Metropolitan Wastewater Management Commission

partners in wastewater management

Greenhouse Gas Inventory for 2014

NOVEMBER 2015

CONTENTS

Cover Photo: David N Jones

Acronym	Definition
ACDP	Air Contaminant Discharge Permit
BEAM	Biosolids Emissions Assessment Model
BOD	Biochemical oxygen demand
CH_4	Methane
CHP	Combined heat and power
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COD	Chemical oxygen demand
DEQ	Department of Environmental Quality
EMS	Environmental Management System
EWEB	Eugene Water and Energy Board
G3C	Good Company's Carbon Calculator
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFC	Hydrofluorocarbons
HVAC	Heating, ventilation, and air-conditioning
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standards Organization
kWh	Kilowatt hour
LED	Light-emitting diode (energy efficient light bulb)
LGOP	Local Government Operations Protocol
LRAPA	Lane Regional Air Protection Authority
MT	Metric Ton
MWMC	Metropolitan Wastewater Management Commission
N_2	Nitrogen gas
N_2O	Nitrous oxide
NWPP	Northwest Power Pool
PFC	Perfluorocarbons
REC	Renewable Energy Certificates
SF_6	Sulfur hexafluoride
T&D	Transmission and Distribution
WW	Wastewater

EXECUTIVE SUMMARY

In 2013, Greenhouse Gas (GHG) inventories were conducted to cover calendar years 2010 and 2012. The inventories provided valuable guidance in managing GHG emissions and has provided a benchmark for future inventories. A subsequent GHG inventory was conducted for the Metropolitan Wastewater Management Commission (MWMC) for calendar year 2014. This inventory provides a detailed GHG evaluation and report on the Eugene/Springfield Regional Sewerage Facilities (MWMC Facilities), comprising the wastewater treatment plant, biosolids management facility, and regional pump stations. The report also includes wastewater pump stations that are owned independently by the City of Eugene and City of Springfield.

As a benchmark, the GHG inventory is used to continue to identify opportunities and strategies for operational cost savings, which may include energy efficiency improvements, cleaner fuel alternatives, prudent procurement decisions, as well as reductions in the MWMC Facilities' environmental impact. These strategies will be managed under the Wastewater Division's ISO 14001 Environmental Management System (EMS) program. Additionally, Wastewater Division staff will use the inventory to evaluate impacts associated with the MWMC Facilities' operations to anticipate how best to comply with possible future regulatory requirements associated with GHG emissions. Wastewater Division staff also use the inventory to engage and educate employees, stakeholders, and the community on GHG reduction efforts.

GHG emissions are divided into three 'scopes'. Scope 1 emissions are direct emissions which originate from equipment and facilities owned and operated by MWMC—primarily from fossil fuel combustion and wastewater treatment processes. Scope 2 emissions are indirect emissions from purchased electricity. Scope 3 emissions are all other indirect emissions that result from the activities of the MWMC Facilities, but where the direct sources are controlled by other entities or service providers. Scope 3 emissions include supply chain related transport, solid waste disposal, employee commuting and business travel, and energy transmission and distribution losses. The MWMC Facilities' emissions will be incorporated as Scope 3 emissions for the cities of Eugene and Springfield GHG inventories, respectively.

The MWMC Facilities' GHG inventory was completed using established GHG inventory protocols and Good Company's Carbon Calculator (G3C). Because wastewater treatment process emissions are unique, primarily emitting methane (CH_4), nitrous oxide (N_2O) and biogenic[1] carbon dioxide (CO_2), methodologies specific to the wastewater treatment processes were also utilized to complete the 2014 inventory.

- In 2014, total emissions were 15,223 metric tons of carbon dioxide equivalent ($MTCO_2e$), a 6.4% reduction from 2012.

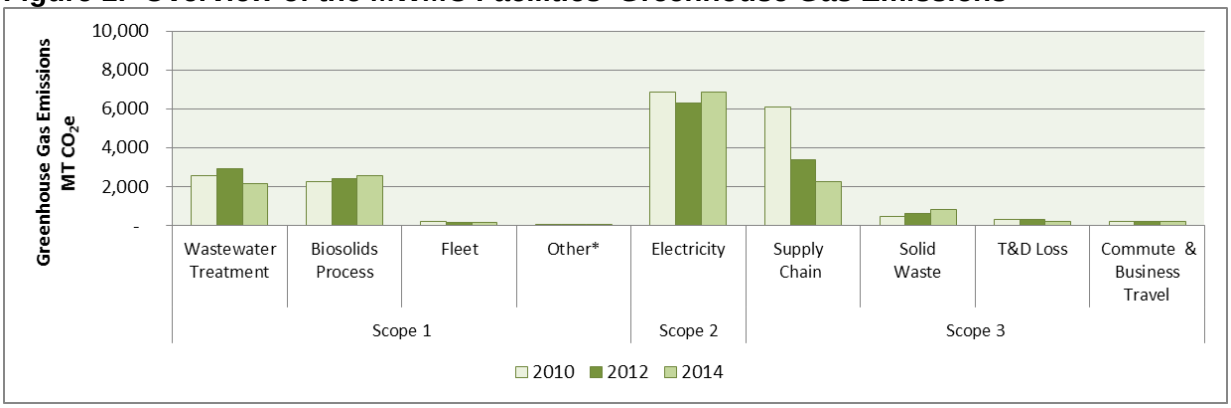
As illustrated in Figure 1, the 2014 emissions for MWMC Facility operations were very similar to the results for 2010 and 2012 except in the area of supply chain related transport. Scope 1 was primarily process-related emissions which included emissions from wastewater treatment and biosolids processing. Scope 1 emissions were 4,895 MT CO_2e in 2014.

