Greenhouse Gas Inventory for Central Marin Sanitation Agency (Year 2012)

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1.0 Summary

This memorandum summarizes the methodology and results of a greenhouse gas (GHG) emissions estimate generated for the 2012 calendar year at the Central Marin Sanitation Agency (CMSA) Regional Wastewater Treatment Facilities (RWTF) on Andersen Drive, next to San Quentin Ridge, in San Rafael, California. GHG emissions were estimated from data logged by CMSA staff in 2012.

The GHG emissions estimate is a voluntary action taken by CMSA. As explained in this memorandum, CMSA does not have a regulatory obligation to estimate and report its emissions. The emissions estimate serves as a tool to verify CMSA's regulatory obligation and also provides CMSA with a baseline measure of the GHG emissions associated with its operations. A GHG baseline will support environmental stewardship practices as CMSA develops its operations plan and facility master plan into the future.

To that end, this memorandum also identities potential areas for further evaluation to reduce GHG emissions (Section 4.0) and includes a brief overview of climate change policies and regulatory drivers and the relevance of GHG accountability for public agencies as it relates to climate change adaptation and facility optimization (Section 5.0).

The GHG emissions estimated for the CMSA RWTF are summarized in Table 1. The highest source of direct emissions from the RWTF in 2012 was anthropogenic CO_2 emissions from the combustion of natural gas, followed by biogenic emissions from the combustion of digester biogas. In voluntary and regulatory GHG reporting programs, the CO_2 emissions associated with combustion of biogas are typically tracked and reported separately from Scope 1 emissions because the gas is from a biogenic source, rather than an anthropogenic source such as natural gas or diesel fuel. Scope 1, anthropogenic and biogenic emissions are defined in Section 3 below.

Tables 3 and 4 provide further details that support the data in Table 1. All of the backup calculations supporting the data in Tables 3 and 4 are in Attachment 1.

Table 1. Summary of CMSA Carbon Dioxide Equivalent (CO_{2e}) Emissions for 2012

Source Type	Primary Source Description	CO_{2e} (Metric Tons)
Stationary Combustion (Anthropogenic)	Cogeneration Engine; Boilers; Flares; Diesel Pumps and Generator	**1,836**
Stationary Combustion (Biogenic)	Cogeneration Engine; Boilers; Flares; Diesel Pumps and Generator	**1,780**
Mobile Anthropogenic	CMSA Vehicles & Biosolids Transfer Trucks	**53**
Wastewater Fugitive and Process Emissions	- Incomplete Methane Combustion; - Effluent Discharge; - Centralized Treatment without Nitrification/Denitrification	**1,116**
Indirect Emissions	Purchased Electricity	**124**
Total Scope 1, 2, and 3 CMSA CO_{2e} Emissions		**4,909**

There are a number of short-term and long-term measures that CMSA can implement to reduce the carbon footprint of its operation and enhance environmental stewardship. The short-term measures are the simplest and most economical approach. The long-term measures require planning and relatively more costly capital and operational expenditure investments.

The recommended short-term measures are as follows:

- Produce more biogenic biogas (e.g., through the digestion of FOG and foodwaste) to offset the need for anthropogenic natural gas in the cogeneration system.
- Upgrade from the Marin Clean Energy "Light Green Service" purchased electricity portfolio to the "Deep Green Service" purchased electricity portfolio.
- Continue to measure the biogas high heat value for the GHG emissions estimate so that use of the higher regulatory default value can be avoided.
- Track the annual fuel consumption for each CMSA vehicle.
- Take the GHG emissions inventory process to "the next level" and register CMSA's GHG emissions with a voluntary registry such as TCR or the U.S. EPA Climate Leaders.

The recommended long-term measures are as follows:

- Investigate measures to avoid, sequester, or reduce wastewater treatment process and fugitive N_2O, CH_4, and CO_2.
- Consider the community-wide benefits of treated effluent water recycling.
- Implement a detailed energy minimization and GHG reduction study.

CMSA is in the process of implementing some of the measures recommended above to reduce GHG emissions (e.g., increasing biogenic biogas production), and are considering the remaining measures (e.g., studying the feasibility of recycling treated effluent). For more background information related to each short- and long-term measure, refer to Section 4.0.

2.0 Site Description

CMSA owns, operates, and maintains the Central Marin RWTF. The RWTF provides wastewater treatment for special districts and municipalities in the San Rafael and Ross Valley areas of central Marin County, California. It also provides wastewater treatment services under contract with the State of California for San Quentin State Prison. Overall, the RWTF serves a population of approximately 120,000.

During normal dry weather operations, the RWTF treats up to 10 million gallons per day (mgd) of wastewater through it primary and secondary treatment system, which is then released as clean effluent in the San Francisco Bay. The facility is equipped to treat and process wet weather flows up to 125 mgd, with a hydraulic capacity up to 155 mgd.

The RWTF's solids handling system produces 6,500 tons of biosolids per year, which are beneficially reused as alternate daily cover at the Redwood Landfill and as land-applied fertilizer for feed crops for livestock in southern Sonoma County. Prior to reuse, the solids removed from the treatment clarifiers are processed through an anaerobic digester and dewatered through centrifuges.

A cogeneration engine uses biogas and natural gas as fuel, and produces energy to supply the Agency's power demand. While using the biogas fuel, the cogeneration system generates electricity for approximately 10 hours each day, and then switches to natural gas fuel for the remainder of the day. CMSA imports and purchases approximately 700 MWh (annually) of grid supplied electricity in order to maintain compliance with utility interconnection agreements when the cogeneration system is online and connected, and during intervals of non-operation such as maintenance activities. CMSA's system is further supported by five diesel engine pumps, a diesel generator, a forklift, a skid steer loader, and a fleet of eleven vehicles.

The GHG emissions inventory herein estimates direct combustion, fugitive, and process GHG emissions associated with CMSA's treatment operations and fleet vehicles and equipment. It also estimates the indirect GHG emissions resulting from imported grid power utilized by CMSA operations and the mobile combustion emissions from hauling biosolids to end-use destinations.

3.0 Methodology

Defining GHG Emissions

GHG emissions inventories must include emissions of all internationally recognized GHGs regulated under the Kyoto Protocol. These are:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur hexafluoride (SF_6)

- Nitrogen trifluoride (NF_3)

For the purposes of this study, GHG emissions are categorized into "scopes" according to the following definitions:[1, 2]

- Scope 1: All direct anthropogenic GHG emissions from sources within a local government's organizational boundaries, owned or controlled by the local government. Direct emissions include emissions from four sources: stationary combustion, mobile combustion, process emissions, and fugitive emissions.
- Scope 2: Indirect anthropogenic GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling. Indirect emissions result from activities that take place within the organizational boundaries of the reporting entity, but occur at sources owned or controlled by another entity (e.g., a regional utility power plant facility where fuel is combusted to generate electricity).
- Scope 3: All other indirect anthropogenic GHG emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity (e.g., employee commuting and business travel), outsourced activities, waste disposal, etc.

Definitions

(from Local Government Operations Protocol)

Anthropogenic emissions – Emissions that are a direct result of human activities or the result of natural processes that have been affected by human activities.

Biogenic emissions – Emissions originating from carbon recently contained in living organic matter.

Carbon Dioxide Equivalent (CO2e) – The universal unit for comparing emissions of different GHGs expressed in terms of global warming potential of one unit of carbon dioxide.

Direct Emissions – Emissions from sources within the reporting entity's organizational boundaries that are owned or controlled by the reporting entity, including stationary combustion emissions, mobile combustion emissions, process emissions, and fugitive emissions. All direct emissions are Scope 1 emissions, with the exception of biogenic CO_2 emissions from biomass combustion.

Emission Factor – A unique value for determining an amount of a GHG emitted on a per unit activity basis (for example, metric tons of CO_2 emitted per million Btus of coal combusted, or metric tons of CO_2 emitted per kWh of electricity consumed).

Fugitive Emissions - Emissions that are not physically controlled but result from the intentional or unintentional release of GHGs. They commonly arise from the production, processing, transmission, storage and use of fuels or other substances, often through joints, seals, packing, gaskets, etc. Examples include HFCs from refrigeration leaks, SF_6 from electrical power distributors, and CH_4 from wastewater treatment facilities.

Global Warming Potential - The ratio of radiative forcing (degree of warming to the atmosphere) that would result from the emission of one mass-based unit of a given GHG compared to one equivalent unit of carbon dioxide (CO_2) over a given period of time.

Indirect Emissions – Emissions that are a consequence of activities that take place within the organizational boundaries of the reporting entity, but that occur at sources owned or controlled by another entity. For example, emissions of electricity used by a manufacturing entity that occur at a power plant represent the manufacturer's indirect emissions.

Mobile Combustion – Emissions from the combustion of fuels in transportation sources (e.g., cars, trucks, buses, trains, airplanes, and marine vessels) and emissions from non-road equipment such as equipment used in construction, agriculture, and forestry. A piece of equipment that cannot move under its own power but that is transported from site to site (e.g., an emergency generator) is a stationary, not a mobile, combustion source.

Process Emissions - Emissions from physical or chemical processing rather than from fuel combustion. Examples include emissions from manufacturing cement, aluminum, adipic acid, ammonia, etc.

[1] California Air Resources Board, California Climate Action Registry (CCAR), Local Governments for Sustainability (ICLEI), The Climate Registry (TCR). (May 2010) *Local Government Operations Protocol For the quantification and reporting of greenhouse gas emissions inventories, Version 1.1*

[2] The Climate Registry. (March 2013) *General Reporting Protocol*, Version 2

Biogenic CO_2 emissions are excluded from the scope categories, but should be tracked separately. Each methodology has different rules about how to report biogenic emissions in GHG emissions inventories. For example, under the California Air Resources Board's (ARB) mandatory reporting of GHGs regulation, reporting entities are required to include biogenic GHGs generated from the combustion of biomass in the calculations that determine whether or not GHG emissions reporting is required. However, biogenic emissions are not counted to determine if a facility has a compliance obligation under California's current cap-and-trade regulation.

