste to the Facility, MSS will legally dispose of all Pomace from the Facility processing at its own expense unless otherwise mutually agreed to in writing. CMSA will verbally notify the appropriate MSS

representative that the Facility's Pomace storage container needs to be emptied along with a written reminder sent to the MSS' email address set forth below in Section 12.01.

b. Residual of Digested Food Solids. CMSA at its own expense will dispose of the Residual of Digested Food Solids through compost, alternative daily cover at landfills, land application, landfill direct disposal, or any other disposal/reuse method consistent with CalRecycle guidelines.

6.05 Records and Reports.

a. General Record Keeping. CMSA and MSS shall each maintain such accounting, statistical and other records related to their individual performances under this Agreement as shall be reasonably necessary to develop the reports required by this Agreement. CMSA and MSS agree to receive input from the other if necessary on data collection, information and record keeping, and reporting activities required to comply with Applicable Laws and to meet their reporting and Food Waste program management needs and Applicable Laws.

CMSA and MSS shall maintain records required to conduct their own operations, to support requests either may make of the other, and to respond to reasonable requests for information necessary to conduct of their respective businesses. Adequate record security shall be maintained to preserve records from events that can be reasonably anticipated such as fire, water damage, theft and earthquake. Electronically maintained data/records shall be protected and backed up in order to ensure complete and accurate retrieval of information.

b. Retention of Records. Unless otherwise herein required, CMSA and MSS shall retain all documents required to be maintained by this Agreement for at least five (5) years after the expiration or earlier termination of this Agreement. Alternatively, either Party may send its records and data to the other Party after the normal retention period has expired. Records and data that are specifically directed to be retained shall be made available to either Party upon receipt of a written request.

c. CERCLA Disposal Records. MSS shall maintain, retain and preserve records that can establish where all Pomace was Disposed. This provision shall survive the expiration or earlier termination of this Agreement. MSS shall maintain these records for a minimum of ten (10) years beyond expiration or earlier termination of the Agreement, in an organized and indexed manner, and either in physical (e.g. weigh tickets) and/or electronic form and provide these records to CMSA on a regular basis. Alternatively, MSS shall send these records to CMSA after MSS's normal retention period has expired.

d. Monthly Reports. CMSA will prepare monthly reports that include summaries of dates and tonnage of Food Waste received at the Facility. MSS has the right to receive copies of the Monthly reports as well as monthly information on the location and Disposal of Residual of Digested Food Solids.

e. Annual Report. CMSA shall prepare an Annual Report which shall include the content of the monthly reports and provide summaries as follows: dates and tonnage of Food Waste received at the Facility; records related to energy production; greenhouse gas credit information. MSS shall have the right to request copies of the Annual Report as well as annual information on the location and Disposal of Residual of Digested Food Solids.

f. Report Submittal.

All reports shall be submitted to:

Central Marin Sanitation Agency
Attn: General Manager
1301 Andersen Drive
San Rafael, California 94901

Marin Sanitary Service, Inc.
Attn: Municipal Contracts and Communications Manager
1050 Anderson Drive
San Rafael, CA 94901

6.06 MSS Right to Tour and Inspect Facility.

MSS and its designated representative(s) have the right, to enter, observe and tour the Facility on reasonable notice during Facility Receiving Hours. MSS can also be accompanied on such tours by city council members, regulators, representatives from educational organizations, and public relations or media representatives. MSS and its representatives or guests will comply with CMSA's safety and security rules at all times while on the Facility site.

6.07 CMSA Right to Tour, Inspect and Monitor Transfer Station.

CMSA and its designated representative(s) have the right, to enter, observe, tour, inspect and monitor the Transfer Station and its operations on reasonable notice to MSS Monday through Friday during normal operating hours with legal holidays and weekends excluded. CMSA and its representatives will comply with MSS' safety and security rules at all times while on the Transfer Station site.

6.08 Ongoing Evolution of Program.

Periodically and when necessary during the Term of this Agreement, the Parties will meet to discuss the ongoing evolution of the food waste processing and disposal program. The Parties agree to use good faith efforts to resolve issues that arise based on concerns or impacts identified during the Term of this Agreement.

ARTICLE 7. COMPENSATION

7.01 General.

CMSA's compensation provided for in this Article will be the full, entire and complete compensation due to CMSA pursuant to this Agreement for all labor, equipment, material and supplies, taxes, insurance, bonds, overhead, transport, Acceptance, Processing, Residual of Digested Food Solids Disposal, and all other things necessary to perform the services required by this Agreement in the manner and at the time prescribed. MSS is not obligated to reimburse CMSA for any losses that CMSA may incur due to fluctuations in the costs of processing Food Waste.

7.02 Disposal Fee and Fee Escalation.

Both sides agree to set the Delivery fee at the Facility at $20 per ton of Food Waste for the first year of the term of this Agreement. Such fee shall be subject to adjustment on each anniversary of the Effective Date by the amount of the annual percentage change in the Consumer Price Index, All Urban Consumers, San Francisco-Oakland-San Jose, CA, All Items (1982-1984=100), published by the United States Department of Labor, Bureau of Labor Statistics (the "CPI") for the previous year (using the CPI for the month most recently published for the immediately preceding year as compared with the CPI for the same month of the second preceding year.

7.03 Revenue Sharing.

The Parties agree that CMSA will retain all revenue realized from the sale of electricity generated by the digestion of Food Waste.
The Parties acknowledge that a potential revenue stream exists in the sale of both Green House Gas Offsets (Credits) and Renewable Energy Certificates (RECs), or other future instruments that attach monetary value to the capture of Green House Gas, or the generation of renewable energy, as a result of the digestion of Food Waste. The Parties also acknowledge that there will be costs associated with pursuing Credits, RECs, or other future instruments. The Parties' intent is to find a way to equitably share revenue created from the processing of the Food Waste received from MSS. CMSA reserves the right to determine whether to pursue Credits, RECs or future instruments associated with that Food Waste and agrees to notify MSS in writing at the time it initiates actions to pursue those Credits, RECs, or future instruments. At that time, the Parties will meet to:

a. Determine revenue potential for Credits, RECs, or future instruments, based on factors such as current market value and market trends; and

b. Agree on cost factors, such as validation, administration, operating, and other potential costs.

c. Agree on allocation of costs and potential revenue.

These meetings will be held in a spirit of cooperation. At the time that these actions are completed, this Section 7.03 will be revised. Once the Parties agree on revenue potential and cost and revenue allocation, the allocation will retroactively apply to any applicable revenue received and costs incurred by CMSA from the date CMSA first notifies MSS that it is initiating the pursuit of Credits, RECs or future instruments associated with Food Waste received from MSS. If the Parties are unable to reach agreement on (a) through (c), the Parties agree to mediate the dispute. If the Parties are unable to reach agreement after mediation, either Party may terminate this Agreement upon ninety (90) days' written notice to the other Party. MSS acknowledges that by entering into this Agreement, it does not obtain any right to or interest in any Credits, RECs or future instruments created from anything other than Food Waste delivered, received and processed by CMSA pursuant to this Agreement.

ARTICLE 8. INSURANCE

8.01 Insurance Requirements.

a. Insurance. Each Party shall purchase and maintain, in full force and effect during the term of this Agreement adequate insurance that shall be no less than the types and amounts of insurance coverage listed below. Each Party's insurers must provide the other Party with thirty (30) calendar days' Notice of any cancellation or reduction in coverage and name the other Party, and its Board of Commissioners or Directors and its employees as additional insureds. Each Party, for itself and its Collectors and contractors, shall supply certificates of insurance and additional insured endorsement to the other Party showing compliance with this Article 8 prior to the delivery of any Food Waste to the Facility. The terms and obligations of this Article shall survive termination of this Agreement.

b. Workers' Compensation Insurance. Each Party shall purchase and maintain during the term of this Agreement, Workers' Compensation and Employer's Liability insurance policy for all of its employees working on this project. Each Party shall ensure that its Collectors and contractors performing any work pursuant to this Agreement for such Party shall procure and maintain at all times during this Agreement, Workers' Compensation and Employer's Liability insurance.

c. Comprehensive General Liability Insurance. Each Party shall purchase and maintain during the term of this Agreement Comprehensive General Liability insurance policy in the amount of one million dollars ($1,000,000) for combined single limit coverage for bodily injury, personal injury and property damage. Each Party shall ensure that its Collectors and contractors performing any work pursuant to this Agreement for such Party shall procure and maintain at all times during the term of this Agreement, General Liability insurance that meets or exceeds the requirements of this Agreement.

The following coverages or endorsements must be indicated on the certificate:

(1) The other Party, its Commissioners or Directors, officers and employees are named as additional insureds in the policy;

(2) The coverage is primary to any other insurance carried by the other Party;

(3) The policy covers contractual liability for the assumption of liability of others;

(4) The policy is written on an occurrence basis;

(5) The policy covers broad form property damage liability

(6) The policy covers personal injury (libel, slander, and trespass) liability;

(7) The policy will not be canceled nor reduced without thirty (30) days' written notice to the other Party.