Scope 2 emissions—which had the highest emissions of the 3 scopes for 2014—consisted of emissions from electricity consumption. Scope 2 emissions were 6,875 MT CO_2e.

[1] Biogenic emissions are GHG emissions generated during the combustion or decomposition of biological material. Anthropogenic emissions are GHG emissions generated from human-caused activities such as combustion of fossil fuels.

Scope 3 emissions in 2014, which included emissions from staff commuting, air travel, solid waste disposal, and electricity transmission and distribution losses, equaled 3,453 MT CO_2e, which was lower than in the prior two inventory periods. Supply chain emissions were highest in 2010 primarily due to intensive construction activity at the MWMC Facilities. The 2014 emissions reflect a continued reduction in construction activity compared to activity during the two prior periods.

Figure 1: Overview of the MWMC Facilities' Greenhouse Gas Emissions



* "Other" category represents emissions from natural gas, refrigerants, and non-fleet fuels.

INTRODUCTION

There are many industry sectors which contribute to GHG emissions including the waste handling and wastewater treatment sectors, which contribute 2.8% of the total GHG emissions. Although domestic and industrial wastewater treatment is cited as the sixth highest contributor to atmospheric CH_4 and the fourth highest contributor to N_2O [2] in the United States, domestic wastewater treatment plants are one of the lower GHG emitting sectors and do not fall under the majority of mandatory reporting regulations.[3]

However, in some regions and states, such as California, domestic wastewater facilities are required to calculate and report emissions from their operations. In Oregon, wastewater facilities which are regulated under a Title V Air Permit or Air Contaminant Discharge Permit are required to report GHG emissions.

Unfortunately, at this time, there has not been a universally adopted method for accurately measuring GHG emissions from wastewater treatment plant operations.[4] However, even without a universally adopted protocol, wastewater treatment facilities should consider using the tools available to identify the major sources of GHG emissions, assess operational changes which could reduce/minimize emissions, and help prepare for potential future mandatory reporting requirements. In addition, GHG information can also help identify opportunities for participation in future carbon trading programs or assist in minimizing potential carbon taxes on GHG emissions.

FEDERAL, STATE AND LOCAL GREENHOUSE GAS UPDATES

United States

The United States has implemented two broad regulations covering nationwide mandatory GHG emission reporting. Neither regulation requires reporting from municipal (domestic) wastewater treatment facilities. The GHG Mandatory Reporting Rule (40 CFR 98) does require reporting from a variety of sectors including industrial wastewater treatment. Title II CFR 40, The Clean Air Act, also requires industrial sectors to report but Title II is focused on mobile sources and has no direct impact on wastewater facilities.

In addition, the EPA recently finalized the Clean Power Plan Rule (CPPR) to cut carbon pollution from existing power plants. The CPPR includes state-specific interim and final goals for power plants.

Oregon

As mentioned above, the Oregon Department of Environmental Quality (DEQ) and Lane Regional Air Protection Authority (LRAPA) require wastewater facilities who hold a Title V air permit or an Air Contaminant Discharge Permit (ACDP) to report GHG emissions. As MWMC is regulated under an ACDP, the MWMC Facilities staff continues to report GHG emissions to LRAPA. The threshold for reporting is currently set at 2,500 MT CO_2e annually. The emissions from the biogas co-generation system and the boiler at the MWMC Facility were 2214 MT CO_2e. Although the emissions reported are less than the threshold for 2014, emissions from the facility

[2] U. S EPA 2006.
[3] Toolbox for Water Utility Energy and Greenhouse Gas Emissions Management, WFR, 2013.
[4] WERF, 2013

need to be under 2500 MT CO_2e for three consecutive years before MWMC is not required to report emissions and the facility has not met this requirement.

Recently, Oregon passed SB 324 (passed in the 2015 Legislative session) which extends Oregon's clean fuels program. The law requires fuel distributors to lower the carbon intensity of vehicle fuels by 10 percent over the next decade. Those distributors who cannot lower the carbon content must buy carbon credits which is essentially a cap and trade program for transportation fuels. Although the bill does not directly impact MWMC Facilities at this time, there may be future opportunities for MWMC to participate in the clean fuels program (i.e. provide electricity from the co-generation system for electric powered vehicles). A state-wide carbon tax program has yet to be approved by the Oregon Legislature.

Local Cities GHG Program Status

Eugene

In 2014, the City of Eugene passed a Climate Recovery Ordinance. The ordinance states that by the year 2020, all city-owned facilities and city operations shall be carbon neutral and by the year 2030, all businesses, individuals and others living or working in the city collectively will have reduced the total use of fossil fuels by 50% compared to 2010 usage.

In addition, Eugene City Council approved a resolution supporting a state-wide carbon tax but the bill did not pass in the 2015 state legislature, which suggests that the City of Eugene is committed to reducing GHG emissions locally and region-wide.

As of this date, city staff have not conducted a 2014 GHG inventory for daily workplace operations but an inventory will be conducted within the next year for the 2014 calendar year. The city is currently in the process of developing a community GHG reduction goal.

Springfield

As of the release of this report, the City of Springfield has not conducted a GHG inventory since 2010.

City of Eugene Wastewater Division's EMS/ISO 14001- Environmental Policy

Fifteen years ago, the Division became certified under the ISO 14001 Environmental Management System (EMS) and committed to continually improving its environmental performance and to provide sound stewardship of the environment.

Recognizing that environmental impacts result from both management decisions and from operational activities, the scope of the EMS encompasses all organizational and operational functions of the Wastewater Division and encourages movement toward sustainable policies and practices. The Division's Environmental Management System is well suited to provide the structure needed for future greenhouse gas reduction strategies and efforts.