Approach

The methodologies used for the RWTF GHG inventory are based on The Climate Registry's (TCR) March 2013 General Reporting Protocol (GRP), Version 2.0; TCR's May 2010 Local Government Operations Protocol (LGOP), Version 1.1, and the ARB's Regulation for the Mandatory Reporting of Greenhouse Gases, Title 17, Div. 3, Chapter 1, Subchapter 10.

- TCR's GRP – a guidance document created by TCR to support their missions to set consistent and transparent standards to calculate, verify, and publicly report GHG emissions into a single registry. The GRP consists of a set of guidelines that help entities determine a) what to report, b) how to quantify GHG emissions, and c) how to report the emissions.

- TCR's LGOP – the U.S. national standard guidebook on how to quantify and report greenhouse gas emissions from local government municipal operations. It provides guidance on how to inventory GHG emissions resulting from government buildings and facilities, government fleet vehicles, wastewater treatment and potable water treatment facilities, landfill facilities, and other operations. It was developed through a collaborative process that included the ARB, TCR, Climate Action Reserve (CAR), and Local Governments for Sustainability (ICLEI).[3,4].

- ARB's Mandatory Reporting of Greenhouse Gas Emissions Regulation (Mandatory Reporting Regulation [MRR])– The requirement for mandatory reporting of GHGs was approved by the ARB in December 2007 and became effective in 2009, requiring the reporting of 2008 emissions, and continuing every year thereafter. The MRR was revised in 2010 and 2012 after its approval in 2007. The current regulation became effective on January 1, 2013. It is among the first of many programs resulting from the 2006 California Global Warming Solutions Act (Assembly Bill [AB] 32), which requires the State of California to restore 1990 GHG emission levels by the year 2020. The details of the California Mandatory Reporting Regulation are in *Subchapter 10, Article 2, Sections 95100 to 95133* of the California Code of Regulations (CCR), Title 17.[5] The Regulation is comprised of rules that establish who must report GHG emissions to ARB, measurement and quantification standards, and reporting and verification procedures. Wastewater treatment operations with annual general

[3] ARB. (Accessed November 5, 2013) Local Government Operations Protocol for Greenhouse Gas Assessments Webpage: http://www.arb.ca.gov/cc/protocols/localgov/localgov.htm.

[4] Local Governments for Sustainability (ICLEI) USA. (Accessed November 5, 2013) Local Government Operations Protocol Webpage: http://www.icleiusa.org/tools/ghg-protocol/local-government-operations-protocol-1.

[5] California Code of Regulations, (January 2013) Title 17 Public Health, Division 3. Air Resources, Chapter 1. Air Resources Board, Subchapter 10 Climate Change

stationary combustion emissions exceeding 10,000 metric tons carbon dioxide equivalent (CO_2e) are subject to the abbreviated mandatory reporting requirements of this regulation. If a facility's general stationary combustion emissions exceed 25,000 metric tons CO_2e per year, then the facility would be subject to a compliance obligation under California's Cap-and-Trade Regulation and required to report GHG emissions to the U.S. Environmental Protection Agency (EPA) under the requirements of 40 Code of Federal Regulations (CFR) Part 98.

Per the LGOP, the CMSA RWTF emissions sources were categorized by scope and are presented in Table 2. The reference for estimating GHG emissions is also included in Table 2.

TABLE 2. CMSA RWTF SCOPES, SOURCES, AND REFERENCES

Scope	Source Type	RWTF Source	Reference for GHG Calculations
1	Stationary Combustion	Cogeneration Engine	MRR
		Boilers	MRR
		Flares	MRR
		Diesel Pumps & Generator	MRR
	Mobile Combustion	CMSA Vehicles	LGOP and TCR GRP
	Fugitive and Process Emissions	Incomplete Combustion of CH_4	LGOP
		Centralized Treatment without Nitrification/Denitrification	LGOP
		Effluent Discharge	LGOP
2	Indirect Emissions	Purchased Electricity	LGOP and TCR GRP
3	Mobile Combustion	Biosolids Disposal by Truck	LGOP and TCR GRP
Biogenic CO_2	Stationary Combustion, Digester Gas	Cogeneration Engine	MRR
		Boilers	MRR
		Flares	MRR

Stationary Combustion Emissions

The ARB MRR methodology was used to estimate the RWTF's stationary combustion GHG emissions so that CMSA's compliance to the MRR[6] could be verified. Stationary combustion at the RWTF includes the combustion of natural gas and biogas in the cogeneration engine, biogas in the two boilers and two flares, and diesel in CMSA's emergency generator and five engine-driven pumps at the effluent pump station. As demonstrated in Attachment 1.C, the estimated total stationary combustion emissions in 2012 were 3,607 metric tons CO_2e. Since this value is less than the ARB's 10,000 metric tons CO_2e per year threshold for mandatory reporting, CMSA is not required to report the RWTF's GHG emissions to the ARB.

[6] California Code of Regulations, et al, January 2013

Non-Stationary Combustion Emissions

The remainder of the RWTF's GHG emissions (i.e., mobile combustion, fugitive, process, and purchased electricity) was estimated in accordance with the LGOP and TCR GRP methodologies. The TCR GRP is the standard in the U.S. for estimating GHGs and voluntary reporting. The calculations in the LGOP are modeled after the TCR GRP and were written specifically for local government operations. The LGOP also has a chapter specific to estimating wastewater treatment process GHG emissions (i.e., Chapter 10 – Wastewater Treatment Facilities) [7]. TCR resources were primarily used for updates to the emission factors for mobile combustion and purchased electricity.

Mobile Combustion Emissions

The mobile combustion emissions were calculated for CMSA's vehicle fleet and Total Waste Systems' biosolids hauling trucks. Since 2012 fuel-usage data was not available for each specific vehicle, it was back-calculated using the logged mileage for each vehicle and the published fuel economy for vehicles on the U.S. Department of Energy's website, http://fueleconomy.gov. CH2M HILL conservatively utilized the "city" miles per gallon (MPG) published instead of the "highway" or "combined" MPG. See Attachment 1.D for additional details about the calculations methodologies and assumptions.

Fugitive and Process Emissions

The basic fugitive and process GHG emissions associated with wastewater treatment are as follows:

- Fugitive stationary CH_4 emissions from the incomplete combustion of digester gas at a centralized publicly owned treatment works (POTW)
- Fugitive CH_4 emissions from septic systems
- Process CH_4 emissions from anaerobic and facultative treatment lagoons
- Process N_2O emissions from centralized POTWs *with* nitrification/denitrification
- Process N_2O emissions from centralized POTWs *without* nitrification/denitrification
- Process N_2O emissions from effluent discharge to receiving aquatic environments

Chapter 10 of the LGOP provides more specifics for each of these emissions sources and provides methods to estimate the emissions.[8] The only emissions from this list produced at the RWTF are fugitive stationary CH_4 emissions from the incomplete combustion of digester gas, process N_2O emissions from centralized POTWs *without* nitrification/ denitrification, and process N_2O emissions from effluent discharge to receiving aquatic environments. See Attachments 1.B and 1.E for the calculations and assumptions used to estimate the RWTF's fugitive and process emissions, respectively.

Purchased Electricity Emissions

Attachment 1.F details the calculations and assumptions used to estimate CMSA's Scope 2 GHG emissions associated with purchased electricity. CMSA purchases electricity in order to maintain compliance with utility interconnection agreements while operating the cogeneration system, and during periods of cogeneration non-operation. Since the

[7] California Air Resources Board, et al, May 2010

[8] Note, when CH2M HILL developed Chapter 10 of the LGOP, it had proposed to the publisher including a methodology to estimate biogenic CO_2 emissions from wastewater treatment processes such as the use of aeration basins, sludge digesters and combustion of biogas. Since this methodology has not been published to date, CH2M HILL did not include this calculation in CMSA's 2012 GHG emissions inventory.

cogeneration unit was offline for nearly three months in 2012, CMSA staff provided an adjusted purchased electricity total of 697,028 kWh to represent a "normal" power year for the purposes of this study.

In 2012, electricity was purchased from PG&E during the months of January through June and from MCE during the months of July through December. MCE offers power supply portfolios that include more renewable energy than PG&E's portfolio. CMSA currently purchases MCE's "Light Green Service" power portfolio, which produces slightly less pounds (lbs) of CO_2e per megawatt-hour (MWh) than PG&E (i.e., 4 lbs/MWh, which is equivalent to 2 metric tons CO_2e reduction per year, or 4,400 lbs CO_2e per year). If CMSA opted for the "Deep Green Service" power portfolio, then the CMSA would realize an emissions reduction of up to 126 metric tons CO_2e per year, or 278,000 lbs CO_2e per year, over the PG&E portfolio and an emissions reduction of up to 124 metric tons CO_2e per year, or 273,000 lbs CO_2e per year, over the MCE "Light Green Service" power portfolio.

Calculations

GHG emissions were calculated based on the following general equation:

Activity Data x Emission Factor = Emissions

Activity data represents a value such as 10 million British thermal units (MMBtu) of natural gas combusted in a stationary engine whereas the emission factor is typically a default factor, such as 53.02 kilograms (kg) CO_2/MMBtu natural gas, available from a protocol or regulation. The GHG emissions were calculated as CO_2e emissions to calculate total emissions. Converting emissions of non-CO_2 gases (e.g., CH_4) to units of CO_2e allows GHGs to be compared on a common basis. Non-CO_2 gases are converted to CO_2e using internationally recognized global warming potential (GWP) factors. GWPs were developed by the Intergovernmental Panel on Climate Change (IPCC) to represent the atmospheric heat-trapping ability of each GHG relative to that of CO_2. For example, the GWP of CH_4 is 21 because one metric ton of CH_4 has 21 times more ability to trap heat in the atmosphere than one metric ton of CO_2[9]. The primary GHGs generated in a typical POTW include CO_2, CH_4, and N_2O. N_2O has a GWP of 310.