(8) The policy(ies) cover(s) products and completed operations.

e. Automobile Liability Insurance. Each Party shall purchase and maintain Automobile Liability insurance policy shall apply to all owned, hired and non-owned autos, vehicles and trailers. The limits of liability shall not be less than $1,000,000 combined single limit each accident for bodily injury and property damage. Each Party shall ensure that its Collectors and contractors performing any work pursuant to this Agreement for such Party shall procure and maintain at all times during the term of this Agreement, Automobile Liability insurance that meets or exceeds the requirements of this Agreement.

f. Pollution Liability Insurance. Each Party shall purchase and maintain a Pollution Liability insurance policy with limits not less than $1,000,000 per occurrence and in the aggregate for bodily injury and property damage. Each Party shall ensure that its Collectors and contractors performing any work pursuant to this Agreement for such Party shall procure and maintain at all times during the term of this Agreement, Pollution Liability insurance that meets or exceeds the requirements of this Agreement.

g. Amounts of Insurance. The amounts of insurance shall not be less than the following:

General Liability – one million dollars ($1,000,000) per occurrence

Auto Liability – one million dollars ($1,000,000) per occurrence

Worker's Compensation – State statutory limit

Pollution Liability – one million dollars ($1,000,000) per occurrence

ARTICLE 9. INDEMNITY

9.01 MSS Indemnification.

MSS, to the greatest extent allowed by Applicable Law, will protect, hold free and harmless, defend and indemnify CMSA, including its Board of Commissioners, individual commissioners, employees, consultants and agents (collectively "indemnitees" or individually "indemnitee") from all liabilities, penalties, costs, losses, damages, expenses, causes of action, claims or judgments, including reasonable attorney's fees, resulting from injury to or death sustained by any person (including MSS' or its subcontractors' employees) or damage to property of any kind, which injury, death or damage arises out of or is in any way connected with MSS', its Collectors' or its contractors' performance of any part of this Agreement. MSS' aforesaid indemnity, defense and save harmless agreement shall apply to any acts or omissions, or negligent conduct, whether active or passive, on the part of one or more of the indemnitees, except that said obligation of indemnity and hold harmless of an indemnitee shall not be applicable to injury, death or damage to property arising from the sole negligence or willful misconduct of that specific indemnitee. This indemnification, defense and hold harmless obligation shall extend to claims asserted after expiration or earlier termination, for whatever reason, of this Agreement.

9.02 CMSA Indemnification.

CMSA, to the greatest extent allowed by Applicable Law, will protect, hold free and harmless, defend and indemnify MSS, its Board of Directors, individual Directors, officers and employees (collectively "indemnitees" or individually "indemnitee") from all liabilities, penalties, costs, losses, damages, expenses, causes of action, claims or judgments, including reasonable attorney's fees, resulting from injury to or death sustained by any person (including CMSA's employees) or damage to property of any kind, which injury, death or damage arises out of or is in any way connected with CMSA's or its contractors' performance of any part of this Agreement. CMSA's aforesaid indemnity, defense and save harmless agreement shall apply to any acts or omissions, or negligent conduct, whether active or passive, on the part of one or more of the indemnitees,except that said obligation of indemnity and hold harmless of an indemnitee shall not be applicable to injury, death or damage to property arising from the sole negligence or willful misconduct of that specific indemnitee. This indemnification, defense and hold harmless obligation shall extend to claims asserted after expiration or earlier termination, for whatever reason, of this Agreement.

ARTICLE 10. BREACHES, DEFAULTS, MEET AND CONFER

10.01 Breaches.

a. Definition. A breach is a material failure to perform any of the material obligations set forth in this Agreement.

b. Notice of Breach. Either Party shall promptly Notify the other Party regarding the occurrence of a breach as soon as such breach becomes known to the Noticing Party. Such Notice shall be given in writing.

c. Cure of Breach. Each of MSS and CMSA shall begin cure of any breach that it commits as soon as possible after it becomes aware of its breach. Upon receiving written Notice of a breach, the breaching Party shall proceed to cure such breach as follows:

(1) Immediately, if the breach is such that in the determination of either CMSA or MSS, the health, welfare or safety of the public is endangered thereby, unless immediate cure is impossible, in which event the Party required to cure shall Notify the other Party, and the other Party may seek substitute services.

(2) Within thirty (30) calendar days of receiving Notice of the breach; provided that if the nature of the breach is such that it will reasonably require more than thirty (30) calendar days to cure, the breaching Party shall not be in default so long as it promptly commences to cure its breach, secures written agreement from the other Party to extend the thirty (30) calendar day cure period (which the other Party shall not unreasonably refuse), and provides the other Party, no less than weekly, written status of progress in curing such breach, and diligently proceeds to complete same.

10.02 Default.

a. **Events of CMSA Default**. Each of the following shall constitute an event of default by CMSA.

(1) **Uncured Breach of Agreement**. CMSA fails to cure any breach as specified in Section 10.01.

(2) **Repeated Pattern of the same Breaches**. CMSA commits the same breach at least three (3) times during any twelve-month period during the term of this Agreement.

b. Notice of Default. CMSA shall be in default from the date of receipt of a Notice from the MSS identifying such default.

c. Events of MSS Default. Each of the following shall constitute an event of default by MSS.

(1) Uncured Breach of Agreement. MSS fails to cure any breach as specified in Section 10.01.

(2) Repeated Pattern of Breaches. MSS commits the same breach at least three (3) times during any twelve-month period during the term of this Agreement.

d. Notice of Default. MSS shall be in default from the date of receipt of a Notice from CMSA identifying such default.

10.03 Request to Meet and Confer.

If any breach occurs that materially affects this Agreement or a Party's ability to perform under this Agreement or a change in Applicable law that affects either Party's ability to receive diversion credits under AB 939, either Party shall send Notice to the other Party describing the problem and requesting a meet and confer meeting. The Parties may choose to meet in person or by teleconference. The meet and confer process is intended to be a prerequisite to sending a Notice of Breach.

If either Party does not agree to meet and confer, does not appear at the meet and confer meeting, or if the Parties are not able to correct the breach or solve the problem resulting from a change in the Applicable Law within a reasonable period of time not to exceed thirty (30) days after the meet and confer, unless the time period is extended by mutual agreement, the aggrieved Party may send a Notice of Breach.
Notwithstanding the above, there is no requirement that the meet and confer process be used for a failure to pay, or for emergencies or urgent matters of public health.

10.04. Remedy for Breach, Other Remedies.

The Parties shall be entitled to all available monetary or equitable remedies, including specific performance and injunctive relief.

a. MSS Remedies in the Event of CMSA Default. Upon CMSA's failure to cure a breach pursuant to Section 10.01 or default pursuant to Section 10.02, MSS shall, in addition to its right to collect monetary damages, have the following rights:

(1) Waive Default. To, at its sole discretion, waive the CMSA breach or default in writing.

(2) Termination. Terminate the Agreement in accordance with Article 11, provided that no termination shall be effective until MSS has given written Notice to CMSA of its decision to terminate the Agreement.

(3) All Other Available Remedies. In addition to, or in lieu of termination, to exercise all of its remedies in accordance with this Article and any other remedies at law and in equity, to which MSS shall be entitled, according to proof.

(4) Damages Survive. If CMSA owes any damages upon MSS's termination of this Agreement, CMSA's liability under this Section 10.03 shall survive termination.

b. CMSA Remedies in the Event of MSS Default. Upon MSS' failure to cure a = breach pursuant to Section 10.01 or default pursuant to Section 10.02, CMSA shall, in addition to its right to collect monetary damages, have the following rights:

(1) Waive Default. To, at its sole discretion, waive the MSS breach or default in writing.

(2) Termination. Terminate the Agreement in accordance with Article 11, provided that no termination shall be effective until CMSA shall have given written Notice to MSS of its decision to terminate the Agreement.

(3) All Other Available Remedies. In addition to, or in lieu of termination, to exercise all of its remedies in accordance with this Article and any other remedies at law and in equity, to which CMSA shall be entitled, according to proof.

(4) Damages Survive. If MSS owes any damages upon CMSA's termination of this Agreement, MSS's liability under this Section 10.03 shall survive termination.

10.05 Substitute Services.

In addition to exercising any or all remedies specified in Section 10.04 with regard to the other Party's failure to cure its breach or its default, or due to an Uncontrollable Circumstance, the first Party may at its sole discretion seek substitute services.

10.06 Waiver.

A waiver by one Party of one breach or default by the other Party shall not be deemed to be a waiver of any other breach or default by that Party, including ones with respect to the same obligations hereunder, and including new incidents of the same breach or default. The subsequent acceptance of any damages or other money paid hereunder shall not be deemed to be a waiver of any pre-existing or concurrent breach or default.