The Wastewater Division will continue to:

- Communicate and reinforce the policy to all persons working for or on behalf of the Division.
- Comply with legal and other requirements.
- Consider environmental consequences and sustainability concepts in planning and decision-making.
- Strive to prevent pollution and promote reduction, reuse, recycling and proper disposal of waste.
- Provide leadership in environmental protection.

Note: ISO (International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The standards were developed to provide a management system to help organizations reduce their environmental impact.
For more information, seehttp://www.acsregistrars.com/iso14001.asp

As an ISO 14001 EMS-certified organization, the City of Eugene Wastewater Division (Operations and Maintenance staff for MWMC Facilities) is committed to climate action strategies that reduce GHG emissions as part of the EMS continuous improvement model. The GHG inventory provides a baseline that allows for strategic planning focusing on areas with the greatest potential for reduction in GHG emissions. Several measures have already been implemented which correlate to GHG reductions, including a reduction in energy consumption from a new aeration blower and the use of natural resources.

Aeration Blower

The EMS model emphasizes incremental changes that result in large-scale, positive outcomes. The Wastewater Division staff will align its strategies with the City of Eugene's Climate Action Plan, as well as the EMS continuous improvement model, by establishing annual objectives and targets aimed at reducing GHG emissions. Table 1 highlights past activities and future opportunities for improvement.

Table 1: Past GHG Reductions and Future Opportunities

Objective	Action Items
GHG Reduction Activities Since 2012	
Reduce Energy Consumption	• Replaced aeration blower with one that is more efficient, reducing power consumption by 25%. • Increased efficiency of air compressors by 45% by implementing best management practices. • Installed Light-emitting diode (LED) street lights throughout the Wastewater Plant.
Natural Resources Reduction	• Implemented zero waste events resulting in reduced consumption of natural resources and production of solid waste.
Reduce Consumption of Chemicals	• Reduced pesticide use by installing mowing strips, hand weeding, burning, scraping, and regrading around vaults to allow access for mowers. • Replaced two pesticides with less toxic products.
Reduce Solid Waste	• Improved workplace recycling program through staff engagement and education.
Opportunities for Improvement for 2016	
Reduce Energy Consumption	• Upgrade and expand the cogeneration system to reduce the need for methane flaring and convert more methane into an onsite energy source. • Continue to replace halogen lights with energy efficient LEDs.

ANTHROPOGENIC VERSUS BIOGENIC GREENHOUSE GAS EMISSIONS

GHG inventory protocol for the accounting of greenhouse gas emissions draws a distinction between human-caused emissions ("anthropogenic") and greenhouse gases from natural processes ("biogenic").

Anthropogenic GHG emissions are those emissions associated with human activities such as the combustion of fossil fuels such as the burning of oil, coal and gas and process emissions from industrial activities.

Biogenic emissions are part of the natural biogeochemical cycling of carbon. Biogenic emissions are carbon dioxide from the combustion of non-fossilized, biologically based materials such as biogas and biofuels (e.g., biodiesel) and natural processes such as the decomposition of organic materials. From an accounting perspective, this CO_2 is a greenhouse gas. However, the biogenic emissions are considered 'short-cycle', which means because the carbon comes from a biological material, it will be rapidly reabsorbed or sequestered through the growth of the biological material which replenishes the original source of the carbon. Therefore, biogenically released carbon is not considered to be part of the global warming problem.

The focus of this inventory is on anthropogenic emissions identified as one of the root causes of climate change. It is these sources that are the target of climate action plans, locally and globally. Biogenic emissions are included in the inventory to acknowledge they exist (and as directed by GHG inventory protocols), but such emissions should be understood as part of the biological carbon cycle and not anthropogenic.

As illustrated in Figure 2, both the biogenic emissions and anthropogenic emissions have decreased over the past 3 inventory years. This is due to several reasons including a decrease in the Global Warming Potential (value) for Nitrous Oxide, a decrease in the amount of biosolids processed in 2014 and a decrease in the supply-chain related transport for purchases and capital construction.

Figure 2: Comparison of the MWMC Facilities' Anthropogenic and Biogenic Emissions for 2010 - 2014

EMISSION SOURCES FROM WASTEWATER OPERATIONS

As mentioned above in this report, the main GHGs from domestic wastewater treatment plant operations are methane, carbon dioxide and nitrous oxide. The sources of each GHG throughout the plant are manifold, depending on the plant process involved.

Methane is produced by the decay of organic material in wastewater as it decomposes in anaerobic conditions. Methane emissions are determined by the amount of organic material and the extent to which this material is allowed to decompose. The organic content of wastewater is typically expressed as either biochemical oxygen demand (BOD) or chemical oxygen demand (COD)[5].

The amount of methane gas produced varies between wastewater facilities based on factors such as primary treatment performance, digester mixing effectiveness, digester solids retention time, and temperature. The primary methane emission sources from the treatment plant are from anaerobic microorganisms in wastewater treatment processes where the methane is produced and released directly into the atmosphere as a fugitive emission. Fugitive emissions are emissions of gases from processes and pressurized equipment due to minor leaks and other unintended causes. Small amounts of methane may also be released as a result of incomplete combustion of the biogas.

[5] IPCC, 1996.

Aeration Basin

The two most significant sources of nitrous oxide in the United States are emissions from the wastewater treatment processes and nitrous oxide emissions that may be generated from nitrogen in the wastewater effluent. The Intergovernmental Panel on Climate Change (IPCC) considers N_2O from the effluent to be a more significant GHG emission source.

The production of direct nitrous oxide emissions depends on the amount of nitrogen in wastewater. Nitrous oxide is produced during both the nitrification and denitrification of urea, ammonia, and proteins. In addition, as wastewater is discharged into a water body, such as a river, the remaining nitrogen in the effluent can be naturally converted and released as dinitrogen gas (N_2). Both sources are accounted for in this inventory.