The calculations for each of the GHG emission source types are included in Attachment 1. The assumptions and methodologies used to calculate emissions are detailed on the calculation tables. These calculations are supported by operations data provided by CMSA staff. On July 31, 2013, CH2M HILL submitted a data questionnaire to be used as a guide to CMSA staff for collecting fuel use data. The data request and submitted data are included in Attachment 2. In addition, CH2M HILL staff Priya Sathyanarayan and Jim Sandoval visited the RWTF on August 29, 2013, to gather additional data and tour the treatment plant.

Results

GHG emissions were estimated for the CMSA RWTF for the scopes and sources identified in Table 2 and are presented in Tables 3 and 4. Table 3 breaks out the emissions by scope and Table 4 by the emissions source type. The RWTF's highest emissions are in the Scope 1 (direct emissions) category. As shown in Table 4, the highest source of direct emissions

[9] California Air Resource Board, et al, May 2010, pg. 20

from the RWTF in 2012 was anthropogenic CO_2 emissions from the combustion of natural gas, followed by biogenic emissions from the combustion of biogas. The CO_2 emissions associated with combustion of digester gas are tracked and reported separately from Scope 1 emissions because the gas is from a biogenic source, rather than an anthropogenic source such as natural gas or diesel fuel.

TABLE 3. SUMMARY OF YEAR 2012 GHG EMISSIONS FOR THE CMSA RWTF

Scope	GHG Emissions (metric tons/ year)				
	Anthropogenic CO_2	CH_4	N_2O	CO_2e	Biogenic CO_2
1	1,846	6.74	3.18	**2,973**	
2	124	0.009	0.002	**124**	
3	23	0.00006	0.00006	**23**	
Biogenic CO_2		0.1094	0.0215	**9**	1,780

CO_2e emissions were estimated using a GWP of 21 for CH_4 and 310 for N_2O.

The only Scope 3 emissions estimated were for the transfer of biosolids using trucks owned by contractor Total Waste Systems from the RWTF to the end-use destination at Synagro in southern Sonoma County (land-applied soil amendment) in May through October and to the Redwood Landfill in Novato (alternative daily cover) in November through April. For the purposes of this study, CH2M HILL did not estimate Scope 3 emissions from any other source.

TABLE 4. SUMMARY OF YEAR 2012 CMSA RWTF GHG EMISSIONS BY SOURCE TYPE

Source	Scope	GHG Emissions (metric tons/ year)				
		Anthropogenic CO_2	CH_4	N_2O	CO_2e	Biogenic CO_2
Stationary Combustion	1	1,816	0.144	0.025	**1,836**	1,780
Mobile Combustion	1 & 3	53	0.013	0.001	**53**	
Fugitive & Process Emissions	1	-	6.58	3.15	**1,116**	
Indirect Emissions (Purchased Electricity	2	124	0.009	0.002	**124**	

All of the backup calculations supporting the data in Tables 3 and 4 are in Attachment 1. The formulas supporting the calculations are in CH2M HILL's GHG inventory spreadsheet tool *CMSA_2012_GHG_Inventory-2013Nov05.xlsx*, submitted to CMSA staff along with this technical memorandum.

4.0 Recommended Measures to Reduce GHGs

There are numerous short-term (i.e., low hanging fruit) and long-term (i.e., blue sky) measures that CMSA can implement to reduce the carbon footprint of its operation. The short-term measures are the simplest and most economical approach. The long-term measures require planning and relatively more costly capital and operational expenditure investment. However, some of the measures have the co-benefits of producing clean and economical energy and increasing energy independence and reducing reliance on fossil fuel based grid power, which has had volatile pricing in the past decade. In the future, they may also provide opportunities to generate carbon offset or renewable energy credits that could provide an additional source of revenue to CMSA.

Short-Term Measures

The following is a list of short-term measures that can reduce the Scope 1, 2, and 3 emissions listed in Table 4:

- *Produce more biogenic biogas to offset the need for anthropogenic natural gas in the cogeneration system.* CMSA has recently invested in this measure through the development of a FOG and foodwaste handling station that will leverage the RWTF's excess digester capacity and enable the addition of FOG and foodwaste with the digester's biosolids feedstock. Increasing the organics feedstock will result in additional biogas production that can be used to offset anthropogenic natural gas in the cogeneration power production. Reducing natural gas use will reduce CMSA's Scope 1 direct emissions. Reducing grid power use will reduce CMSA's Scope 2 indirect emissions and reduce the power plant owner's Scope 1 emissions. Redirecting the food waste away from the landfills is also aligned with the California CalRecycle goals to reduce landfilled waste. However, any Scope 3 emissions implications of receiving trucked in waste needs to be also accounted for in relationship to beyond the fence emissions displaced elsewhere. If possible, accounting of these displaced/ reduced emissions due to more controlled management of waste in CMSA digesters needs to be evaluated.
- *Upgrade from the Marin Clean Energy "Light Green Service" purchased electricity portfolio to the "Deep Green Service" purchased electricity portfolio.* Since the CO_2 emission factor for the Light Green Service is 389 lbs CO_2/MWh versus zero lbs CO_2 for the Deep Green Service, CMSA would realize a Scope 2 GHG emissions reduction of up to 124 metric tons CO_2e per year, or 273,000 lbs CO_2e per year, by upgrading to the Deep Green Service. According to MCE's customer service agent[10], the cost increase to upgrade from Light Green to Deep Green is $0.01/kWh for commercial and residential customers. Since CMSA purchased 697,028 kWh of electricity in 2012, upgrading to Deep Green would cost approximately $7,000 per year more than the Light Green Service or PG&E service.
- *Continue to measure the biogas high heat value for the GHG emissions estimate.* Utilizing the 2013 measured value of 680 British thermal units per standard cubic foot (Btu/scf), instead of the ARB's default of 841 Btu/scf, yielded a reduction in

[10] October 17, 2013 telephone communication: Jim Sandoval/CH2M HILL & MCE Customer Service Agent; (888) 632-3674.

combusted biogas GHGs of 421 metric tons in 2012—a 19% reduction in direct biogenic CO_2 emissions and 10% reduction of all direct CO_2 emissions.[11]

- *Track the annual fuel consumption for each CMSA vehicle.* Understanding the true MPG for each vehicle may yield CO_2e results that are improved over utilizing the "city" MPG rating. For the same reason it is also recommended that CMSA require Total Waste Systems to track the fuel usage and mileage for each truck that hauls biosolids to the end-use destinations.
- *Take the GHG emissions inventory process to "the next level" and register CMSA's GHG emissions with a voluntary registry such as TCR or the U.S. EPA Climate Leaders.* Registration can serve as a good risk management measure for the organization because publicly documenting and verifying the GHG emissions of the RWTF would establish a baseline inventory from which actions taken to avoid, sequester, or reduce GHG emissions can be measured. For example, some local governments (e.g., City of San Rafael) have set carbon reduction goals. Establishing a baseline inventory will help them understand their progress. Establishing a baseline may also help a facility document any early actions to reduce emissions, which may assist in complying with future GHG regulations, or with obtaining potential carbon offset or renewable energy credits[12].

Long-Term Measures

As CMSA looks forward with facility master planning and long-range CIP budget forecasting, climate change needs to be a key consideration. The following long-term measures should be considered to reduce the carbon footprint of the RWTF:

- *Investigate measures to avoid, sequester, or reduce wastewater treatment process and fugitive N_2O, CH_4, and CO_2*[13] These measures should be considered during future RWTF master planning. Some examples of operational processes to investigate include:
  - N_2O and biogenic CO_2 from secondary treatment systems, such as aeration basins and trickling filters
  - CH_4 and biogenic CO_2 emissions that are uncollected or controlled from secondary wastewater treatment processes
  - CH_4 and biogenic CO_2 fugitive emissions from solids handling processes (e.g., anaerobic digestion of sludge and biosolids dewatering)
  - Post-digestion CH_4 fugitive emissions from facility conveyance and storage infrastructure
  - CH_4 emissions from the incomplete combustion of digester gas
  - N_2O emissions from wastewater effluent in receiving aquatic environments
  - CO_2 from fugitive industrial wastewater constituents in the influent[14]

[11] Since biogas HHV was not measured in 2012, it is assumed that its value is closer to the 2013 measured HHV of 680 Btu/scf than it is to the ARB's default value of 841 Btu/scf.

[12] Sandoval, James E. *Climate Change Risks and Opportunities at Wastewater Treatment Plants*. Water Environment Federation/Air & Waste Management Association Odors and Air Pollutants 2010 Conference in Charlotte, North Carolina, USA, March 23, 2010

[13] It should be noted that to measure and calculate these emissions, the best methodology specifically at the RWTF would need to be reviewed. Methodologies for measuring process emissions at POTWs are still in the research and development phase and have uncertainties. Although, there are a number of research projects that are providing incite to the wastewater scientific community

  - CO_2, CH_4, and N_2O from mobile equipment and vehicle fuel combustion
  - N_2O and CH_4 from land application or composting of treated biosolids[15]

- *Consider the community-wide benefits of treated effluent water recycling.* In response to California's AB 32 Scoping Plan, which proposes a comprehensive strategy to reduce overall GHG emissions in California and targets a 23% water recycling goal by 2030, the State Water Resources Control Board is funding recycled water development projects.