10.07 Determination of Remedy or Cure of Breach or Default.

Upon request of either Party, an event of breach or default shall be considered remedied or cured upon signature by both Parties of a written agreement specifying the event and stating that remedy and/or cure of such event has been completed.

10.08 Uncontrollable Circumstances.

a. Performance Excused. Neither Party shall be in breach of its obligations hereunder in the event, and for so long as, it is impossible or extremely impracticable for it to perform such obligations due to an Uncontrollable Circumstance if such Party exerted Reasonable Business Efforts to prevent such Uncontrollable Circumstance, and such Party expeditiously takes all actions within its control to end, or to ameliorate the effects of such Uncontrollable Circumstance as soon as possible.

b. Notice. The Party claiming excuse from performance of its obligations based on an Uncontrollable Circumstance shall Notify the other Party as soon as is reasonably possible, but in no event later than three (3) working days after the occurrence of the event constituting the Uncontrollable Circumstance. The Notice shall include a description of the event, the nature of the obligations for which the Party claiming Uncontrollable Circumstance seeks excuse from performance, the expected duration of the inability to perform and proposed mitigation measures.

ARTICLE 11. TERMINATION

11.01 Parties' Right to Suspend or Terminate.

a. Suspension. Either Party shall have the right to suspend this Agreement, in whole or in part, upon the occurrence of a default under Article 10 regarding an occurrence that endangers public health, welfare or safety, provided such suspension is for no longer than forty-five (45) calendar days.

b. Termination. The Parties shall have the rights to terminate this Agreement if one or more of the following events occur:

(1) Default. Occurrence of a default, or a breach which is not cured within the time frame specified, as set forth in Article 10.

(2) Criminal Activity. Either Party may terminate this Agreement if the other Party is found guilty of criminal conduct. The term "found guilty" shall be deemed to include any judicial determination that the Party or any of the Party's officers, directors, commissioners or employees is guilty, including any admission of guilt, including, but not limited to, the pleas of "guilty," "nolo contendere," "no contest," or "guilty to a lesser crime" entered as part of any plea bargain.

(3) Facility Damage or Destruction. Either Party may terminate this Agreement in the event the Facility or the Transfer Station is totally destroyed or is materially damaged and CMSA or MSS, as the case may be, either is unable to reconstruct or repair the Facility or Transfer Station or its Board of Commissioners or Directors decides it is not financially feasible to reconstruct or repair the Facility or Transfer Station.

(4) Exceedance of Disposal Fee Cap. CMSA shall have the right to terminate this Agreement if it determines after the third year of this Agreement that a Delivery fee greater than the then current fee is warranted and MSS is unwilling to pay that amount (per Section 7.02), subject only to CMSA's submitting the dispute over the Delivery fee increase to mediation prior to termination.

(5) Failure to Agree on Revenue Sharing. If the Parties do not come to agreement regarding the sharing of revenue as discussed in Section 7.03, either Party may terminate this Agreement. Notice of termination shall be effective thirty (30) calendar days thereafter; provided that such Notice shall be effective immediately if the public health or welfare is threatened.

c. Payments Upon Termination. Upon termination, CMSA shall accept as full payment for services rendered to the date of termination any payments required based on the portion of work actually performed. If MSS has made any payment for services that have not been performed, then CMSA shall promptly repay to MSS that amount.

ARTICLE 12. OTHER PROVISIONS

12.01 Notices.

Except as otherwise specified in this Agreement, all Notices, requests, acknowledgements, approvals, and other communications made hereunder to be sent pursuant to this Agreement shall be made in writing, and sent to the Parties at their respective addresses specified below or to such other address as a Party may designate by written notice delivered to the other parties in accordance with this Section. All such notices shall be sent by either: (i) personal delivery, in which case notice is effective upon delivery; (ii) certified or registered mail, return receipt requested, in which case notice shall be deemed delivered on receipt if delivery is confirmed by a return receipt; (iii) nationally recognized overnight courier, with charges prepaid or charged to the sender's account, in which case notice is effective on delivery if delivery is confirmed by the delivery service; (iv) facsimile transmission, in which case notice shall be deemed delivered upon transmittal, provided that (a) a duplicate copy of the notice is promptly delivered by first-class or certified mail or by overnight delivery, or (b) a transmission report is generated reflecting the accurate transmission thereof. Any notice given by facsimile shall be considered to have been received on the next business day if it is received after 5:00 p.m. or on a non-business day.

If to MSS:

MSS President
Attn: Patty Garbarino
1050 Anderson Drive
San Rafael, California 94901
Telephone: (415)
Fax: (415)
Email: Patty.Garbarino@marinsanitary.com

If to CMSA:

CMSA General Manager
Attn: Jason Dow
1301 Andersen Drive
San Rafael, California 94901
Telephone: (415) 459-1455
Fax: (415) 459-3971
Email: jdow@cmsa.us

12.02 Authorized Representatives.

a. MSS. For purposes of this Agreement, the MSS authorized representative will be its Compliance Manager or her/his designee.

b. CMSA. For purposes of this Agreement, CMSA's authorized representative will be its General Manager or her/his designee.

12.03 Assignment.

Neither Party may assign its rights or responsibilities under this Agreement to any other Person without the consent of the other Party, which consent will not be unreasonably withheld.

12.04 Conflicting Provisions.

In the event the provisions of this Agreement herein conflict with those of the Exhibits hereto, the provisions of this Agreement shall prevail.

12.05 Governing Law.

This Agreement shall be governed by, and construed and enforced in accordance with, the internal laws of the State of California, irrespective of choice of law principles.

12.06 Amendments.

The Parties may change, modify, supplement, or amend this Agreement only upon mutual written agreement duly authorized and executed by both Parties.

12.07 Venue; Attorneys' Fees.

The exclusive venue for any legal proceedings shall be Marin County, or, in case of federal jurisdiction, Federal District Court, Northern District. The prevailing Party in any dispute arising under or in connection with this Agreement shall be entitled to recover its reasonable attorneys' fees and costs from the other Party.

12.08 Entire Agreement.

This Agreement contains the entire Agreement between the Parties with respect to the transactions contemplated hereby. All Exhibits are hereby incorporated into this Agreement by reference. This Agreement shall completely and fully supersede all prior understandings and agreements between the Parties with respect to such transactions. However, nothing in this paragraph shall supersede or diminish the representations and warranties as contained in Article 2. This Agreement shall not be interpreted for or against either Party, it having been prepared with the participation of both Parties.

12.09 Savings Clause.

If any phrase, clause, section, subsection, paragraph, subdivision, sentence, term, or provision of this Agreement, or the application of any term or provision of this Agreement to a particular situation, is finally found to be void, invalid, illegal, or unenforceable by a court of competent jurisdiction, then notwithstanding such determination, such term or provision will remain in force and effect to the extent allowed by such ruling and all other terms and provisions of this Agreement or the application of this Agreement to other situations will remain in full force and effect.

IN WITNESS WHEREOF, the PARTIES hereto have Executed this Agreement on the date first above written.

Marin Sanitary Service, Inc.

Patricia Garbarino

MSS President

18 May 13

Date

ATTEST:

Marcia Tarbell

MSS Secretary

5/20/13

Date

Central Marin Sanitation Agency

CMSA Board Chair

5/15/2013

Date

ATTEST:

CMSA Board Secretary

5/15/13

Date

Exhibit A
MSS Participant Assessment & Contamination Control Procedures for Food Waste Delivered to CMSA

Participant Assessment:

1) Potential participants for the food waste program include restaurants, assisted living facilities, grocery stores, schools, hospitals, and any other business or institutional facility that has food service.
2) Participants will be prescreened by MSS staff prior to enrollment. Management control over kitchen staff will be assessed and is key to the success of the program.

Program Requirements:

1) Source separation is required. Program participants will be required to separate acceptable food waste from non-acceptable materials and place the acceptable materials in designated containers. The ideal candidate for the program will have significant pre-served food waste available for collection and may be permitted to include post consumer food waste if adequate practices are established to control contamination.
    a. Acceptable food waste includes: Fruits, Vegetables, Meat, Seafood, Small Bones, Dairy, Eggs, Breads, Pastas, Sauces, Cooking Oil, Grease, Tea Bags, Coffee Grounds and Paper Filters.
2) Zero Tolerance Rule for Contamination. The program will clearly establish zero tolerance for any unacceptable waste materials. Unacceptable waste materials considered contamination by this program includes:, Styrofoam, all plastics including bags, glass, metal, liquids, paper, cardboard, wood, yard waste, and all other non-food waste materials.
3) Once the commercial entity has proven its ability to consistently deliver clean pre-consumer food scraps, the method of handling post-served/post-consumer food scraps will be reviewed to determine if this material can be included in the collection program..