Carbon dioxide is produced during the aerobic treatment process and from purchased electricity. During the anaerobic digestion process, the BOD_5 is either incorporated into biomass or converted to carbon dioxide and methane. Other emission sources of carbon dioxide result from the combustion of biogas. As mentioned above, the carbon dioxide emissions from the combustion of sludge or digester gas are considered biogenic.

GLOBAL WARMING POTENTIAL CHANGES

Global Warming potential (GWP) is a relative measure of how much heat a GHG traps in the atmosphere. The larger the GWP, the more that a given gas warms the earth's surface and lower atmosphere compared to carbon dioxide over the same time period, usually within a 100-year timeframe. The IPCC regularly studies, revises and provides the generally accepted values for GWP.

The GWP for each gas can also change over time based on new information regarding energy absorption and the lifetime of the gas. Therefore, the change in the GWP over time for each gas will impact the overall calculated amounts of GHGs emitted.

As an example, in the 2010 and 2012 inventories, the GWP for methane was 21 and the nitrous oxide GWP was 310. However, for the 2014 inventory, the GWP for methane increased to 34 and nitrous oxide decreased to 298[6]. Table 2 lists the former and the current GWP values used to calculate GHG emissions.

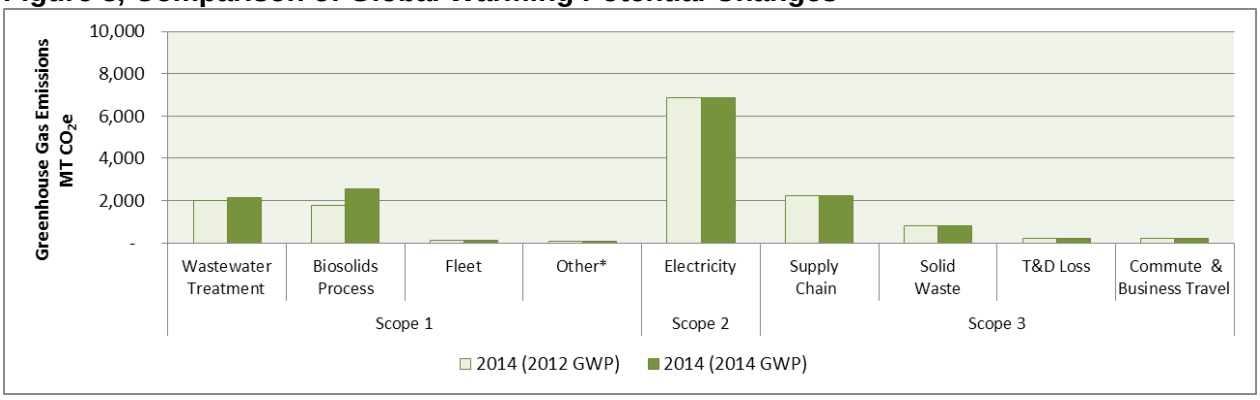
Table 2: Past and Current GWP of GHGs

GHG	GWP	
	2010-2012 Inventory Values	2014 Inventory Values
Carbon Dioxide	1	1
Methane	21	34
Nitrous Oxide	310	298

[6] IPCC's Fifth Assessment Report, 2014

The significance is the GWP revisions by the IPCC can influence the GHG emission inventory results. As illustrated in Figure 3, the emissions from the biosolids management process, primarily from the biosolids storage lagoons, increased when using the most recent GWP in the calculation.

Figure 3, Comparison of Global Warming Potential Changes



For 2014, if the previous GWP for methane (21) was used in the calculation instead of the more recently revised value (34), the estimated GHG emissions would have been 1,776 MT CO_2e instead of 2567 MT CO_2e for the biosolids management process, a decrease of nearly 31 percent.

GHG INVENTORY SCOPES

In many GHG inventory protocols, emissions sources and activities are classified as either producing direct or indirect GHG emissions. Direct emissions are those that stem from sources owned or controlled by a particular organization. Indirect emissions occur because of the organization's actions, but the direct source of emissions is initiated or triggered by a third party or a separate entity.

To distinguish direct from indirect emissions sources, three 'scopes' are defined for traditional GHG accounting and reporting purposes (Western Regional Institute, The Greenhouse Gas Protocol).

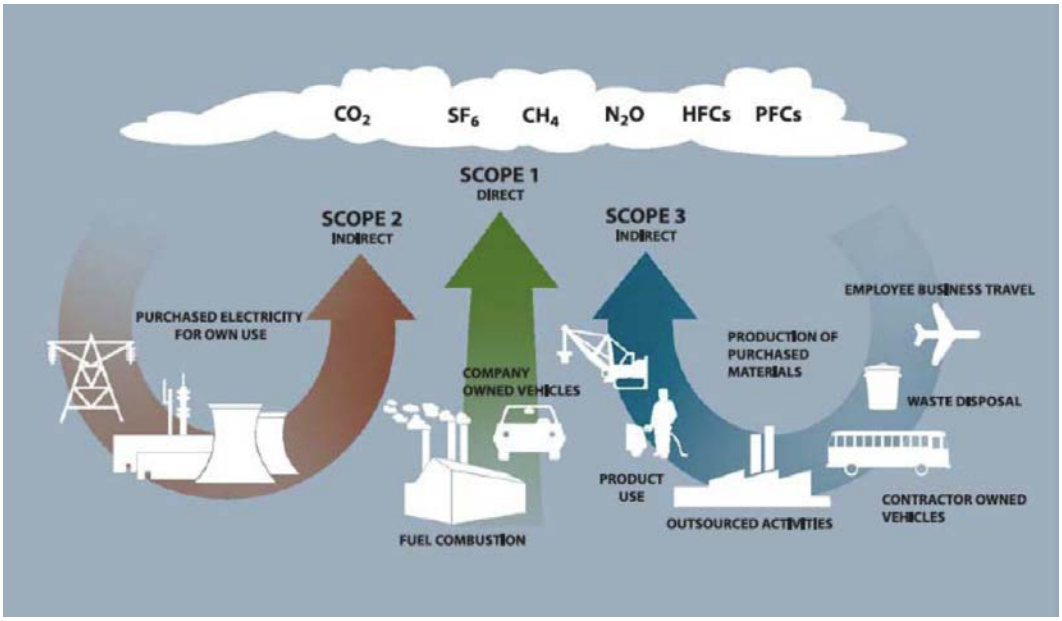
Scope 1 – Direct sources of GHG emissions that originate from equipment and facilities.