- *Implement a detailed energy minimization and GHG reduction study.* The AB 32 Scoping Plan also proposes measures to increase water system energy efficiency and increase renewable energy production in California to reduce GHG emissions. A study would assess every component of the treatment system (i.e., primary, secondary, solids handling, etc.), establish goals and priorities for CMSA, and lay out a roadmap for implementation that aligns with the goals of CMSA, the San Rafael Climate Change Action Plan, and AB 32.
  - Energy Efficient Conservation Block Grants are still available through the California Energy Commission (CEC). Go to http://www.energy.ca.gov/recovery/blockgrant.html for further details.
  - The Scoping Plan measure to increase renewable energy production seeks to *identify and implement specific projects that take advantage of the State's water system-related opportunities to generate renewable electricity. Examples of renewable energy existing within water and wastewater systems include water moving through conduits, sunlight, wind, and gases emitted during treatment of wastewater at wastewater treatment plants.*[16] POTWs have a number of opportunities to develop their resources into renewable energy resources, including foodwaste digestion and cogeneration (already planned at the RWTF), distributed solar PV, concentrated solar power, biosolids-to-energy, small wind turbines, micro-hydro turbines, effluent heat recovery, waste-derived alternative fuel, algae-based biodiesel, geothermal, etc.

5.0 Regulatory Drivers for Managing Emissions and Responding to Climate Change

The threat of global climate change is driving many new environmental regulatory policies from international down to local levels. Many of these policies are resulting in regulatory measures that may directly or indirectly impact POTWs. The following provides an overview of climate change regulations that may impact POTWs in California.

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14 Apgar, D.; Andrews, N.; Deslauriers, S.A.; Kerr, D.; Lorenz, S.E.; O'Connor, C.A.; Porter, R.C. (October 2009) *Protocols for Estimating Greenhouse Gas Emissions from Municipal Wastewater Sources*, Water Environment Federation; Alexandria, Virginia

15 Ibid

16 California Air Resources Board. *Climate Change Scoping Plan Appendices VOLUME I: SUPPORTING DOCUMENTS AND MEASURE DETAIL*

State and Federal Regulations

The State of California and the U.S. EPA have implemented several regulations to report and control GHG emissions. The regulations that currently impact some POTWs include:

- *California Air Resources Board Mandatory Reporting of GHGs*.
  - Facilities with Scope 1 and biogenic stationary combustion $CO_2e \geq 10{,}000$ metric tons CO_2e per year are required to submit an abbreviated emissions report.
  - Facilities with Scope 1 and biogenic stationary combustion $CO_2e \geq 25{,}000$ metric tons CO_2e per year are required to submit a complete emissions report.
  - POTW process GHG emissions are exempt from reporting at this time.
- *California Air Resources Board GHG Cap-and-Trade Program*. Facilities with Scope 1 stationary combustion $CO_2e \geq 25{,}000$ metric tons CO_2e per year have an enforceable GHG emissions compliance obligation. Neither combustion of biomass nor POTW process emissions count toward the 25,000 metric tons CO_2e per year emissions threshold.
- *U.S. EPA Mandatory Reporting of GHGs.* Facilities with Scope 1 stationary combustion $CO_2e \geq 25{,}000$ metric tons CO_2e per year are required to report emissions. POTW process GHG emissions are exempt from reporting at this time.
- *U.S. EPA Tailoring Rule.*[17]
  - Title V Applicability: Facilities with the potential to emit ≥ 100,000 tons per year (tpy) CO_2e
  - Prevention of Significant Deterioration (PSD) Applicability for New Projects:
    - GHG potential to emit (PTE) ≥ 100,000 tpy CO_2e, or
    - "PSD anyway" sources ≥ 75,000 tpy CO_2e
  - PSD Applicability for Modified Sources:
    - "PSD anyway" source with GHG PTE ≥ 75,000 tpy CO_2e,
    - Existing PTE ≥ 100,000 tpy and increase and net increase both ≥ 75,000 tpy CO_2e, or
    - Existing minor source with GHG PTE ≥ 100,000 tpy CO_2e

Since the CMSA RWTF emissions do not meet any of the above ARB or U.S. EPA GHG regulatory thresholds, CMSA is not obligated to comply with any of the state or federal GHG regulations at this time.

Local Regulations

At a local level, there are no climate change regulations or ordinances that directly impact CMSA. The Bay Area Air Quality Management District (BAAQMD) will carry out U.S. EPA's Tailoring Rule through its update to Regulation 2. However, as demonstrated through the emissions estimate herein, CMSA's emissions are far below all compliance thresholds of the Tailoring Rule and CMSA's PTE levels are likely below the thresholds as well (although, to be prudent, CMSA should verify this).

In 2002, the Marin County Board of Supervisors signed a resolution to join the Cities for Climate Protection Campaign (CCP). This campaign is administered under the

[17] CH2M HILL. (April 2012) *Bay Area Clean Water Agencies (BACWA) Air Issues and Regulations Committee Newsletter*; BACWA; Oakland, California

International Council for Local Environmental Initiatives (ICLEI) of the Local Governments for Sustainability and attempts to reduce international GHG emissions through actions by local governments. Through this action, Marin County pledged to:

1. *Analyze greenhouse gas emission levels.* Determine current GHG emissions and forecast the growth in emissions that will occur without preventative action.
2. *Set a reduction target.* The target is the specific reduction that Marin aims to achieve by a designated year; e.g., 20% GHG reduction by 2020.
3. *Develop a local action plan*. This plan is a description of policies, programs, and measures that Marin will implement in order to meet its target.
4. *Implement the local action plan.* Follow through on the proposed actions.
5. *Monitor the progress and report results.* Determine the success of the plan[18].

In 2006, the Marin County Community Development Agency developed a *Greenhouse Gas Reduction Plan*. As a result of analyzing emissions from internal government operations as well as from the County as a whole, a target has been made to voluntarily reduce GHG emissions 15%-20% below 1990 levels by the year 2020 for internal government and 15% countywide. This target exceeds the state target for GHG reductions. The inventory shows that in order to reduce GHG emissions, Marin County needs to address transportation issues and energy use. The plan lists resources and programs available to support measures, and describes potential actions that can be taken to further reduce emissions[19].

The City of San Rafael published its *Climate Change Action Plan* in April 2009. Some of the key findings in the plan that may be of interest to CMSA are summarized as follows:

- *The largest single purpose use of electricity in Marin County is related to the pumping, treatment and disposal of water and wastewater. Water conservation not only minimizes the need to find new sources and expand infrastructure, but also saves energy to treat and convey water and wastewater. It has also been proven that employing water conservation techniques and using native plant materials is less expensive than securing and providing new water supplies[20].*
- It is recommended that the City monitor sea level rise and plan for shoreline defense and increase its understanding and preparation for the effects of climate change through participation in Marin County's regional vulnerability assessment, preparing a local vulnerability assessment for San Rafael, and continuing to provide emergency planning and community awareness.
- Move toward a zero waste goal and eliminate organic materials from the landfill.
- Target a goal of reducing City GHG emission 25% from 2005 levels by2020 and surpass the State's 15% goal for local governments.

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18 Marin County Community Development Agency (October 2006) *Marin County Greenhouse Gas Reduction Plan*; http://www.co.marin.ca.us/depts/CD/main/comdev/advance/Sustainability/susinitiatives/climate/pdf/FinalMarinGHGReductionPlan_Sep19.pdf

19 Ibid

20 City of San Rafael (April 2009) *Climate Change Action Plan*; http://acm.cityofsanrafael.org/Assets/CDD/Climate+Change+Action+Plan.pdf

The county and City climate change goals are not mandatory. However they provide CMSA opportunity to leverage community-wide support to meet its own sustainability goals. CMSA is playing a key role in helping the county and City achieve their goals by reducing energy use at the RWTF; increasing renewable energy by expanding the solids processing and cogeneration system to accommodate FOG and foodwaste feedstock; diverting biosolids away from landfill disposal through utilizing the material for soil amendment in Sonoma County and alternative daily cover at Redwood Landfill; and implementing the GHG emissions estimate herein, which will provide more accuracy to the City and county GHG emissions inventories. Additionally CMSA has plans to partner with the Marin Municipal Water District to develop a recycled water feasibility study in 2014, which will support San Rafael's water conservation goal.

Climate Change Adaptation

Most of the media attention and regulations around climate change have been focused on reducing GHG emissions to avoid climate change. However reports from the global scientific community indicate that state climate change is already occurring and we need to prepare for its impacts. Accordingly, planning ahead for climate change adaptation is an important issue that CMSA should integrate into facility master planning and capital improvement and operational budgeting[21]. A 2009 study commissioned by the National Association of Clean Water Agencies (NACWA) and the Association of Metropolitan Water Agencies (AMWA) estimates the cost for U.S. wastewater and water utilities to respond to the impacts of climate change through 2050 could range from $448 to $944 billion[22].

Climate change may manifest in the form of increased extreme precipitation events, increased droughts, and sea level rise and storm surges. There are numerous issues that may impact wastewater collection, treatment, and discharge systems, and CMSA should be prepared. Some of these issues were introduced in the NACWA/AMWA study and a brainstorm matrix drafted by staff of the Sanitation Districts of Los Angeles County (LACSD)[23], as follows:

- Greater necessity for stormwater storage and treatment facilities during extreme storm events
- Facility and infrastructure flooding
- Potential need to accommodate both reduced drought flows and greater stormwater flows that do not coincide seasonally
- Ocean level rise impact on total discharge head of pump stations
- Impacts to temperature-dependent treatment processes
- Activated sludge efficacy affected by warmer air and warmer water temperatures
- Possible negative salt balance (excessive salt levels) in biosolids cakes
- Negative impacts on chlorine residuals with elevated wastewater temperatures
- Increased sulfide generation due to higher temperatures and substrate concentrations

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[21] Sandoval, et al, March 23, 2010

[22] National Association of Clean Water Agencies and Association of Metropolitan Water Agencies. (October 2009) *Confronting Climate Change: An Early Analysis of Water and Wastewater Adaptation Costs;* Washington, D.C.