Training:

Training will be conducted for all kitchen staff describing participation procedures, acceptable food scrap materials, and zero tolerance for contamination.

1) Training will be conducted in the predominant language spoken by kitchen staff.
2) Once participation has started, follow-up visits will be scheduled at regular intervals to fewer than three per year.
3) If deficiencies are noted, retraining of kitchen and management staff will be conducted by MSS.

Containers/Signage and Training Materials:

Each participant will receive the following program materials and services:

1) An appropriate number of 23 gallon “Slim Jim” collection containers for indoor use.

2) Clearly labeled curbside collection containers (32 and/or 64 gallon carts or 1-2 yard boxes) for outdoor storage of food scraps.
3) Outreach and training materials to instruct staff in proper participation procedures and maintain awareness:
    a. 11" x 17" posters displaying approved and prohibited food scraps for placement on walls.
    b. 8" x 11" signs displaying approved and prohibited food scraps for placement on walls or collection containers.
    c. 5" x 10" “bumper sticker” signage for differentiating food collection containers from refuse containers.
    d. Participation decal to display for public awareness.

Signs will be distributed in sufficient numbers to serve needs of new participants. Additional posters and signs will be provided upon request.

Oversight:

1) MSS Driver may check contents of collection carts regularly. In instances where contaminants are detected, food scraps will be left uncollected and a notice of non-collection left on the cart. The restaurant name and date will be recorded for follow-up by route supervisor/outreach coordinator.
2) Outreach staff may conduct spot checks of participants to assess participation, sufficient number of collection containers, fill levels of containers, and contamination. Outreach staff may use these spot check opportunities to update restaurants on procedural changes or other important information.
3) Repeated contamination incidents and/or or inability by management to correct the identified problem(s) may result in removal from program and a charge to have the contaminated materials removed.

Exhibit B
Food Waste Participant Agreement

Thank you for your interest in participating in the Commercial Food to Energy (F2E) Program. Participation in this program requires consistent effort and a dedicated team. You must meet the following criteria to participate in this program.

Program Requirements:

1. Source separation of food waste is required. Program participants will be required to separate acceptable food waste from non-acceptable materials and place the acceptable materials in designated containers.
    a. Acceptable food waste includes: Fruits, Vegetables, Meat, Seafood, Small Bones, Dairy, Eggs, Breads, Pastas, Sauces, Cooking Oil, Grease, Tea Bags, Coffee Grounds and Paper Filters.
2. Zero Tolerance Rule for Contamination. Curbside F2E containers must be free of ALL contamination.
    a. Unacceptable waste materials considered contamination by this program includes:, Styrofoam, all plastics including bags, glass, metal, liquids, paper, cardboard, wood, yard waste, and all other non food waste materials.
3. Training of all kitchen staff and others who handle food waste trained on collection policies and procedures.

Marin Sanitary Service will provide the following:

1. Green carts and/or dumpsters to meet your food waste volume needs.
2. Education and training of staff.
3. Outreach materials including signs, posters, stickers, etc.
4. On-site assessment of your food waste and recycling practices.
5. Feedback to improve your program including recommendations for service levels and cart needs.

The undersigned has read, understands and agrees to the terms and conditions in this program as detailed in this agreement and in the attached Participant Assessment and Contamination Controls procedure.

_____	_____
Name of participating entity	For Marin Sanitary Service, Inc.
_____	_____
Printed name of person responsible for the program	Contact information: Email and Phone#
_____	_____
Signature	Date

Please mail, fax or scan and email this agreement to:

Kim Scheibly: Contracts and Communications Manager
Marin Sanitary Service, Inc.
1050 Andersen Drive,San Rafael, CA 94901
Fax: (415) 451-4741
Email: kim.scheibly@marinsanitary.com

Exhibit C
Marin Sanitary Service & CMSA Service Areas

Appendix 5C

CMSA RISK ANALYSIS

CMSA FOG STATION EQUIPMENT FUNCTION AND RISK

Equipment name:	Equipment function:	Possible options if equipment is out of service. CMSA Operation Department will review and make this to SOP, in case the equipment is out of service.	Can CMSA staff operate the FOG station without this equipment for 72 hours (YES / NO): Please explain why. Comments from team:	Consequences if equipment is out of service (other than increase staff time to operate)	Recommend having Spare Parts onsite?	Typical delivery time from purchase to shipment:	What spare parts we have onsite, provided by the Digester Contract Requirements?	Purchasing additional spare parts?
pH Meter	Measure the PH value, and if the PH is out of range, SCADA will close the FOG receiving MOV valve (MOV 21.4).	The pH meter will be bypassed, and will not affect the FOG receiving MOV. If there is programming issue, operator will operate the FOG Station MOV valve from SCADA or locally. pH value will be checked manually by collecting sample from a discharge port.	YES. The pH meter will be bypassed.	Will not be continuously measuring the received FOG pH value.	No There is little to no impact if equipment is out of service, with the temporary solution in place.	1 weeks	NONE.	
MOVs	Motor Operated Valve (MOV) open or close a valve using electricity power. There are total of 5 MOVs installed at the FOG station and are sized 6-inches or less. MOV 21.1 is a digester sludge dilution valve to the slurry tank MOV 21.2 is a digester sludge recirculation pump's isolation valve MOV21.3 is a reclaimed water dilution valve to the slurry tank. MOV 21.4 is to let FOG delivery truck to dispose FOG waste to the FOG pit. MOV 21.5 is a chlorine spray nozzles isolation valve for slurry tank odor control.	Operators can open or to close the MOV using the attached handle. Manually operating the valve will put the FOG station operation in manual mode in SCADA. If the MOV cannot be replaced for a longer duration period of time and opening / closing the valve using the attached handle were too troublesome (because of the MOV gear reducer), CMSA maintenance department can replace the MOV with a manual hand wheel. Operation will run the FOG station equipment manual mode in SCADA if the MOVs are not in service.	YES. Staff will open or close the valve manually.	FOG station equipment will operate in manual mode from SCADA.	No Although Al suggested having 1 or 2 on shelf. Team discussed this, and verified that typically, we have the spare plug valve in stock, just not the MOV. Based on operation record, chance of MOV failure is very rare.		NONE	
Card Reader	Activating the card reader by the FOG truck driver will automatically open the MOV 21.4 by SCADA, and record the time that FOG truck driver has disposed FOG waste into the slurry tank. The volume will be calculated by the slurry tank level sensor.	CMSA operation staff will manually record the FOG drivers' information, time of arrival, and FOG truck tank volume information.	YES. Staff will record FOG truck drivers' info, time of arrival, and FOG truck tank volume.	None.	No Al suggested having 1 because it may affect billing. We currently have spare in stock because we are using card reader at 4 other locations throughout the plant.		Card reader.	
Odor Control Scrubber (OSC 21.1)	To prevent odor emissions from the slurry tank.	Use chlorine spray nozzles inside the slurry tank to reduce odor emissions. Paddle finisher waste bin to be emptied more often.	YES. Odor control scrubber will not affect receiving and processing the FOG or the food waste.	Potential increase odor emissions at the FOG station.	No Al suggested having 1 change of media on site. Team discussed this and suggested that odor mister can be used during the period that the odor control scrubber is out of service.	Motor: estimated Activated carbon media:	NONE	
Slurry tank level transmitter	Control mixing pump and paddle finisher feed pump start and stop when food waste / FOG are received. Calculate the received FOG volume.	CMSA operation staff will record the FOG drivers' information, time of arrival, and FOG truck tank volume information. CMSA operation staff will operate the FOG station by putting the mixing pumps and the paddle finisher feed pump in hand.	YES. FOG station will operate in manual mode from SCADA.	None.	No Al pointed out that running the equipment in hand may shorten life of equipment if unable to shut down equipment in reasonable time.	6-8 weeks	NONE	