Scope 2 – Indirect GHG emissions from purchased electricity, heat, or steam.

Scope 3 – All other indirect sources of GHG emissions that may result from the activities of the MWMC Facilities but occur from sources owned or controlled by another organization or entity, such as emissions embodied in material goods purchased, solid waste handling, employee commuting, business related travel, and other emissions.

Scope 1 (direct) and Scope 2 (indirect) emissions must be reported for most protocols and registries. Scope 3 emissions are indirect and usually considered optional when reporting, but serve to clarify an organization's entire carbon footprint and illuminate the potential regulatory and financial risks an institution may face due to its carbon footprint. Figure 4 illustrates the three scopes of emissions.

Figure 4: Greenhouse Gases Accounting and Reporting Scopes



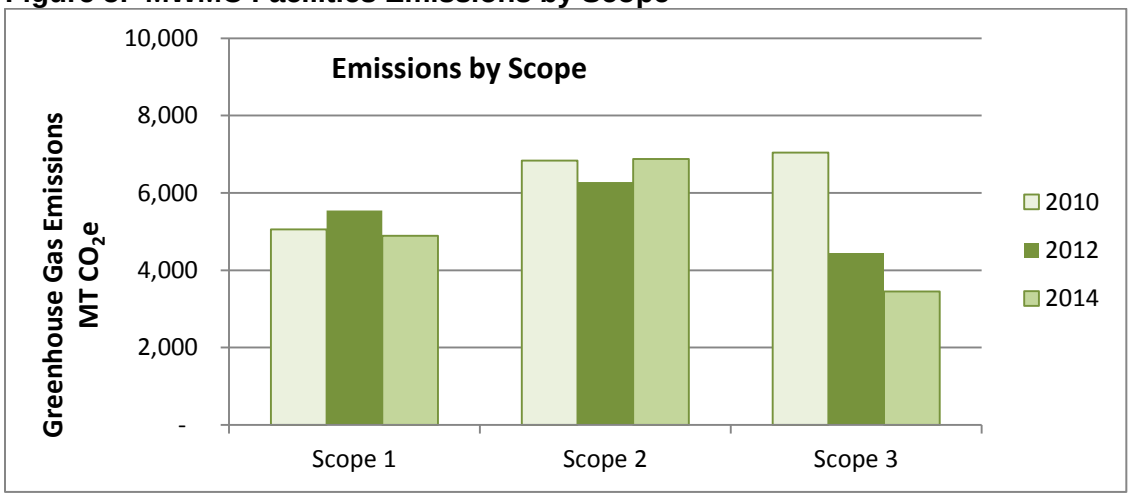
Source: WRI/WBCSD Greenhouse Gas Protocol, Corporate Accounting and Reporting Standard (Revised Edition).

All emissions are reported in metric tons of carbon-dioxide equivalent (MT CO_2e). The analysis includes carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons (HFCs). As MWMC Facilities do not use perfluorocarbons (PFCs) or sulfur hexafluoride (SF_6) in its processes, these two GHGs are not included here. Overwhelmingly, the direct and indirect CO_2-equivalent emissions are CO_2 from the combustion of fossil fuels.

OVERVIEW OF RESULTS

As shown in Figure 5, in 2014, the largest source of emissions from the MWMC Facilities was from Scope 2, electricity consumption, which increased by 9.4% from 2012 to 2014. This was primarily due to increased aeration in 2014 to enhance nitrogen removal.

Figure 5: MWMC Facilities Emissions by Scope



Scopes 1 and 2 (2014) yield 11,770 MT CO_2e. For a sense of scale, this is equivalent to[7]*:*

- Annual emissions from 2,453 passenger vehicles or
- Annual emissions from the energy consumed by 606 homes (US average)

Scope 3 emissions (2014) yield 3,453 MT CO_2e. For a sense of scale, this is equivalent to:

- Annual emissions from 767 passenger vehicles or
- Annual emissions from the energy consumed by 189 homes (US average)

Description of Greenhouse Gas Emissions Categories

Table 3 provides detailed information on sources of anthropogenic emissions for MWMC operations.

Table 3: Greenhouse Gas Emissions Categories for 2014

WRI[8] Scope	Emissions Sources	Description	2014 MT CO_2e
	Wastewater Treatment and Biosolids Process Emissions		
Scope 1 (Direct Emissions)	Effluent discharge to the Willamette River	N_2O emissions are generated as nitrogen is discharged to the Willamette River in the treatment plant's effluent.	943
	Nitrogen removal from wastewater	N_2O emissions associated with the nitrification/ denitrification process.	631
	Biosolids storage lagoons	Lagoons may, at times, have an anaerobic layer and therefore are capable of producing methane.	1,953

[7] EPA equivalency calculator: http://www.epa.gov/cleanenergy/energy-resources/calculator.html
[8] World Resources Institute

