CLIMATE ACTION PLAN OF THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

November 19, 2021 Draft
with July 8, 2022 Addendum

Addendum to the 2021 Draft Climate Action Plan (July 8, 2022)

The Metropolitan Water Reclamation District of Greater Chicago (MWRD) strives to report its greenhouse gas (GHG) emissions with international standards and best practices, yet many of these standards are being continuously analyzed and revised. In similar reporting, the MWRD's Climate Action Plan (CAP) is a living document to be updated on a biennial basis, or as needed when major changes occur. The original Draft CAP was developed in 2020, and an update was issued in the fall of 2021 to better align with the Strategic Plan 2021-2025. Due to the timing of revisions in international GHG emission inventories and ongoing research toward emissions in wastewater treatment processes, the most recent draft of the CAP does not reflect some of those changes.

The MWRD's carbon footprint was estimated based on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) protocols for GHG inventories for the wastewater sector. The United Nations Framework Convention on Climate Change has mandated to transition to AR5 by 2024 and likely AR6 shortly thereafter, in reporting national GHG inventories. The most current AR6 Working Groups I-III reports were released in 2021 and 2022, and a final AR6 synthesis report is scheduled to be released in late 2022 or early 2023. The AR6 has made significant changes to the global warming potential of specific GHGs and revised guidelines and emission factors for estimating GHGs for the wastewater sector. The next revision of the CAP will use IPCC's AR6 guidelines to estimate the carbon footprint and an increase in all reported values are expected for the years reported in the plan.

There remains significant uncertainty in the estimation of emissions in wastewater treatment processes. Currently, there are significant technological and economic challenges to mitigate these emissions and most wastewater utilities worldwide are scrambling to address this issue to meet their climate goals. According to the Water Research Foundation (WRF), further field research is required to establish a better scientific basis of emission factors that are specific to the different wastewater treatment processes in the diverse climate regions of the world. Only recently, this area of research has gained attention and research grants are being provided by the funding agencies to quantify these emissions.

This research gap was highlighted at the April 2022 Research Summit of the WRF. WRF announced funding of two research projects in the 2023 Research Priority Program (1) Establishing Industry-Wide Guidance for Water Utility Life Cycle Greenhouse Gas Emission Inventories, and (2) Beyond Net Zero Carbon: Advancing Carbon Offset and Interdependencies through the Water-Energy-Food Nexus to address the urgent nature of this knowledge gap.

MWRD staff has and will participate in projects and use the research results in updating future revisions to our CAP. The MWRD is also starting to conduct this research specific to our operations. As the science and associated field trials are defensible, future update to these emissions values can be expected in the methodologies.

The next revision of MWRD's CAP is expected to be completed before the end of 2022. The revised CAP will include updates from AR6 and better communicate the significance of these updates to stakeholders. The revised CAP goals will be aligned with the goals of our sister agencies.

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About the Metropolitan Water Reclamation District of Greater Chicago

Created in 1889, the Metropolitan Water Reclamation District of Greater Chicago is an award-winning, special-purpose district responsible for treating wastewater and providing stormwater management for residents and businesses in its service area, which encompasses 882.1 square miles and includes Chicago and 128 suburban communities throughout Cook County. Our services are provided to an equivalent population of 10.35 million each day, including 5.25 million residents, a commercial and industrial equivalent of 4.5 million people, and a combined sewer overflow equivalent of 0.6 million people. As the protector of water resources, we work diligently to protect Lake Michigan, the source of drinking water, as well as the health and safety of citizens and area waterways. With a total treatment capacity of more than 2 billion gallons per day, we own and operate seven water reclamation plants, 560 miles of intercepting sewers and force mains and 23 pumping stations. In addition, we control 76.1 miles of navigable waterways, own and operate many regional stormwater reservoirs, and have undertaken significant improvements of streams, channels, and creeks to provide regional flood protection. Our Tunnel and Reservoir Plan, which includes more than 109 miles of tunnels and three major reservoirs, also protects area waterways from pollution and mitigates flooding in communities served by combined sewer systems across 375 square miles.

FOREWORD

The Metropolitan Water Reclamation District of Greater Chicago (MWRD) was created in 1889 out of public health concerns to protect the region's water resources. Through the back-breaking engineering of carving out 61 miles of canals, the MWRD transformed the waterway system, reversed the flow of the Chicago River, protected the source of drinking water in Lake Michigan and forever preserved Chicago's health and vibrancy. Over the next century, the MWRD introduced countless technologies, policies, and programs to protect the Chicago area's water environment. The MWRD developed critical wastewater treatment systems and built hundreds of miles of infrastructure below ground to collect water from local sewers and convey it for treatment. Industrial wastes were properly collected. Stormwater management programs and plans were implemented. In addition to water, critical resources were recovered for sustainable reuse. Water quality experienced a resurgence. These continuing layers of innovation helped stabilize Cook County communities and strengthened public health, the urban ecosystem, and the economy. But after all these chapters, the mission is far from complete. Climate change is the next momentous challenge that confronts the MWRD.