CMSA FOG STATION EQUIPMENT FUNCTION AND RISK

Equipment name:	Equipment function:	Possible options if equipment is out of service. CMSA Operation Department will review and make this to SOP, in case the equipment is out of service.	Can CMSA staff operate the FOG station without this equipment for 72 hours (YES / NO): Please explain why. Comments from team:	Consequences if equipment is out of service (other than increase staff time to operate)	Recommend having Spare Parts onsite?	Typical delivery time from purchase to shipment:	What spare parts we have onsite, provided by the Digester Contract Requirements?	Purchasing additional spare parts?
					Team discussed this and reported the chance that level sensor will fail are rare and the consequences are none.			
Paddle Finisher	The paddle finisher is designed to screen the food waste slurry and remove the unwanted materials that could clog downstream equipment. The paddle finisher screens are 3/8-inch in diameter. According to K/J design document, paddle finisher does not need to operate when FOG only is in the Slurry Tank, and based on the operating experience, if the food waste stream from MSS is free from waste products, it's possible that the paddle finisher may not be routinely needed to screen the food waste slurry.	Increase mixing the slurry tank, using the FOG/F2E Mixing Pumps. These pumps are designed to chop as it pumps, keeping oversized solids and stringy material from clogging downstream process. Heavier size material may be screened off from the Rock Trap Grinder (RTG 21.1).	YES. Depending on the received food waste quality, according to K/J design intent, paddle finisher can be out of service, if it is not causing downstream equipment to clog (i.e. digester centrifuge feed pump), paddle finisher can be out of service during the repair period.	CMSA operation staff may not able to screen out the unwanted materials from the food waste slurry. Al suggested having a rebuild kit on the shelf.	No Teams discussed this and reviewed the contingency plan and post no concern without spare parts onsite because MSS will sort out and chop off heavier food waste, and the received FOG will be screened by the heavy object trap. The mixing pump and the rock trap grinder will further break down the slurry.		- SPARE HOSES - LUBRICANT REFILLS	
Sludge Recirculation Pump P21.4	Sludge Recirculation Pump is to minimize the potential for solids deposition in the piping while maintaining a minimum velocity of 3 feet per second, which is approximately 300 gpm, circulating the sludge and pumping the waste slurry to the online digester.	Use the Hose pump (positive displacement pump) to pump the waste slurry directly to the online digester.	YES. Team discussed this and agreed with the using the hose pump will able to pump out the waste slurry to the digester. Operation staff will verify.	The waste slurry's solid concentration may vary without the sludge recirculation pump to assist. If the waste slurry's solid concentration is too thick, it may cause the hose pump fail to pump. Additional sludge/3W could be added to dilute the slurry.	NO Maintenance staff, Abel, believe that we can get the spare parts the local vendor, and able to rebuild the pump quickly, as we are using similar type of pump at other location.	-	- IMPELLER - CUTTER BAR OR CUTTER PLATE - SET OF IMPELLER FASTENING HARDWARE - CUTTER BAR SHIMS OR CUTTER POLATE - SHAFT SLEEVE - CARTRIDGE CAP - THRUST BEARING TOOL - UPPER CUTTER TOOL - LIP SEAL TOOL - SET ALLTHREAD W/ NUTS AND WASHERS	-
Sump pumps	The sump pump is designed to remove any drainage from the lower equipment area and rainwater. The pumps discharge to the Slurry Tank.	Use portable sump pump if the sump pumps are out of service.	YES. Use portable sump pump for keeping the FOG equipment area dry.	None.	NO There is little to no impact if equipment is out of service, with the temporary solution in place.		NONE	
Equipment Area Exhaust Fan	The exhaust fan is to minimize the potential for harmful gases to accumulate in the lower equipment area.	Use portable fan if the exhaust fan is out of service.	YES. Use portable exhaust fan if the permanent exhaust fan is out of service.	None.	No. There is little to no impact if equipment is out of service, with the		NONE	

CMSA FOG STATION EQUIPMENT FUNCTION AND RISK

Equipment name:	Equipment function:	Possible options if equipment is out of service. CMSA Operation Department will review and make this to SOP, in case the equipment is out of service.	Can CMSA staff operate the FOG station without this equipment for 72 hours (YES / NO): Please explain why. Comments from team:	Consequences if equipment is out of service (other than increase staff time to operate)	Recommend having Spare Parts onsite?	Typical delivery time from purchase to shipment:	What spare parts we have onsite, provided by the Digester Contract Requirements?	Purchasing additional spare parts?
					temporary solution in place.			
FOG/F2E Mixing Pumps	The mixing system was designed with the corner nozzles and waste mixing nozzles keeping the material away from collecting in dead zones. These pumps are designed to chop as it pumps, keeping oversized solids and stringy material from clogging downstream process.	Using 1 mixing pump and mix the slurry tank in longer period for flow circulation. Either common the mixing nozzle or adjust the nozzle location for keeping the slurry waste material away from collecting in dead zones.	YES. Lead operator reported that the texture of the recent received food waste is watery and will able to mix well with only one pump in service.	Potential decease the slurry tank's mixing performance.	No. FOG or waste slurry will able to mix using one pump. Al suggested that we should have a 2nd pump available just in case they both out of service. Team discussed this, and agreed that we will not consider two failures happen at the same time.		-SET OF PUMP BEARINGS	
Rock Trap Grinder RTG21.1	Rock Trap Grinder will let rocks and gravel to drop out, and will use the grinder cutter to shred any larger size solids. RTG21.1 will start and stop based on the operation of Paddle Finisher Feed Pump P21.3.	Increase mixing the slurry tank, using the FOG/F2E Mixing Pumps. These pumps are designed to chop as it pumps, keeping oversized solids and stringy material from clogging downstream process. Paddle Finisher Feed Pump (Hose pump P21.3) may be able to operate without the rock trap grinder in service, unless material had plugged the rock trap grinder.	YES. Mixing waste slurry longer will shred the waste in smaller size, and the paddle finisher will capture the remaining unwanted waste. There is a concern of the risk of damaging the paddle finisher feed pump (P21.3) and the paddle finisher, if the rock trap grinder is not in service. It's recommended to have the spare parts onsite to rebuild.	There is risk of damaging the paddle finisher feed pump (P21.3) and the paddle finisher, if the rock trap grinder is not in service.	YES. Protect downstream equipment.		- SEAL ASSEMBLIES - BEARING ASSEMBLIES - GASKETS - CUTTER HEAD TENSIONING DEVICES (WAITING FOR GSE TO PORIVDE) - COMPLETE CUTTING SURFACES	
Paddle Finisher Feed Pump (Hose Pump P21.3)	Paddle Finisher Feed Pump P21.3 operates will intake the waste slurry material from the slurry tank, sending it to the Paddle Finisher, and discharge it back to the paddle finisher wet well. When the paddle finisher	Option 1: Operator will open the manual (normally close) isolation valve so that the FOG/F2E feed pump (Hose Pump P21.5) can take the waste slurry from the slurry tank to the paddle finisher. When the paddle finisher wet well is full and spill over back to slurry tank. Operator will shut off the paddle finisher, and close the manual isolation valve back to normal, and serve it as an FOG/F2E feed pump. The paddle finisher wet well volume is approximately 1180 gallon (size 8'x4'x5'), assuming the hose pump feed rate is 60 gallon per minute; operator will have to switch the isolation valve manually and	YES. Options are available to bypass the out of service pump. Al suggested having a rebuild kit on shelf. Team discussed this, and suggested that this is a critical item because it will be too troublesome if the pump is out of service, as changing hose,	Option 1: Require close to a full time operator staff to be staged at the FOG Station during the period slurry tank is being empty. Option2: unable to screen the unwanted materials from the food waste slurry. Potential slurry waste material with size bigger than 3/8" in diameter may be sent to	YES. Require too much staff time to run the FOG station if the hose pump is out of service.	-	- HOSES - LUBRICANT REFILLS	-

Equipment name:	Equipment function:	Possible options if equipment is out of service. CMSA Operation Department will review and make this to SOP, in case the equipment is out of service.	Can CMSA staff operate the FOG station without this equipment for 72 hours (YES / NO): Please explain why. Comments from team:	Consequences if equipment is out of service (other than increase staff time to operate)	Recommend having Spare Parts onsite?	Typical delivery time from purchase to shipment:	What spare parts we have onsite, provided by the Digester Contract Requirements?	Purchasing additional spare parts?
		turning on/off the paddle finisher approximately once every 20 minutes. Option 2: Increase mixing the slurry tank, using the FOG/F2E Mixing Pumps. These pumps are designed to chop as it pumps, keeping oversized solids and stringy material from clogging downstream process. Bypass the paddle finisher.	coolant, and wear shoes can be done in few hours.	the digester, and clog the downstream equipment.				
FOG/F2E Feed Pump (Hose Pump P21.5)	FOG or food waste slurry is fed to the digesters using FOG/F2E Feed Pump P21.5	Option 1: Operator will open the manual (normally close) isolation valve so that the Paddle finisher feed pump (Hose Pump P21.3) can take the waste slurry from the paddle finisher wet well to the Digester feed pipe. When the paddle finisher wet well is empty, operator will close the isolation valve and run the paddle finisher until the paddle finisher wet well is full again. The paddle finisher wet well volume is approximately 1180 gallon (size 8'x4'x5'), assuming the hose pump feed rate is 60 gallon per minute; operator will have to switch the isolation valve, turning on/off the paddle finisher manually approximately once every 20 minutes. Option 2: Increase mixing the slurry tank, using the FOG/F2E Mixing Pumps. These pumps are designed to chop as it pumps, keeping oversized solids and stringy material from clogging downstream process. Calculate the received FOG or food waste volume. Run the paddle finisher and let the paddle finisher to spill over to the slurry tank. Pump the waste slurry using the sludge recirculation pump (P21.5) to empty the slurry tank, upon having at least one turnaround by the paddle finisher, and continue mixing the slurry tank by the FOG/F2E mixing pump.	YES. Options are available to bypass the out of service pump. Al suggested having a rebuild kit on shelf. Team discussed this, and suggested that this is a critical item because it will be too troublesome if the pump is out of service. Changing the hose, coolant, and wear shoes can be done with few hours.	Option 1: Require close to a full time operator staff to be staged at the FOG Station during the period slurry tank is being empty. Option2: Potential some material may not have been screened by the paddle finisher. Potential sending more debris to the digester, and clog the downstream equipment.	YES. Require too much staff time to run the FOG station if the hose pump is out of service.	-	- HOSES - LUBRICANT REFILLS	-
Flow Meter	There are 2 flow meters installed at the FOG station. FIT 21.103 measures the amount of FOG or waste slurry being sent to the digester. FIT 21.203 measures the amount of digester sludge in circulation.	There is a revolution counter on the hose pump. The revolution counter is locally displayed at the hose pump control panel. Each revolution is 1.77 gallon per revolution. Staff can record the revolution and calculate the amount of FOG or waste slurry that is sent to the digesters if no water or sludge are added to the slurry tank for dilution.	YES. Staff will record the hose pump revolution counter, and calculate the volume of food waste slurry and FOG are sent to the digester.	None	NO There is little to no impact if equipment is out of service, with the temporary solution in place.	5 weeks	NONE	
MCC 21.1 Main feeder	Serve power to the FOG station equipment.	None. FOG Station has only one electrical feeder, from the utility side.	No.	FOG station equipment won't work if there is loss in power from the utility side.	NO E/I technician, Russ reported that it's very		NONE	