[23] Adams, G.M. (January 14, 2008) Climate Change Impacts on the Wastewater Industry, Adaptation Challenges, Revision 2, Los Angeles County Sanitation Districts

- More sanitary sewer/combined sewer overflows caused by higher inflow from more intense storms
- Very significant impact of peaking factors on plant design and hydraulics
- Need for new pumps and pipes
- Need for rehabilitated and expanded dikes
- Receiving water quality impacts
- Need for more decentralized treatment
- Increased concentration of sewage, creating odor, treatment process, and other problems
- Increased treatment requirements and wear on facilities due to higher peak flows and handling of higher concentrations of solids and sulfides
- Higher energy demands
- Expanded regulations for wet weather management
- Concentration impacts caused by loss of dilution during droughts
- Greater demand for recycled water and direct reuse facilities
- Greater demand for reuse of urban runoff and Low Impact Development (LID) to maximize the infiltration and/or capture of stormwater in communities to increase local water supplies

The impacts of climate change will be felt differently in different geographies. To understand how climate change may impact CMSA's infrastructure, it is recommended that CMSA conduct a site-specific analysis. Localized modeling can be done to predict likely changes in precipitation, temperature, and sea level rise. The projected changes can then be incorporated into CMSA's planning process. If CMSA is not already doing so, participating in Marin County's regional vulnerability assessment may help augment some of the level of effort for data gathering and analysis level and the cost to develop a climate change adaptation plan.

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Attachment 1

Central Marin Regional Wastewater Treatment Facilities
2012 Greenhouse Gas Emissions Calculations

Attachment 1.A

Summary

Central Marin Regional Wastewater Treatment Facilities 2012 GHG Emissions

Source	Scope	Emissions (metric tons/year)			
		Anthropogenic CO2	CH4	N2O	CO2e
Stationary Combustion	1	1,816	0.144	0.025	1,827
Mobile Combustion	1 and 3	53	0.013	0.001	53
Fugitive CH4 and Process N2O Emissions	1	-	6.579	3.153	1,116
Indirect Emissions (Purchased Electricity)	2	124	0.009	0.002	124
Biogenic CO2 (metric tons/yr)	1,780	-	0.1094	0.0215	9

1.Emissions estimated following the Local Government Operations Protocol (LGOP), Version 1.1, May 2010 (LGOP, 2010); The Climate Registry General Reporting Protocol, Version 2.0, March 2013; and California Air Resources Board (ARB) Regulation for the Mandatory Reporting of Greenhouse Gases (GHG), Title 17, Div. 3, Chapter 1, Subchapter 10, starting with Section 95100. The ARB GHG regulation references 40 Code of Federal Regulations Part 98 Subpart C.

2.Mobile combustion includes scope 1 emissions from CMSA owned vehicles and scope 3 emissions from biosolid hauling.

3.Biogenic emissions from combustion are reported separately from the scopes (LGOP, 2010).

2012 Summary of Emissions by Scope

Scope	Emissions (metric tons/year)				
	Anthropogenic CO2	CH4	N2O	CO2e	*Biogenic CO2*
1	1,846	6.74	3.18	**2,973**	
2	124	0.009	0.002	**124**	
3	23	0.00006	0.00006	**23**	
Biogenic		0.1094	0.0215	**9**	*1,780*

Definition of Scope Numbers (LGOP, 2010):

Scope 1: All direct GHG emissions (with the exception of direct CO2 emissions from biogenic sources).

Scope 2: Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.

Scope 3: All other indirect emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity (e.g., employee commuting and business travel), outsourced activities, waste disposal, etc.

Stationary Combustion and Fugitive Methane

Methodologies:
*Basic methodology: Emissions = Activity Data * Emission Factor * Mass Conversion Factor*

General Stationary Combustion Emissions:
Calculation methodology from California Air Resources Board (ARB) Regulation for the Mandatory Reporting of Greenhouse Gases (GHG), Title 17, Div. 3, Chapter 1, Subchapter 10, starting with Section 95100.
Emission factors from Table C-1 of Subpart C, Part 98.

CH4 Emissions from Incomplete Combustion:
Calculation methodology from LGOP, Version 1.1, Chapter 10: Wastewater Treatment Facilities, May 2010 (LGOP, 2010).

Assumptions:
None identified.

Color coding:

User entry cells
Pre-defined cells

Source	Emissions (metric tons/year)				
	Anthropogenic CO2	*Biogenic CO2*	CH4	N2O	CO2e
General Stationary Combustion Emissions from natural gas and biogas, estimated on the *ARB Mandatory Reporting Check* tab, including one cogen engine, two biogas fuel boilers, and two waste biogas flares.	1,808.57	*1,780.01*	1.44E-01	2.49E-02	1,819.32
General Stationary Combustion Emissions from five diesel engine-driven pumps and a diesel generator, estimated on thee *ARB Mandatory Reporting Check* tab.	7.85	*0*	3.18E-04	6.37E-05	7.88
TOTALS	**1,816.42**	***1,780.01***	**0.144**	**0.025**	**1,827.19**

NOTES:
1. The emission factor used to calculate the biogas emissions did not include pass-through CO2 emissions (which doubles the factor).
2. CO2e is the sum of anthropogenic CO2, CH4, and N2O.

Calculation of CH4 Fugitive Emissions from Incomplete Combustion of Digester Gas
Equation 10.1 from LGOP, Version 1.1, May 2010 (LGOP, 2010):

$$CH_4 \text{ incomplete combustion of digester gas [metric tons } CH_4\text{/year]} = \text{Digester Gas } [ft^3/day] \times F_{CH4} \times \rho(CH_4)[g/m^3] \times (1 - DE) \times 0.0283[m^3/ft^3] \times 365.25[day/year] \times 10^{-6} [\text{metric ton/g}]$$

where

Term	Description	Value	CO_2e (metric tons/yr)	
CH_4 incomplete combustion of digester gas	= CH_4 emissions from incomplete combustion of digester gas [metric ton CH_4/year]	**6.58**	**138.16**	
Digester Gas	= measured standard cubic feet of digester gas produced per day [ft^3/day]	137,355		Data source: Annual digas consumption provided in CMSA 2012 GHG Study Compiled Data document divided by 366 days in 2012.
F_{CH4}	= measured fraction of CH_4 in biogas	0.70		Data source: CMSA IR meter (average of mole% CH4 in *Kg C per Kgmoles Gas)*
$\rho(CH_4)$	= density of methane at standard conditions [g/m^3]	662.00		
DE	= CH_4 destruction efficiency from flaring or burning in engine	0.99		
0.0283	= conversion from ft^3 to m^3 [m^3/ft^3]	0.0283		
365.25	= conversion factor [day/year]	365.25		
10^-6	= conversion from g to metric ton [metric ton/g]	1.E-06		

Attachment 1.C

Reporting Applicability Check for Revised Regulation
Central Marin Regional Wastewater Treatment Facilities

Emission Factor Sources:
40 CFR Part 98 Subpart C, General Stationary Fuel Combustion Sources, December 2010 (see http://www.epa.gov/ghgreporting/reporters/subpart/index.html).
Emission factors and High Heat Values for Diesel, Natural Gas, and Biogas from 40 CFR Part 98 Subpart C, Tables C-1 and C-2.

Methodology:
Basic methodology: Emissions = Fuel Use x High Heat Value (HHV) x Emission Factor

Diesel Fuel Emissions Methodology
40 CFR Part 98 Subpart C, Section 98.33(a)(1)(i), Equation C-1, and Section 98.33(c)(1) Equation C-8

Equation C-1 or C-8: CO_2, CH_4, or $N_2O = 1 \times 10^{-3} \times Fuel \times HHV \times EF$

Where: CO_2, CH_4, N_2O = Annual CO_2, CH_4, or N_2O mass emissions for a specific fuel type (metric tons).
Fuel = Volume of the fuel combusted during the year, from company records as defined in § 98.6 (standard cubic feet for gaseous fuel and gallons for liquid fuel).
HHV = Default high heat value of the fuel from Table C-1 of 40 CFR 98.
EF = Fuel-specific default CO_2 emission factor, from Table C–1 of this subpart (kg CO_2/MMBtu), or CH_4 and N_2O emission factors, from Table C-2 of this subpart (kg CH_4 or N_2O/MMBtu).
1×10^{-3} = Conversion factor from kilograms to metric tons.

Natural Gas and Biogas Emissions Methodology
40 CFR Part 98 Subpart C, 98.33 (a)(2), Equations C-2a and C-2b, and 98.33 (c)(2), Equation C-9a

Equation C-2a or C-9a:
Where: CO_2, CH_4, N_2O = Annual CO_2, CH_4, or N_2O mass emissions for a specific fuel type (metric tons).
Fuel = Volume of the fuel combusted during the year, from company records as defined in § 98.6 (standard cubic feet for gaseous fuel and gallons for liquid fuel).
HHV = Annual average HHV of the fuel from all valid samples for the year (MMBtu per mass or volume). The average HHV shall be calculated according to the requirements of paragraph (a)(2)(ii) of this section.
EF = Fuel-specific default CO_2 emission factor, from Table C–1 of this subpart (kg CO_2/MMBtu), or CH_4 and N_2O emission factors, from Table C-2 of this subpart (kg CH_4 or N_2O/MMBtu).
1×10^{-3} = Conversion factor from kilograms to metric tons.