WRI Scope	Emissions Sources	Description	2014 MT CO_2e
Scope 1 (Direct Emissions)	Biogas combustion	System inefficiencies result in a fugitive loss of methane. It is assumed that 1% of biogas escapes to the atmosphere regardless of the equipment used (generator, boiler, and flare).	558
	Land application of biosolids	As biosolids are land applied, a portion of the nitrogen in the fertilizer becomes oxidized N_2O.	441
	Biosolids drying beds	When biosolids are stored in piles with no aeration for a period of time, the potential exists for air pockets in the storage piles to turn anaerobic and generate methane.	173
	Non Process Emissions		
	Fleet	The wastewater division's fleet includes 54 vehicles which operate on gasoline, biodiesel, diesel or propane.	128
	Natural gas	The MWMC Facilities uses natural gas for the waste gas burner pilot light, boiler pilot light, space heating, water heating, and as backup fuel for the boiler.	52
	Refrigerants	Refrigerant loss from heating, ventilation, and air-conditioning (HVAC) systems.	7
	Other fuels	Diesel fuel is used in emergency generators at pump stations and the treatment plant.	9
Scope 2 (Indirect Emissions)	Electricity	The MWMC Facilities used 18.4 million kWh in 2014.	6,875
Scope 3 (Indirect Emissions)	Supply Chain (Embodied emissions in purchased goods and services)	In 2012 there were $7.5 million in purchases and in 2014, there were $5.4 million in purchases. The reduction in 2014 was mainly due to less capital construction work done as compared to 2012.	2,249
	Solid waste	Solid waste emissions include operational waste and the volatile organic material in the grit hauled to the Lane County Landfill.	791

WRI Scope	Emissions Sources	Description	2014 MT CO_2e
Scope 3 (Indirect Emissions)	T & D Losses	Transmission and distribution (T&D) losses from power occur as electricity travels from the point of generation to the point of consumption. This figure assumes slightly more than 6% T&D losses for the US grid.	219
	Commute	Employees primarily commute to work by driving alone in their vehicles. The average distance staff commutes round trip is 14 miles/day.	180
	Business travel	Business travel encompasses employees' use of air travel and rental cars associated with meetings, conferences, and trainings.	14
Total MT CO_2e			**15,223**

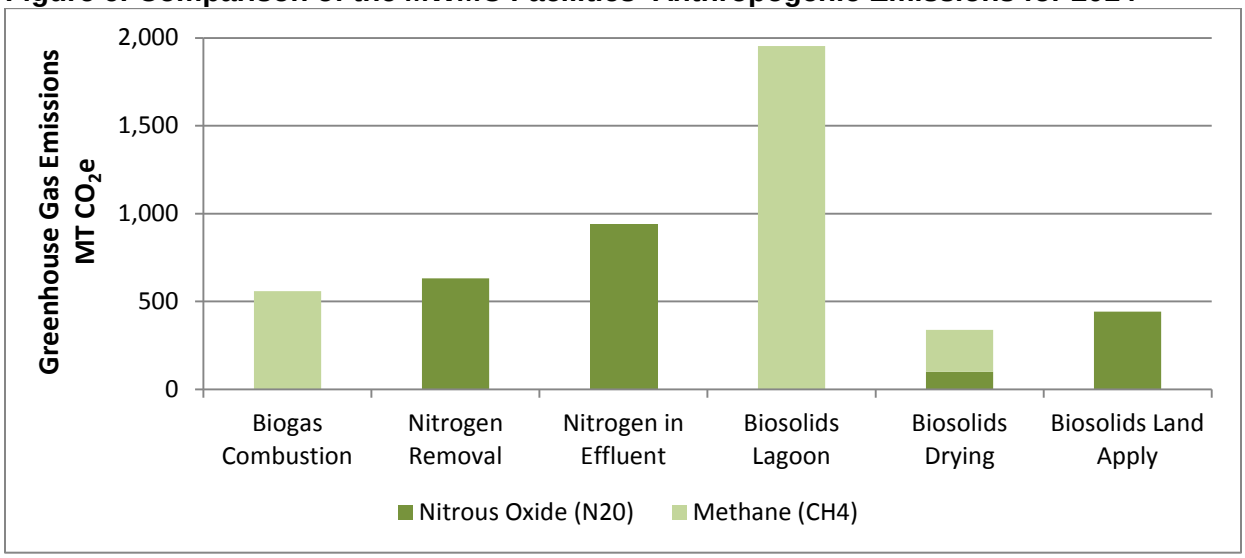
Emissions Details by Scope Category

Scope 1 - Wastewater Treatment and Biosolids Process Emissions

Wastewater treatment and biosolids process emissions accounted for 96% of Scope 1 emissions in 2012 and 99% of Scope 1 emissions in 2014.

As illustrated in Figure 6, methane is the largest source of anthropogenic GHG emissions from the biosolids lagoon process. In the prior inventory from 2010-2012, nitrous oxide from the effluent was the largest source of emissions but due to the revised GWP for methane (see p.8) the methane accounting for lagoons resulted in higher emissions even though there was a lower volume of solids processed in 2014 than 2010 or 2012.