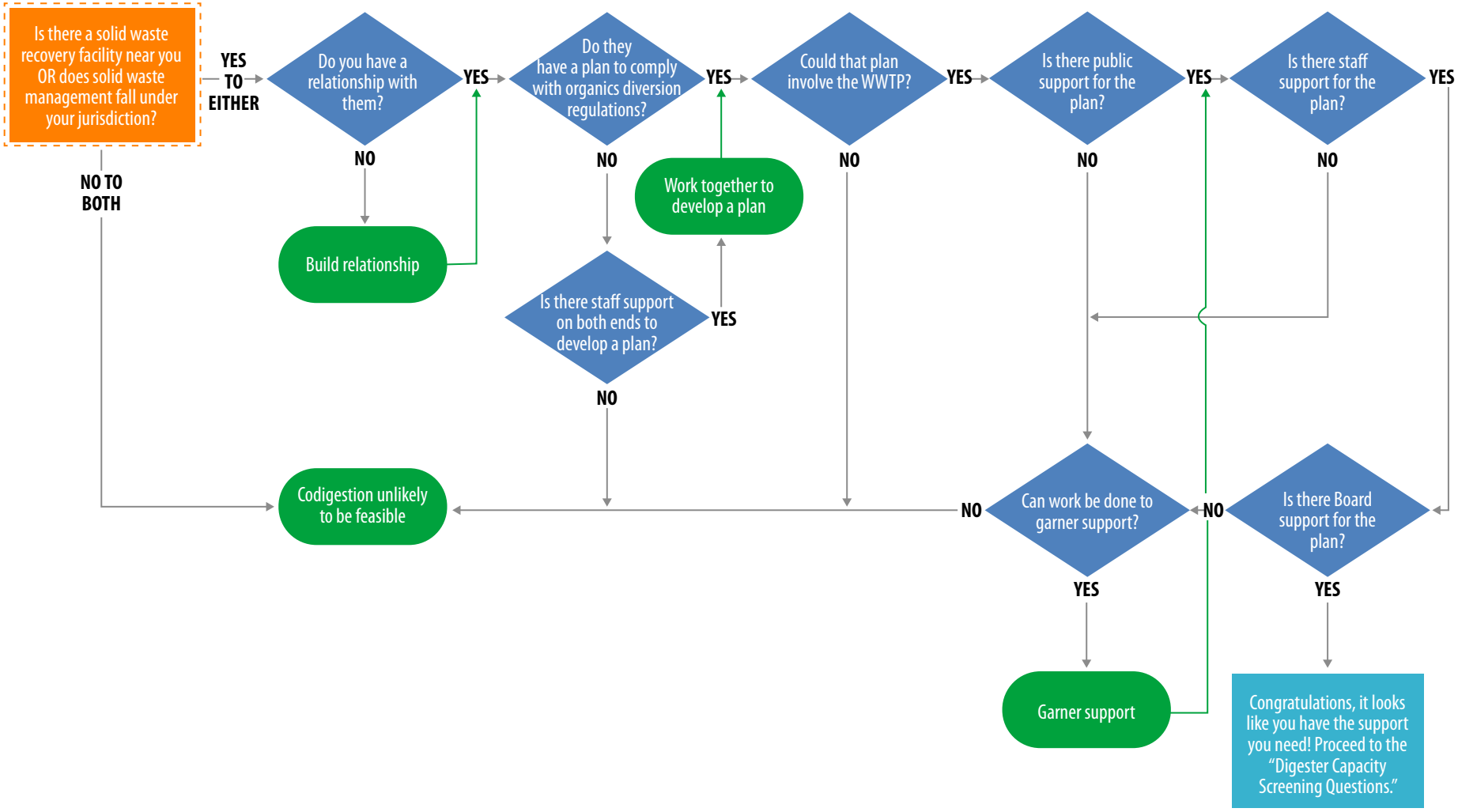
CMSA FOG STATION EQUIPMENT FUNCTION AND RISK

Equipment name:	**Equipment function:**	**Possible options if equipment is out of service. CMSA Operation Department will review and make this to SOP, in case the equipment is out of service.**	**Can CMSA staff operate the FOG station without this equipment for 72 hours (YES / NO): <u>Please explain why.</u> Comments from team:**	**Consequences if equipment is out of service (other than increase staff time to operate)**	**Recommend having Spare Parts onsite?**	**Typical delivery time from purchase to shipment:**	**What spare parts we have onsite, provided by the Digester Contract Requirements?**	**Purchasing additional spare parts?**
					infrequent that the feeder will fail.			
RTU21.1 / FOG/F2E PLC	FOG system instrumentation and controls are hard wired to RTU21.1 located in outside adjacent to the FOG/F2E Facility	CMSA operation staff will operate all the FOG station equipment in hand (manually).	YES. CMSA operation staff will operate all the FOG station equipment in hand (manually).	Require close to a full time operator staff to be staged at the FOG Station during the period slurry tank is being empty.	YES. Require too much staff time to run the FOG station if the hose pump is out of service.	-	- SPARE PLC - EXPANSION MODULE	-

Appendix 5D

SCREENING QUESTIONS FOR CO-DIGESTION

Partnership and Support Screening Questions



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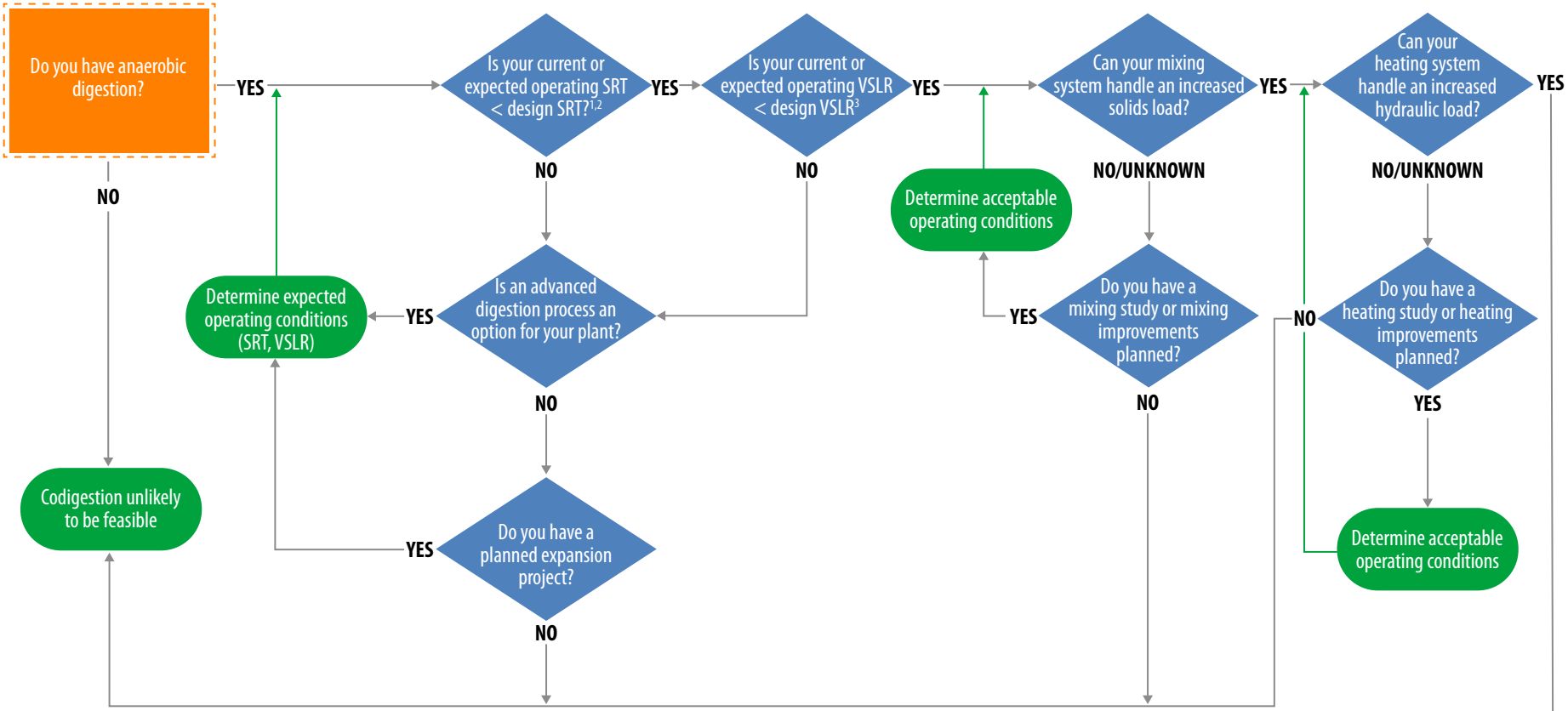
Digester Capacity Screening Questions