Equation C-2b: $HHV_{annual} = \Sigma (HHV_i \times Fuel_i) / \Sigma Fuel_i$
Where: HHV_{annual} = Weighted annual average HHV of the fuel (MMBtu per volume).
HHV_i = HHV of the fuel for month "i"
$Fuel_i$ = Volume of the fuel combusted during month "i"

Emission Calculations for 2012

Emission Source(s)	Type of Fuel	Annual Fuel Consumption	Fuel Consumption Units	High Heat Value (HHV)	HHV Units	CO_2 Emission Factor (kg/MMBtu)	CO_2 Emissions (metric tons/year)	CH_4 Emission Factor (kg/MMBtu)	CH_4 Emissions (metric tons/year)	N_2O Emission Factor (kg/MMBtu)	N_2O Emissions (metric tons/year)	CO_2e Emissions (metric tons/year)
Facility Diesel Fuel	Diesel	769	Gallons	0.138	MMBtu/gal	73.96	7.85	3.00E-03	3.18E-04	6.00E-04	6.37E-05	8
Facility Natural Gas	Natural Gas	33.182	MMscf	1,028	MMBtu/MMscf	53.02	1,809	1.00E-03	3.41E-02	1.00E-04	3.41E-03	1,810
Facility Digester Gas - Cogen	Biogas	48.851	MMscf	680	MMBtu/MMscf	52.07	1,730	3.20E-03	1.06E-01	6.30E-04	2.09E-02	1,738
Facility Digester Gas - Boilers (2)	Biogas	0.474	MMscf	680	MMBtu/MMscf	52.07	17	3.20E-03	1.03E-03	6.30E-04	2.03E-04	17
Facility Digester Gas - Flares (2)	Biogas	0.947	MMscf	680	MMBtu/MMscf	52.07	34	3.20E-03	2.06E-03	6.30E-04	4.06E-04	34
											Total (metric tons/year)	**3,607**

Notes:

1. For completeness, the diesel fuel use has been included. However, the "relatively stand-by" diesel engine-driven pumps may be exempt from reporting per 40 CFR Part 98 Subpart C, Section 98.30(b)(2). The diesel values are from the 8/13/13 "CMSA 2012 GHG Study Compiled Data" spreadsheet.
2. The natural gas and digester gas fuel consumption includes gas to the one dual fuel cogen engine, two digester gas fuel boilers, and two waste digester gas flares. Natural gas use based on the PG&E meter value.
3. Since the WWTF's cogen engine was offline from 10/18/12 - 12/31/12, the natural gas that would typically be used by the engine during this period was estimated by CMSA staff.
4. Since the 2012 HHV for natural gas was not available, CMSA provided PG&E's October 2013 HHV of 1,028 MMBtu/MMscf.
5. The HHV for biogas was measured on 8/29/13 by Centek Laboratories using ASTM Method 3588. If CMSA were obligated to comply with 40 CFR Part 98, HHVs would ideally be measured monthly to produce an accurate annual weighted average HHV. See 40 CFR 98.33(a)(2)(ii).

Comparison of Emissions to Threshold

Sector	Reporting Threshold (metric tons CO_2e/yr)	Reporting Required?
General Stationary Combustion (GSC)	10,000	No

Mobile Sources

Methodology:
Calculation methodology from TCR General Reporting Protocol, Version 2.0, Chapter 13 and LGOP, Version 1.1, Chapter 7: Vehicle Fleet, May 2010 (LGOP, 2010).
*Basic methodology: Emissions = Activity Data * Emission Factor * Mass Conversion Factor*
Emission factors from The Climate Registry's 2013 Default Emission Factors document and Tables G.11, G.12, G.13, and G.14 of the LGOP, Version 1.1, May 2010 (LGOP, 2010).

Calculations:
CO_2 Emissions (metric tons/year) = Fuel Usage (gallons/year) x CO_2 Emission Factor (kg/gallon) x 0.001 (metric tons/kg)
CH_4 Emissions (metric tons CO_2e/year) = Mileage (miles/year) x CH_4 Emission Factor (g/mile) x 0.000001 (metric tons/g)
N_2O Emissions (metric tons CO_2e/year) = Mileage (miles/year) x N_2O Emission Factor (g/mile) x 0.000001 (metric tons/g)
CO_2e Emissions (metric tons/year) = CO_2 Emissions (metric tons /year) + CH_4 emissions x 21 (metric tons CO_2e/metric tons CH_4) + N_2O emissions x 310 (metric tons CO_2e/metric tons N_2O)

Assumptions:
Due to the small number of vehicles and climate in San Rafael, it was assumed that air conditioning use was negligible such that fugitive emissions from vehicle air conditioning systems would be minor and did not need to be estimated.
Biosolids hauling truck has an assumed fuel economy (miles/gallon) of 5.5.

Color coding:
User entry cells
Pre-defined cells

Vehicle Type and Year[1]	Year	VIN	Fuel Type	Fuel Usage (gallons/year)	Fuel Economy (miles/gallon)[7]	Mileage (miles/year)	CO2 Emission Factor (kg/gallon)	CO2 Emissions (metric tons/year)	CH4 Emission Factor (g/mile)	CH4 Emissions (metric tons/year)	N2O Emission Factor (g/mile)	N2O Emissions (metric tons/year)	CO2e (metric tons/year)
Ford F150 (ES/Lab)[2]	2012	1FTFX1CF3CFA45687	Gasoline	457.1	16	7,314	8.78	4.01	0.0163	0.00012	0.0066	0.00005	4.03
Ford F150[3]	2000	1FTPF17MXYKA91404	CNG	312.3	11	3,435	0.007	0.00	0.737	0.00253	0.050	0.00017	0.11
Ford E250 (E/I)	2008	1FNE24W58DA82877	Gasoline	80.8	15	1,212	8.78	0.71	0.0163	0.00002	0.0066	0.00001	0.71
Ford F450	2007	1FDXF46P87EB32036	#2 Diesel	22.7	11	250	10.21	0.23	0.0010	0.00000	0.0015	0.00000	0.23
Ford Ranger 2009	2009	1FTYR14D99PA63193	Gasoline	246.9	16	3,950	8.78	2.17	0.0163	0.00006	0.0066	0.00003	2.18
Ford Ranger 2006	2006	1FTYR14D67PA18368	Gasoline	572.5	15	8,588	8.78	5.03	0.0159	0.00014	0.0089	0.00008	5.05
Ford Crown Victoria[3]	2001	2FAFP7298IXI9I220	CNG	907.7	14	12,708	0.007	0.01	0.737	0.00937	0.050	0.00064	0.40
Ford Explorer	2005	1FMDU62E95UB29612	Gasoline	342.4	14	4,793	8.78	3.01	0.0157	0.00008	0.0101	0.00005	3.02
Honda Civic Eleven	2006	JHMFA36226S011241	Gasoline Hybrid	103.3	40	4,131	8.78	0.91	0.0161	0.00007	0.0057	0.00002	0.92
Honda Civic Twelve	2006	JHMFA36206S030693	Gasoline Hybrid	157.1	40	6,285	8.78	1.38	0.0161	0.00010	0.0057	0.00004	1.39
Toyota Highlander	2007	JTEEW21A670043898	Gasoline Hybrid	473.6	28	13,260	8.78	4.16	0.0170	0.00023	0.0041	0.00005	4.18
Caterpillar 5000 # Forklift (P5000-LP)[4]	2008	AT3511036	Propane	939.3	N/A	149	5.590	5.25	0.0010	0.00000	0.0001	0.00000	5.25
Bobcat Skid Steer Loader S185[5,6]	2006	530313189	#2 Diesel	240.3	2.7	89	10.21	2.45	0.58	0.00014	0.26	0.00006	2.48
Diesel Heavy Duty Trucks - Biosolid Hauling			#2 Diesel	2,293.1	5.5	12,612	10.21	23.41	0.0051	0.00006	0.0048	0.00006	23.43
Total Mobile GHG Emissions						**78,776**		**52.73**		**0.013**		**0.001**	**53.38**

Notes:

1. The diesel and gasoline light duty trucks are CMSA owned and are classified as Scope 1 emissions. The diesel heavy duty trucks represent the biosolid hauling trucks that are contractor owned and are classified as Scope 3 emissions.

2. The Climate Registry's 2013 Default Emission Factors document only has data through year 2010. The Ford F150 (ES/Lab) truck is a 2012, but is considered a 2010 for calculation purposes.
3. The CO2 emission factor for CNG vehicles is in units of kg/scf. Accordingly the CO2 emission factor has been converted from 0.054 kg CO2/scf to 0.007 kg CO2/gallon.
4. No fuel economy data for the Caterpillar P5000-LP Forklift could be found in an internet querry. Gallons of propane fuel usage were estimated to be 939 gallons using the following formula for propane gas: annual fuel use (gal/yr) = (hrs use) x hp x (10,000 BTU/hr/hp) x (1 gal/92,000 BTU). 2008 P5000-LP has a HP of 58 at 2675 rpm. Propane BTU properties found at http://www.yamaha-propane-natural-gas-generators.com/fuel_consumption.htm. The Climate Registry's 2013 Default Emission Factors document only has Canadian emission factors for CH4 and N2O in g/liter. Accordingly, the CH4 and N2O emissions factors from Table G.4 of the LGOP have been used.

5. The Bobcat Skid Steer fuel usage is based on a specified fuel economy of 2.7 gallons/hour and 89 hours operated in 2012. Fuel economy reference is October 6, 2007, Bobcat S185 Skid-Steer Loader Sepcifications document: http://webcache.googleusercontent.com/search?q=cache:pLk-mFWABqMJ:lewisrentspdx.com/LinkClick.aspx%3Ffileticket%3DYEwnKm3htpU%253D%26tabid%3D+&cd=4&hl=en&ct=clnk&gl=us.