There is no time to delay. The planet's seven-warmest years have all occurred since 2014, according to the National Oceanic and Atmospheric Administration. Climate change threatens to alter precipitation, water resources and the reliable systems that the MWRD has installed to protect area water quality, public health, and safety. To meet this daunting obstacle, the MWRD has developed a Climate Action Plan (CAP) that prioritizes carbon reduction, which will support the Strategic Plan 2021-2025 to guide the agency for generations. This document will guide future infrastructure planning and outline how the MWRD will address climate action through a variety of adaptive and mitigative strategies to maintain its reliable and essential services. It also details how the MWRD aims to reduce its carbon footprint and manage the impacts of climate change that are already manifested in 21st century water challenges. The CAP is a living document, intended to be updated every three years as the MWRD copes with the unpredictable nature and unforeseen challenges of climate change.

LIST OF ACRONYMS

Acronym	Definition
Calumet WRP	Calumet Water Reclamation Plant
CAP	Climate Action Plan
CAWS	Chicago Area Waterways
CCSMP	Cook County Stormwater Management Plan
CEJA	The Climate and Equitable Jobs Act
CH4	Methane
CHP	Combined Heat and Power
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
CSO	Combined Sewer Overflow
Egan WRP	John E. Egan Water Reclamation Plant
eGRID	Emissions and Generation Resource Integrated Database
EUI	Energy Use Intensity
EV	Electric Vehicles
FEJA	The Future Energy Jobs Act
GHG	Greenhouse Gas
GI	Green Infrastructure
Hanover Park WRP	Hanover Park Water Reclamation Plant
IEPA	Illinois Environmental Protection Agency
IPCC	The Intergovernmental Panel on Climate Change
IT	Information Technology Department
kBTU	Kilo-British Thermal Unit
kWh	Kilowatt Hour
kWh/MG	Kilowatt Hour per Million Gallons
Kirie WRP	James C. Kirie Water Reclamation Plant
Lemont WRP	Lemont Water Reclamation Plant
LGO	Local Government Operations
MG	Million Gallons
MT CO2e	Metric Tons of Carbon Dioxide Equivalent
MMBTU	Million British Thermal Unit
MMT CO2e	Million Metric Tons of Carbon Dioxide Equivalents
MWh	Mega Watt Hour
MWRD	Metropolitan Water Reclamation District of Greater Chicago
NDC	National Determined Contribution
N2O	Nitrous Oxide
NOAA	The National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O'Brien WRP	Terrence J. O'Brien Water Reclamation Plant
ODS	Ozone-Depleting Substances
PBC	Public Building Commission

LIST OF ACRONYMS (Continued)

Acronym	Definition
REC	Renewable Energy Credits
SEDAC	The Smart Energy Design Assistance Center
Stickney WRP	Stickney Water Reclamation Plant
TARP	Tunnel and Reservoir Plan
US	United States
USEPA	United States Environmental Protection Agency
UN	The United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USCA	United States Climate Alliance
WMO	Watershed Management Ordinance
WRP	Water Reclamation Plant
YR	Year

EXECUTIVE SUMMARY

Scientific consensus has concluded that the earth's climate is changing on both a regional and global scale because of the increased emissions of greenhouse gases (GHGs). This trend is expected to result in multiple negative outcomes. The Metropolitan Water Reclamation District of Greater Chicago (MWRD) has recognized this global threat as something that will affect us and has made a conscious effort to lead in this critical, life-changing phenomena by developing a Climate Action Plan (CAP) to ensure continued delivery of high-quality wastewater treatment and stormwater management services in its service area while staying mindful of solutions appropriate for this global problem.

The plan is an integrated strategy to identify actions that will not only prioritize the MWRD's progress in achieving GHG reduction targets, but also work to contribute to reductions in GHGs for the region and in our industry. While the MWRD's actions alone will not solve this global problem, it allows the MWRD to do its part, make a regional impact reducing its carbon footprint, and in doing so, encourage others to participate in the greater solution to this global problem. This initial iteration of the CAP will provide the framework that will identify the MWRD's overall strategy, assumptions, and future initiatives. The CAP is a living document and will be updated on a three-year cycle. The subsequent versions will provide status of the MWRD's progress and more detailed information about specific initiatives. Future updates will also include the results of an investigation into estimating the carbon footprint of our biosolids operations through literature reviews and utility outreach; currently there is no established or proven method for estimating these emissions.