NOTES:
1. Consider annual average, maximum month, and future flow and load projections as well as acceptable level of equipment redundancy.
2. Typical design SRTs can be found in the Water Environment Federation's Manual of Practice No. 8.
3. Typical VSLR can be found in the Water Environment Federation's Manual of Practice No. 8.

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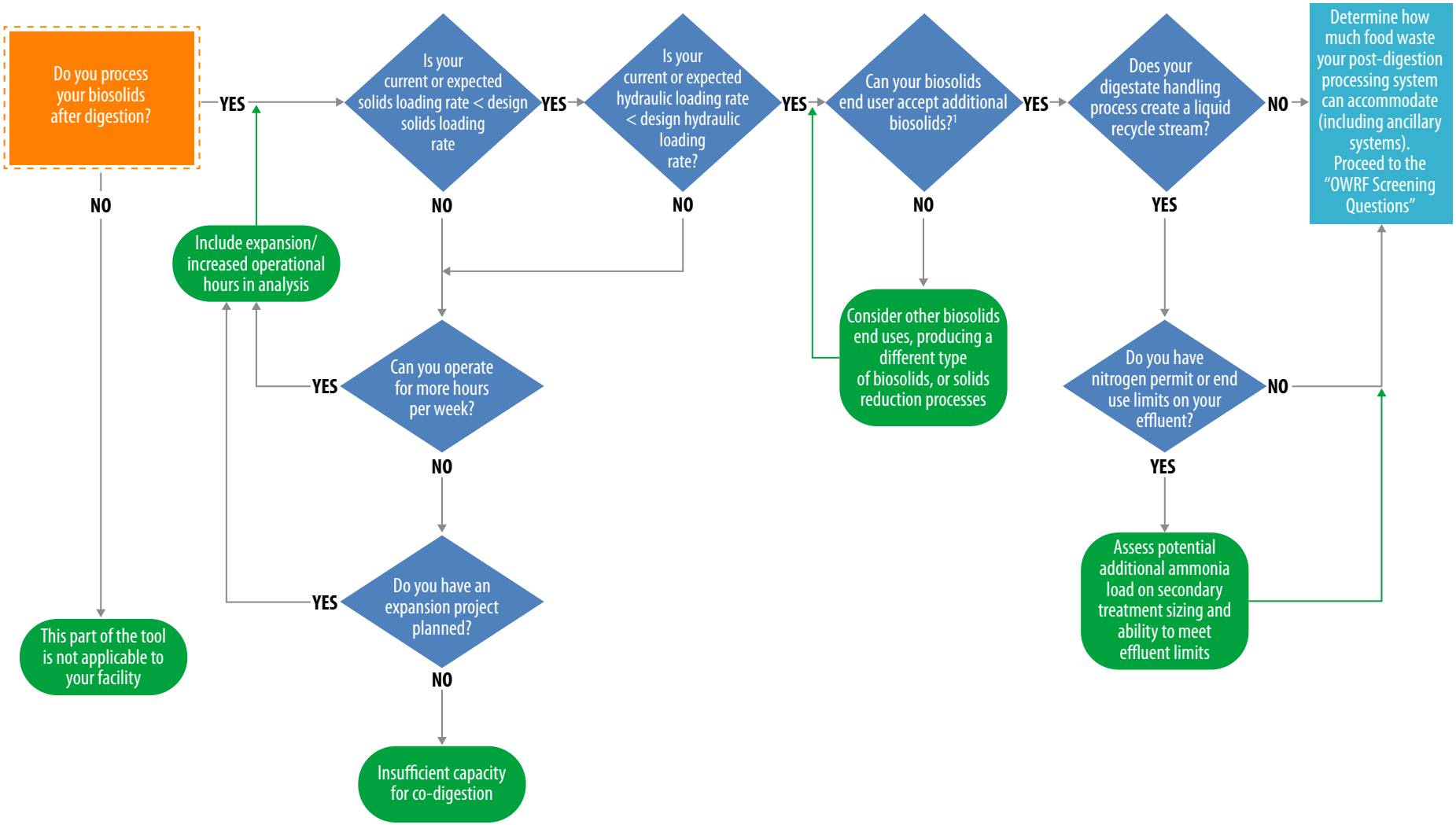
Post Digestion Solids Handling Capacity Screening Questions



NOTES:
1. Depending on the characteristics and digestibility of the food waste, biosolids production and/or dewatering polymer demand may increase with the addition of food waste co-digestion.

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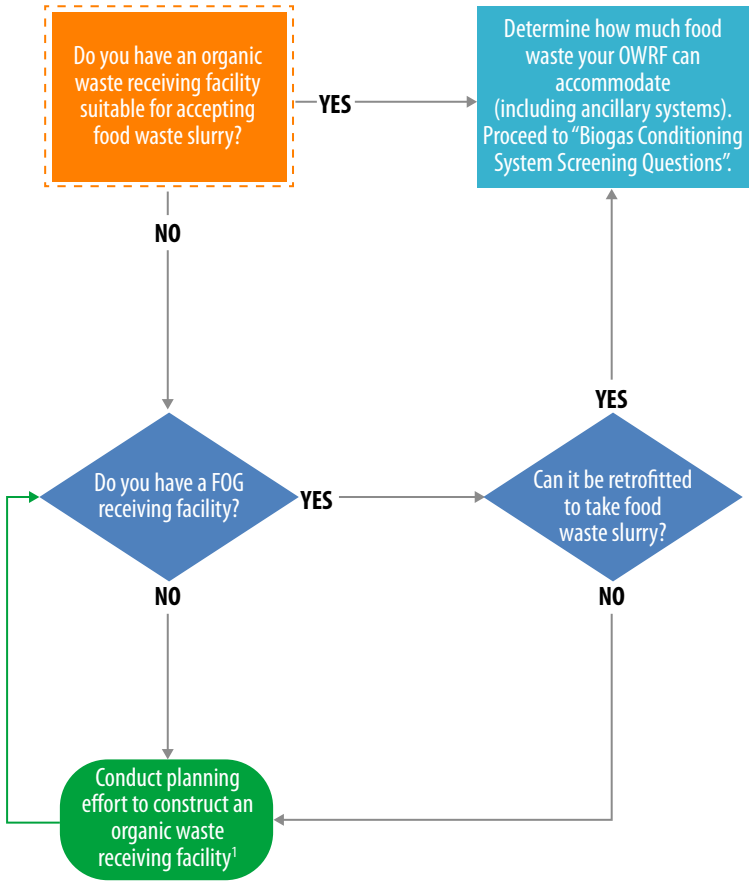
Organic Waste Receiving Facility (OWRF) Screening Questions



Considerations for OWRF and Waste Management Agency (WMA) Feedstock Agreements

- Does the WMA have green bin (source separated) or black bin waste available for codigestion?
- Green bin waste can have high levels of contamination if the facility of origin doesn't adequately separate waste. In this case additional education can help clean up the feedstock.
- Black bin waste will require organic waste separation and the processes currently on the market have high levels of contamination. Advanced polishing may be required to remove contamination and keep O&M costs lower.
- If you are receiving black bin waste, you may be required to obtain a permit from CalRecycle under current regulations. Such a permit may require your facility to develop standard operating procedures for the OWRF.
- Feedstock agreements with the WMA can be helpful in receiving a consistent quantity and quality of feedstock.
- When finalizing feedstock agreements, consider contingencies for situations where you are unable to receive feedstock (e.g. if digester must be taken out of service for cleaning).