6. The CH4 and N2O emissions factors for construction equipment have units of g/gallon instead of g/mile. Accordingly the emissions factors for the Bobcat are multiplied by the gallons used, not the miles driven.
7. Since the annual fuel use amount for each individual vehicle was not available, it was back-calculated from vehicle MPG database at the U.S. Department of Energy website http://fueleconomy.gov/. "City" MPG values were used for CMSA-owned vehicles since the majority of miles are likely off-highway.

Attachment 1.E

Process Emissions

Methodology:
Calculation methodology from LGOP, Version 1.1, Chapter 10: Wastewater Treatment Facilities, May 2010 (LGOP, 2010).

Calculations:
See equations below.

Assumptions:
The facility does not include lagoons, nitrification/denitrification, or septic systems.

Color coding:

User entry cells
Pre-defined cells

Process N_2O Emissions - WWTFs without Nitrification/Denitrificaiton
Equation 10.8 from LGOP, Version 1.1, May 2010 (LGOP, 2010):

$$N_2O_{plant\ w/o\ nit/denit}\left[\frac{metric\ ton\ N_2O}{year}\right] = P\ [person] \times EF_{w/o\ nit/denit}\left[\frac{g\ N_2O}{person \times year}\right] \times 10^{-6}\left[\frac{metric\ ton}{g}\right]$$

where

Term	Description	Value	CO_2e (metric tons)
N_2O plant	= N_2O emissions from a centralized WWTP [metric ton N_2O/year]	**0.35**	**109**
P	= population that is served by the WWTP without nitrification/denitrification [person]	110,000	
EF w/o nit/denit	= emission factor for a WWTP without nitrification/denitrification [g N_2O/person/year]	3.2	
10^-6	= conversion from g to metric ton [metric ton/g]	1.E-06	
CO2e (metric ton)	= N2O Global Warming Potential	310	

Note: if a significant quantity of industrial wastewater (N) is co-discharged with domestic wastewater, then the population should be multiplied by a factor of 1.25. Since only 3% is industrial, the factor is not used.

Process N_2O Emissions - Effluent discharge to receiving aquatic environments
Equation 10.9 from LGOP, Version 1.1, May 2010 (LGOP, 2010):

$N_2O_{effluent}$ [metric tons N_2O/year] = $TN_{effluent}$ [kg N/day] x $EF_{effluent}$ [(kg N_2O - N)/(kg sewage - N)] x 44/28 [(kg N_2O)/(kg N_2O - N)] x 365.25 [days/year] x 10^{-3} [metric tons/kg]

where

Term	Description	Value	CO_2e (metric tons)
N_2O effluent	= N_2O emissions from effluent discharge to aquatic environments [metric ton N_2O/year]	**2.8**	**868**
TN effluent	= measured average total nitrogen discharged [kg N/day]	976	
EF effluent	= emission factor [kg N_2O-N/kg sewage-N produced]	0.005	
44/28	= conversion of kg N_2O-N into kg N_2O (molecular weight ratio of N_2O to N_2)	1.57	
365.25	= conversion factor [day/year]	365.25	
10^-3	= conversion from kg to metric ton [metric ton/kg]	1.E-03	
CO2e (metric ton)	= N2O Global Warming Potential	310	

TOTAL N2O PROCESS EMISSIONS	**3.15**	**977.41**

Attachment 1.F

Purchased Electricity

Methodology:
Calculation methodology from LGOP, Version 1.1, Chapter 6: Facilities, May 2010 (LGOP, 2010).
Emission factors from Table 14.1 of The Climate Registry's 2013 Default Emission Factors, updated on April 2, 2013 (see http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/).

Calculations:
Emissions (metric tons) = Electricity Use (MWh) × Emission Factor (lbs/MWh) / 2,204.62 (lbs/metric ton)
CO2e Emissions (metric tons/year) = CO2 Emissions (metric tons/year) + CH4 emissions x 21 (metric tons CO2e/metric tons CH4) + N2O emissions x 310 (metric tons CO2e/metric tons N2O)

Assumptions:
None identified.

Color coding:
User entry cells
Pre-defined cells

Electricity Use

Facility	Purchased Electricity (kWh/year)
RWTF (January-June 2012)	348,514
RWTF (July-December 2012)	348,514
Total	697,028

Emissions

Grid Power Utility[1]	Electricity Use (MWh/year)[2]	CO2 Emission Factor (lbs/MWh)[3, 4]	CO2 Emissions (metric tons/year)	CH4 Emission Factor (lbs/MWh)	CH4 Emissions (metric tons/year)[5]	N2O Emission Factor (lbs/MWh)	N2O Emissions (metric tons/year)[5]	CO2e (metric tons/year)
PG&E (January-June 2012)	349	392.87	62	0.02894	0.0046	0.00617	0.00098	63
Marin Clean Energy (July-December 2012)	349	389	61	0.02894	0.0046	0.00617	0.00098	62

Notes:
1. CMSA changed its power utility provider from PG&E to Marin Clean Energy on July 1, 2012.
2. It is assumed that each utility provided 50% of CMSA's power consumption in 2012.
3. The most current CO2 emission factor published for PG&E is for 2011. It is published at http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/#jump3.
4. The most current CO2 emission factor published for Marin Clean Energy is for 2011. It is published at www.marinenergyauthority.com/PDF/5.13.13_Tech._Comm._Packet.pdfCached.
5. CH4 and N2O emission factors were not published for PG&E or Marin Clean Energy. Accordingly, California values published by the Western Electricity Coordinating Council were used. They are published in Table 14.1 of The Climate Registry's 2013 Default Emission Factors document. The latest values published are from 2009.

Attachment 2

Data Request Form

Summary of Collected Data

REQUEST FOR 2012 DATA

2012 Greenhouse Gas Emissions Inventory

Central Marin Sanitation Agency Wastewater Treatment Facility

Please provide the following data for calendar year 2012. The data will support the estimation of Scope 1, Scope 2 and limited Scope 3 Greenhouse gas (GHG) emissions.[1]

SCOPE 1 GHG Data

1. Mobile Combustion
    a. Provide the following information for <u>each</u> vehicle owned by CMSA that is dedicated to the wastewater treatment facility (WWTF). For CMSA vehicles that partially support the WWTF, provide a percentage.
        i. Vehicle Owner[2]
        ii. Make
        iii. Model
        iv. Model Year
        v. Fleet ID#
        vi. 2012 miles traveled
        vii. Fuel type (gasoline, diesel, biodiesel 20, etc.)
        viii. Fuel use amount (gallons or liters) in 2012
            1. Measured carbon content of fuels and measure fuel density or heat content. If you cannot obtain these, then we need the measured heat content. If you cannot obtain the measured heat content, then we'll use the less accurate Tier B calculations which allow for default values for carbon and heat content.
        ix. Vehicle type and associated control technology in Table 13.4 of the attached "2013-TCR-Default-Emissions-Factors.pdf" file
            1. If gathering the control technology is not possible or too cumbersome, The Climate Registry (TCR) General Reporting Protocol (GRP) allows reporting agencies to utilize Table 13.5, in which case you need to provide the vehicle type on Table 13.5

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[1] Scope 1 GHG emissions are from sources *owned or controlled* by the CMSA WWTF. Scope 2 emissions result from the generation of electricity, heat or steam *purchased* by the WWTF. Scope 3 emissions are from *sources not owned or directly controlled* by the WWTF, *but related* to the facility activities.

[2] The GHG emissions of vehicles that are not owned by CMSA (e.g., biosolids transfer trucks) will be moved to the Scope 3 emissions category.

2. Stationary Combustion

    a. A list of stationary emission sources such as natural gas and dual fuel boilers, generators, flares, fuel powered pumps, or cogeneration engines and the fuel type for each source. An inventory of emergency or standby equipment.

    b. The total facility natural gas and digester gas throughput in 2012 (units of standard cubic feet [scf] for natural gas and scf or MMBtu for digester gas) in all stationary emissions sources including:[3]

        i. Cogeneration engines

        ii. Flares

        iii. Boilers

    c. The monthly and annual average natural gas heat content (units of Btu/scf). The monthly value should be provided on the utility bill/invoice.

    d. The measured monthly and annual average digester gas heat content (units of Btu/scf)

    e. The total facility diesel throughput in 2012 (units of gallons) in all stationary emissions sources.[4]

    f. The total facility gasoline throughput in 2012 (units of gallons) in all stationary emissions sources. [4]

    g. Additional information to consider: How is fuel use metered? Is there one meter for each fuel type (e.g. PG&E natural gas meter)? Does each unit have a separate meter? The regulation requires that emissions are calculated based on a meter with calibrated accuracy of $\pm$ 5 percent. For example, if the individual natural gas meters do not have this accuracy, you can report the fuel use by the individual meters and use the PG&E meter to estimate emissions. ARB assumes PG&E (or other supplier) meters meet the $\pm$ 5 percent accuracy.

    h. If the total General Stationary Combustion GHG emissions are found to exceed 10,000 metric tons CO2e, then CH2M HILL may request additional data that may include the following information. <u>However, it is not necessary to collect this data at this time.</u>

        i. The cogeneration operation in 2012. This information will be used to calculate the CO_2 emissions from electricity generation.

            a. The nameplate generating capacity (MW) of each cogeneration engine.

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[3] GHG emissions from any natural gas, digester gas or other gaseous fuels that are combusted in the WWTF in stationary equipment other than digester engines or equipment permitted by the BAAQMD is likely considered to be *de minimis* (i.e., less than 5% of the WWTF's total GHG emissions), and therefore the GRP does not require reporting. However, if this data is easily obtainable, please include it in the data submission so we can verify *de minimis*. If it's tedious to obtain this data, then discuss with CH2M HILL before collecting the data.