Figure 6: Comparison of the MWMC Facilities' Anthropogenic Emissions for 2014

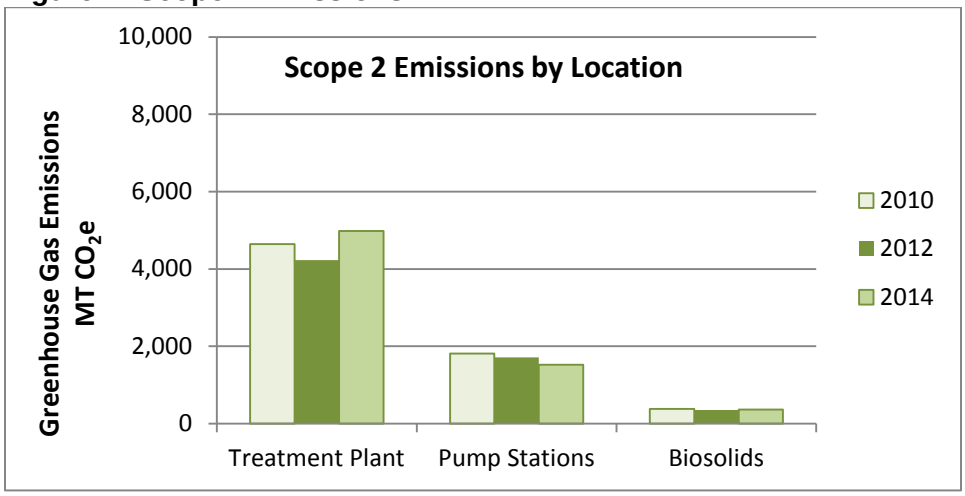


Scope 2 - Electricity

Scope 2 emissions resulting from the consumption of electricity decreased by 2.2% between 2010 and 2012 and increased 9.4% between 2012 and 2014. The increase in 2014 was primarily due to increased aeration to enhance nitrogen removal. Efforts to reduce electricity use over the last four years have included large and small scale energy efficiency projects. The projects included implementation of an air compressor management program, installation of a passive grit collection system, replacement of pump station equipment with more efficient variable frequency drive pumps, and efficiency improvements to odorous air controls.

As shown in Figure 7, treatment plant operations, as expected, continue to be the largest source of Scope 2 emissions (electricity consumption) among the three MWMC Facilities' locations.

Figure 7: Scope 2 Emissions



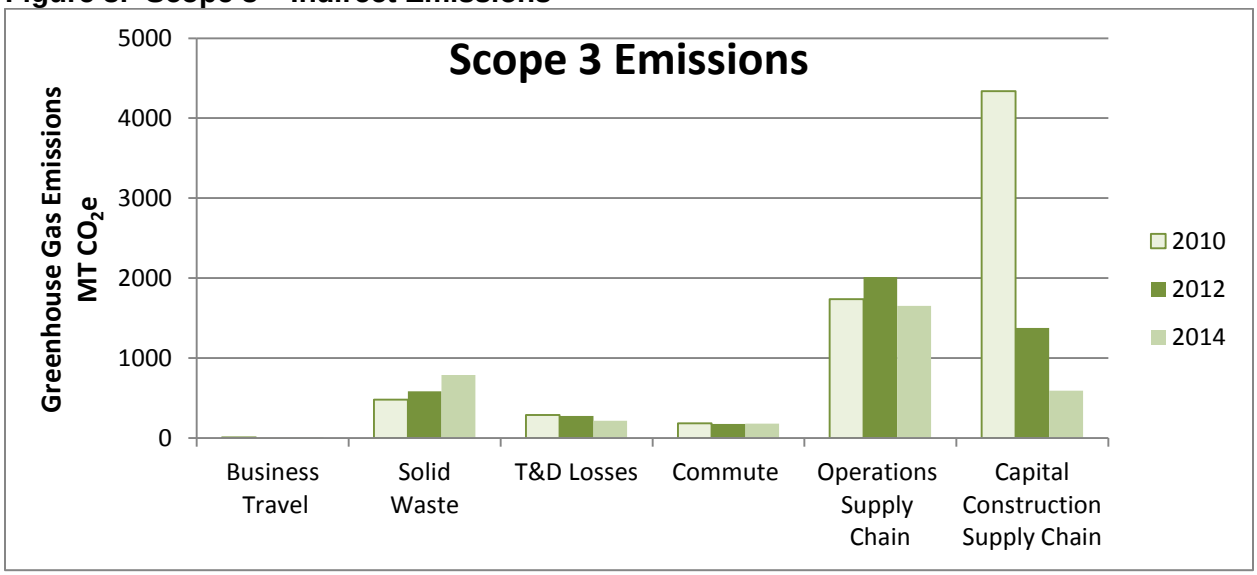
Scope 2 - Electricity Use Emission Factors

Greenhouse gas inventories require several assumptions to be factored in to estimate GHG emissions from certain sources. The most significant assumption in this inventory is the emissions factor used to calculate emissions from electricity use. An emissions factor is a representation of the carbon intensity per unit of electricity (e.g., MT CO_2e / megawatt-hour). This inventory uses the Northwest Power Pool (NWPP) regional grid emissions factor to calculate the amount of emissions resulting from electrical usage. This factor was chosen as it is consistent with Eugene's and Springfield's GHG inventory and current GHG inventory protocol.

Scope 3 - Indirect Emissions

As illustrated in Figure 8, the primary emissions categories for Scope 3 are operations supply chain, solid waste, and activity specific to capital construction. The emissions embodied in purchased goods and services are factored in to estimate the quantity of GHG emissions produced by suppliers and service providers.

Figure 8: Scope 3 – Indirect Emissions



The operations supply chain category includes chemicals used in the treatment processes at MWMC Facilities. Chemicals comprise a large proportion of the materials and supplies emissions. The purchase of replacement parts and components is another significant proportion of this category. Purchases of vehicles, heavy equipment, laboratory supplies, and professional services comprise the remaining items are also accounted for in operations supply chain emissions.

The capital construction and maintenance category includes all capital construction projects during the reporting period (2014). Construction activities that utilize concrete, steel, and other building materials produce a substantial GHG emissions footprint. Other emissions are produced mainly from purchases related to maintenance of buildings, facilities, and equipment.