NOTES:
1. It is recommended that facilities considering OWRFs assess whether additional staff will be required to operate and maintain the facility.

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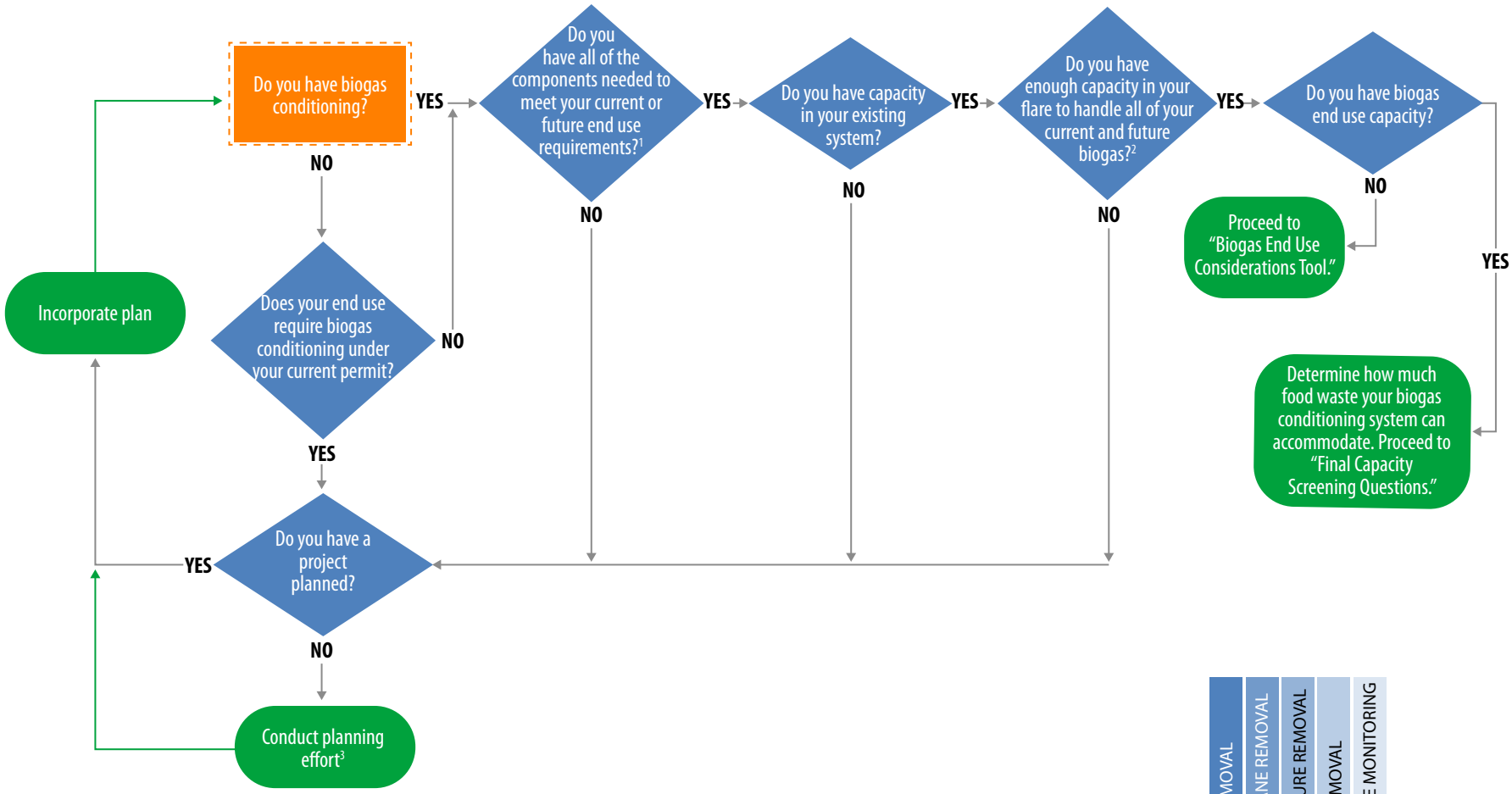
Biogas Conditioning System Capacity Screening Questions



	H_2S REMOVAL	SILOXANE REMOVAL	MOISTURE REMOVAL	CO_2 REMOVAL	ONLINE MONITORING
COGENERATION	●	●	●		
PIPELINE INJECTION	●	●	●	●	●
VEHICLE FUEL	●	●	●	●	
BOILER	●	●	●		

NOTES

1. Typical conditioning needs for new equipment are shown to the right.
2. Flares typically need to be able to handle all biogas at once to comply with local air regulations. NOx emissions may be higher in biogas from food waste codigestion.
3. See Summary Paper No. 5A, section 5.2 case studies and list of references for information about other small to medium facility planning processes. See Summary Paper No. 5D for more information on funding sources that may be available to your facility.

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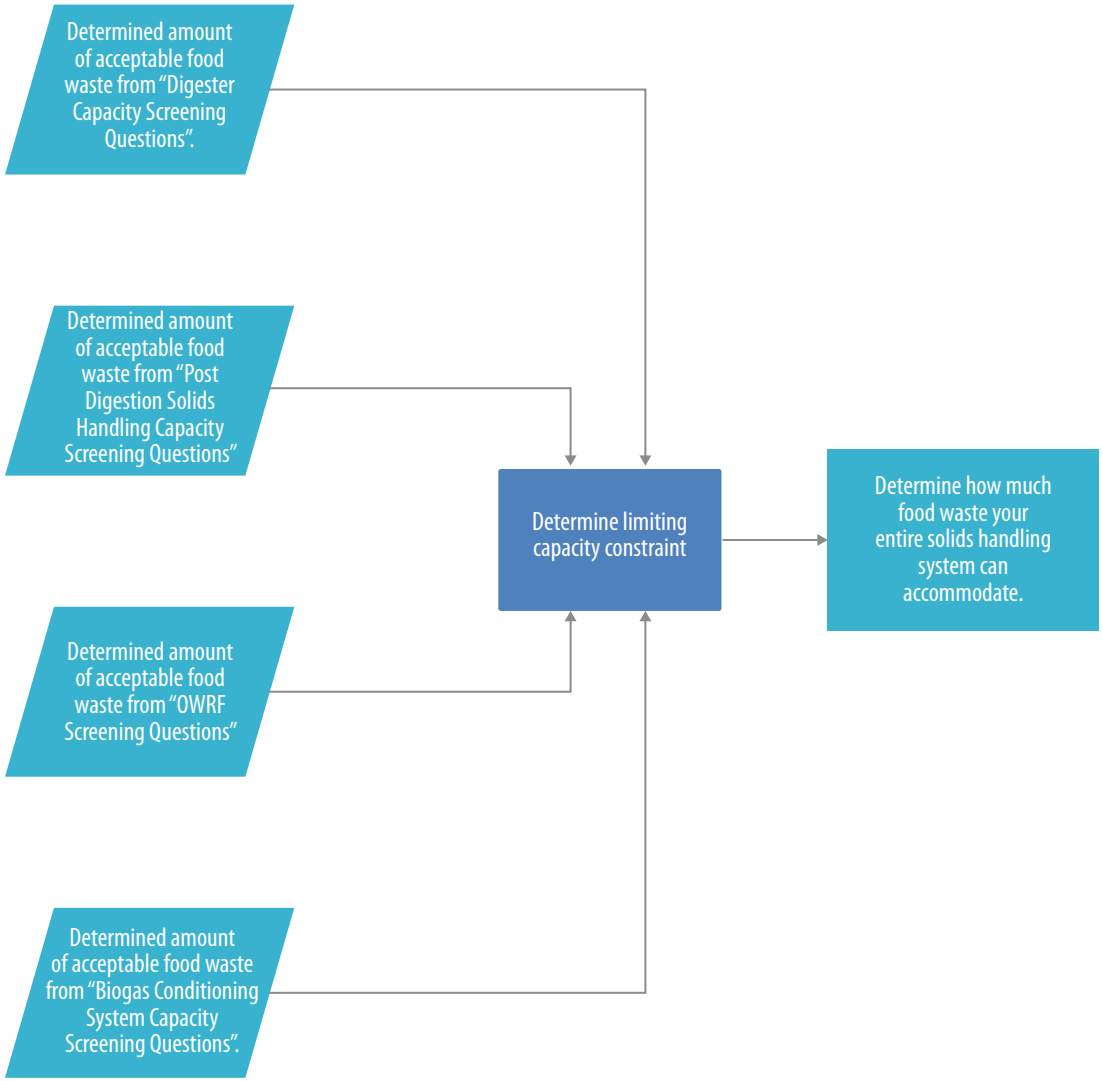
Final Capacity Assessment



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