[4] GHG emissions from any gasoline or diesel that are combusted in the WWTF in stationary equipment other than equipment permitted by the BAAQMD is likely considered to be *de minimis* (i.e., less than 5% of the WWTF's total GHG emissions), and therefore the GRP does not require reporting. However, if this data is easily obtainable, please include it in the data submission so we can verify *de minimis*. If it's tedious to obtain this data, then discuss with CH2M HILL before collecting the data.

b. Net power generated (MWh) for each engine

c. Efficiency of electricity generation (if known).

i. *If the efficiency values are not known, the regulation provides the following default values: §95112(b)(4)(A) "Operators may use assumed values of 0.35 for electricity generation efficiency and/or 0.80 for thermal energy production efficiency, when parameters are unknown."*

ii. The following information regarding electricity generation, as applicable:

a. Electricity sold wholesale (MWh)

b. Electricity sold or provided directly to end-users (MWh) and end-user's NAICS code

c. Electricity consumed on-site (MWh)

3. Wastewater Treatment Process Emissions

a. Population serviced by the WWTF

b. Population serviced by the WWTF's anaerobic digester (if different than 4.a)

c. Measured fraction of CH4 in the WWTF's biogas (only if measured)

d. Percentage of industrial and commercial discharges into the WWTF (if known)

e. Measured average total nitrogen discharged (kg N/day) from the WWTF to the ocean outfall (only if measured)

f. Amount of known significant industrial contributions of nitrogen (kg N) discharged into the WWTF

Scope 2 GHG Data

1. Purchased Electricity

a. Known electricity use (metered readings or utility bills) in kilowatt-hours (kWh) or megawatt-hours (MWh) at the WWTF in 2012

CMSA 2012 GHG Study Compiled Data
Jeff Boheim E/I Tech
8/13/2013

Scope 1, Section 1.												
Mobile Combustion	Vehicle Decription	ID #	Make	Year - Model	2012 miles	Fuel type	Source of information	Additional information	Brake HP	KW output	efficiency	
1	Ford F150 (ES/Lab)	1FTFX1CF3CFA45687	Ford	2012 - F150	7,314	Gasoline	NEXGEN PM records					
2	Ford F150	1FTPF17MXYKA91404	Ford	2000 - F150	3,435	CNG	NEXGEN PM records					
3	Ford E250 (E/I)	1FNE24W58DA82877	Ford	2008 - E250	1,212	Gasoline	NEXGEN PM records					
4	Ford F450	1FDXF46P87EB32036	Ford	2007 - F450	250	#2 diesel	NEXGEN PM records					
5	Ford Ranger 2009	1FTYR14D99PA63193	Ford	2009 - Ranger	3,950	Gasoline	NEXGEN PM records					
6	Ford Ranger 2006	1FTYR14D67PA18368	Ford	2006 - Ranger	8,588	Gasoline	NEXGEN PM records					
7	Ford Crown Victoria	2FAFP7298IXI9I220	Ford	2001 - Crown Victoria	12,708	CNG	NEXGEN PM records					
8	Ford Explorer	1FMDU62E95UB29612	Ford	2005 - Explorer	4,793	Gasoline	NEXGEN PM records					
9	Honda Civic Eleven	JHMFA36226S011241	Honda	2006 - Civic	4,131	Gasoline hybrid	NEXGEN PM records					
10	Honda Civic Twelve	JHMFA36206S030693	Honda	2006 - Civic	6,285	Gasoline hybrid	NEXGEN PM records					
11	Toyota Highlander	JTEEW21A670043898	Toyota	2007 - Highlander hybrid	13,260	Gasoline hybrid	NEXGEN PM records					
CMSA Total 2012 miles					**65926**							
12	Caterpillar 5000 # Forklift	AT3511036	Cat/Mitsub	2008 - P5000-LP	149 (hours in 2012)	Propane	NEXGEN PM records					
13	Bobcat Skid Steer Loader	530313189	Bobcat	2006 - S185	89 (hours in 2012)	#2 diesel	NEXGEN PM records					
								Total gasoline consumption in 2012 = 911 gallons				
Scope 1, Section 2.,												
Stationary Combustion	Source Description			Natural gas cu. Ft. per year	Digester gas **cu. ft.** per	#2 Diesel 2012						
1	~~Gaseous cogen. 2012~~	~~E12.01~~		~~27,228,000~~	~~39,512,420~~		CMSA Op's daily spreadshee	Waukesha P48 GLD, lean burn, digester/natural gas fueled	1182	750		
1	~~**Gaseous cogen. 2011**~~	~~E12.01~~		~~**31,448,000**~~	~~**51,898,127**~~		CMSA Op's daily spreadsheet					
1	**Gaseous cogen. 2012 - corrected for norn**	E12.02		**33,182,000**	**48,851,336**		Constructed from Op's 2011 and 2012 data					
2	Boilers (2) estimated			not possible	**474,000**		estimated					
3	Flares (2)estimated			not possible	**947,000**		estimated					
					2012 Diesel **hours**							
4	Diesel generator	E12.02			**11**	unknown - see hours	CMSA Op's Round sheet	Cummins , KTA 2300, 38 liter turbo diesel, 1800 RPM	1135	750		
5	E 20.1 (Diesel engine driven pumps)	E20.1			**16**	unknown - see hours	CMSA Op's log book	Caterpillar C9 E-cert common rail diesel injection, variable speed	275			
6	E 20.2 (Diesel engine driven pumps)	E20.2			**14.5**	unknown - see hours	CMSA Op's log book	Caterpillar C9 E-cert common rail diesel injection, variable speed	275			
7	E 20.3 (Diesel engine driven pumps)	E20.3			**13.6**	unknown - see hours	CMSA Op's log book	Caterpillar C9 E-cert common rail diesel injection, variable speed	275			
8	E 20.4 (Diesel engine driven pumps)	E20.4			**17**	unknown - see hours	CMSA Op's log book	Caterpillar C9 E-cert common rail diesel injection, variable speed	275			
9	E 20.5 (Diesel engine driven pumps)	E20.5			**19.1**	unknown - see hours	CMSA Op's log book	Caterpillar C9 E-cert common rail diesel injection, variable speed	275			
*	**We will probably not be able to distinguish between burning digester gas in the boilers and/or flares**							**Total diesel fuel consumption in 2012 = 769 gallons**				
Scope 1, Section 3.,												
WWTP Emissions	Process Parameter											
1	Popualtion Served by CMSA	**110000**										
2	Pop. Served by CMSA digesters	**110000**										
3	Measured fraction of CH4 in biogas	**70%**						Typical value on IR based aspirator sampler in boiler room.				
4	% Industrial and Commercial disch.	**3% or .25 MGD**										
5	Measured total nitrogen to bay	**976 kg/day**										
6	Amount of sig. Nitrogen into CMSA	**none**										
Scope 2, Section 1.,												
Purchased Electricity												
	Purchased Electricity 2012 (kWh)	1,492,920										
	Purchased Electricity 2012 (kWh)	697,028		Source: Utility invoices, Op's spreadsheets, and adjusted for generator failure								
Supplementary data												
per 10/10/13 discussion												
Item 1.: HHV from utility bill?	Checked PGE & Spurr bills - no HHV listed											
Item 2.: Natural gas metering?	Natural gas: Metered with Utility's meter											
Item 3.: Vehicle typical usage?	Assume all city miles											
Item 4.: Propane consumption?	Not available for 2012 - future action item											
Item 5.: Purchased Electricity?	Marin Clean Energy - "Light Green" for half of 2012, balance = PG&E.											
Item 6.: Biogas CH4 %?	70-72% on CMSA IR meter. No lab data as of 10/10/13.			**Biogas: HHV = 680 BTU/cf, LHV = 610 BTU/cf**								
Item 7.: CMSA Staff Report on MCE	Separately attached.											
Item 8: Footnote:	CO2 from WWTP process tanks?											
Item 9: Footnote:	Generator failure - annualized data for typical year.											
CMSA Action Items												
Track vehicle fuel use as well as mileage												
Track propane usage												
Track biosolids hauling mileage												
Obtain biosolids hauling truck/engine data												

BASELINE MILEAGE WORKSHEET

Description: Baseline mileage is the total annual mileage to haul biosolids to their current disposal/use site. This mileage will be used to calculate avoided mileage, which will be used to determine part of the overall benefit (well to wheels) for a proposed B2E facility. It will demonstrate the reduction in biosolids hauling miles, truck traffic, fuel consumption, and greenhouse gas emissions.

Avoided mileage will be calculated as "Baseline Mileage - Total Annual Hauling Miles to the B2E Facility."

Instructions: Identify the biosolids disposition alteratives used (i.e., land application, alternative daily cover, composting, landfill), the location of the diposition site, one-way mileage number of annual loads, and annual mileage for hauling biosolids to the agency's disposal/use site.

	Biosolids Disposition				Disposition Site Location				One-way mileage to Disposition Site				Annual Truck Loads to Disposition Site				Annual Mileage for Disposition Alternative			
Coalition Member	Land Application	ADC	Composting	Landfill	Land Application	ADC	Composting	Landfill	Land Application	ADC	Composting	Landfill	Land Application	ADC	Composting	Landfill	Land Application	ADC	Composting	Landfill
City of Burlingame																				
Central Marin Sanitation Agency	2466 tons @ 26.8%	4024 tons @ 26.8%			Synagro site in Southern Sonoma County	Redwood Landfill in Novato			17.4 miles	16.9 miles			139	230			2419	3887		
Delta Diablo Sanitation District																				
Dublin San Ramon Services District																				
Fairfield-Suisun Sewer District																				
Ironhouse Sanitary District																				
City of Livermore																				
North San Mateo County Sanitation District																				
City of Palo Alto																				
City of Richmond																				
San Francisco Public Utilities Commission																				
City of San Jose																				
City of Santa Rosa																				
Sausalito Marin City Sanitary District																				
South Bayside System Authority																				
City of Millbrae																				
Union Sanitary District																				
Vallejo Sanitation District																				
West County Wastewater District																				