METHODS: DATA, PROTOCOLS, AND SENSITIVITY ANALYSIS

This inventory follows the Local Government Operations Protocol (LGOP), which was developed jointly by The Climate Registry and affiliated organizations.[9] However, the protocol only requires the reporting of emissions in Scopes 1 and 2 as defined by the World Resources Institute. Therefore, this inventory has been expanded to include several additional Scope 1 process emission sources specific to biosolids management as well as shared emission categories from Scope 3. The use of these tools to measure additional emissions sources has enabled a more accurate inventory of MWMC Facilities' GHG emissions.

The protocols and methods used to account for the additional Scope 1 and Scope 3 emissions sources are documented in Good Company's Carbon Calculator (G3C) and the G3C-WW (Wastewater) module used to calculate emissions for this inventory. The additional Scope 1 emissions sources were estimated using either LGOP (for emissions associated with denitrification and discharge of effluent) or the Canadian Ministers of the Environment's

[9] The Local Government Operations (LGO) Protocol was developed in collaboration among The Climate Registry (TCR), the California Air Resources Board (CARB), the California Climate Action Registry (CCAR, now the Climate Action Reserve), and ICLEI Local Governments for Sustainability. The LGO Protocol follows the same format as The Climate Registry's General Reporting Protocol (GRP).

Biosolids Emissions Assessment Model (BEAM) for emissions associated with biosolids storage, drying and land application.

Displaced emissions from grid electricity and conventional natural gas are calculated to be the same as an equal quantity of grid-purchased electricity or natural gas. BEAM was used to estimate benefits associated with displaced conventional fertilizer and soil carbon sequestration from land application of biosolids. Carbon sequestration by poplar trees at the Biocycle Farm was calculated using the methodology specified by the Climate Action Reserve's *Urban Forest Protocol*.[10]

EMISSION BENEFITS FROM EXISTING MWMC PRACTICES

In addition to the emissions released by MWMC Facilities' operations, this inventory identified the GHG emission benefits that result from wastewater treatment operations. These benefits include *displaced* GHG emissions *(*e.g., electricity generated from biogas) and *carbon sequestration* (e.g., emissions captured by poplar trees).

It's important to note that these measured benefits are not subtracted from MWMC Facilities' operational inventory to determine "net emissions". Lack of guidance from GHG inventory protocol or precedent in other similar GHG inventories prohibit such subtractions. Notwithstanding, the following content is presented to highlight and scale the existing, positive practices implemented at MWMC Facilities that provide a measurable GHG benefit—regardless of whether GHG benefits can be factored into the current GHG accounting.

Displaced GHG Emissions Categories

- **Displaced Grid Electricity (~ 2,606 MT CO_2e)**
  Biogas-generated electricity, which is considered renewable and the emissions largely biogenic, displaces sub-regional grid electricity[11] that has significantly higher anthropogenic carbon intensity. The "renewableness" of biogas-generated electricity is accounted for with Renewable Energy Certificates, or RECs (1 kWh of electricity = 1 REC).

  MWMC Facilities sells 100% of the RECs generated at the treatment plant to EWEB and therefore cannot claim any of the associated environmental benefits. For Fiscal Year 2014-15, MWMC Facilities received $4,300 for RECs, which is significantly lower than in previous years, as the market value of RECs have decreased.

- **Displaced Conventional Natural Gas (-1,553 MT CO_2e)**
  The wastewater treatment plant displaces the use of natural gas with biogas in the boiler as well as capturing the heat generated from the plant's combined heat and power (CHP) system. If the plant purchased and combusted natural gas to generate an equivalent amount of heat, it would result in an additional 1,553 MT CO_2e. The benefits are accounted for by not including emissions from the equivalent quantity of natural gas or the biogenic emissions from the biogas.

[10] For more information on CAR's Urban Forest Protocol visit http://www.climateactionreserve.org/how/protocols/urban-forest/.
[11] Oregon is part of the Northwest Power Pool (NWPP) sub-regional electricity grid. In 2009, the GHG emissions intensity of the NWPP grid was approximately 823 pounds of CO_2e / MWh. For more information, see http://www.epa.gov/cleanenergy/energy-resources/egrid/.

- **Displaced Conventional Fertilizer (- 49 MT CO_2e)**
  Substituting biosolids for conventional fertilizer displaces the emissions that would have otherwise been created in the production of conventional fertilizers.

Carbon Sequestration Categories

- **Carbon Sequestration by Biocycle Poplar Trees (-30,491 MT CO_2e)**

The nearly 88,000 poplar trees growing at the Biocycle Farm managed by MWMC Facilities sequester carbon through photosynthesis. While these trees currently capture and store a significant quantity of carbon, some of the trees since the last inventory were harvested from Management Unit 1 in 2013 and 2014. Nonetheless, although the number of trees at the Biocycle Farm has decreased, the carbon sequestration benefit was higher in 2014 than in 2010 (-20,581 MT CO2e) and 2012 (-25,670 MT CO2e) due to the continued growth of the trees.

Poplar Seed

- **Soil Carbon Sequestration (-324 MT CO_2e)**
  When biosolids are applied to soil, a proportion of the organic carbon remains trapped and therefore increases the health and sequestration potential of the existing soil.

ALLOCATION OF MWMC FACILITIES' GHG EMISSIONS TO EUGENE AND SPRINGFIELD

Both cities have conducted their own GHG inventories in past years but did not include wastewater treatment operations due to the complexities associated with calculating emissions from the regional wastewater treatment facilities. Although neither city at this time has completed their respective 2014 inventory, the City of Eugene has proposed to conduct an inventory within the next year for 2014.

CONTACT INFORMATION AND ADDITIONAL RESOURCES

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For more information, call or email:

Tanya Haeri-McCarroll, 541-682-8613 tanya.m.haeri-mccarroll@ci.eugene.or.us
John Huberd, 541-682-8603 john.c.huberd@ci.eugene.or.us
Sharon Olson, 541-682-8625 sharon.r.olson@ci.eugene.or.us