The baseline assumptions and milestones for the MWRD CAP will closely follow the goals established in the Paris Agreement and the United States Climate Alliance. The MWRD will use the established 2005 carbon footprint as the baseline to calculate future reductions and has set milestones of a 28 percent reduction by 2025 and an 80 percent reduction by 2050 with additional stretch targets of 50 percent reduction and achieving net zero by 2025 and 2050, respectively, as laid out in the Strategic Plan 2021-2025. These targets are aligned with the federal government's April 2021 announced economy-wide target of 50 - 52 percent reduction in GHG emissions by 2030 and a net zero emission economy by 2050.

While the MWRD is not in any way legally required to follow these milestones, the MWRD remains committed to reducing its carbon footprint in the belief that climate solutions for individual organizations ultimately drive broader environmental, economic, and health benefits.

As a recognized leader in its industry, the MWRD will continue to be proactive in planning and preparing for the anticipated impact of local climate events, such as increased record-breaking flooding, heat, and drought, on its ability to serve its communities and fulfill its mission. Even small steps can make a big difference. In addition, the MWRD will work to further strengthen its collaboration with other regional agencies in areas, such as emergency management, public health, and waste reduction to support development of renewable energy resources. Working together, we can make an even greater impact by reducing our collective carbon footprint and the deleterious impact on our communities and the world.

INTRODUCTION

Background

Climate change is a rapidly growing threat to communities throughout the world (IPCC, 2021). Locally, northeastern Illinois has already experienced, and is projected to see, even greater adverse weather events including record-breaking flooding, heat, and drought (CMAP, 2018; Wuebbles et al., 2021). The region broke the record for most consecutive days above 100°F during the Midwest's drought in 2012 and suffered from Presidentially Declared Disasters during the floods of 2008, 2010, 2013 and 2019. The impacts of climate change have significant implications for the built environment, economies, ecosystems, and people in this region. Flooding leads to major road, rail, and utility outages, sewer overflows, damaged property, and financial losses for local businesses. Flooding also contributes to increased pollution such as nutrients and other contaminants entering our waterways. Heat waves have caused illnesses, hospitalizations, and deaths in vulnerable populations, and drought has had significant adverse effects on the region's agricultural sector and natural areas.

As climate change warms the atmosphere and alters the hydrological cycle, changes to the amount, timing, form, and intensity of precipitation will continue (CMAP, 2018; Makra and Gardiner, 2021; Wuebbles et al., 2021). These impacts are likely to affect the water and wastewater utilities designed to protect water quality, public health, and safety. Studies indicate that the full impact of climate change has not yet been experienced; however, the MWRD is planning for a changing climate to ensure that it can continue to provide reliable, high-quality wastewater treatment and stormwater management services while reducing its carbon footprint. Despite the federal government's notice of intent to withdraw from the Paris Agreement in June 2017 and its official withdrawal in November 2019 issued by the prior administration, the MWRD's Board of Commissioners (Board) passed a resolution in July 2017 to honor the United States (US) GHG-emission reduction targets in the Paris Agreement by continuing to reduce the MWRD's GHG emissions. Knowing that climate change could adversely impact the residents of Cook County and MWRD operations through increased precipitation and flooding, the MWRD 2021-2025 Strategic Plan (Strategic Plan) affirmed that it is critically important to examine potential sources of renewable energy, find ways to reduce our carbon footprint, and recover valuable raw materials with the goal of addressing climate change and improving our water environment.

Purpose, Use, and Update Schedule

The CAP will be used to: (1) inform future infrastructure planning, (2) support climate resiliency infrastructure investment decisions, and (3) guide mitigation of the MWRD's GHG emissions. The collective scientific understanding of climate change is still developing; consequently, the MWRD's work to address climate change will continue to evolve as the science is better understood, as will the activities to adapt to changes in the environment. The 26th United Nations (UN) Climate Change Conference of the Parties (COP26) is scheduled to be held in the United Kingdom from November 1-12, 2021. The COP26 summit will bring parties together to accelerate action towards the goals of the Paris Agreement and the UN Framework Convention on Climate Change (UNFCCC). The anticipated recommendations from the COP26 will be considered in the next cycle of CAP updates. In the past, the MWRD's assessment of GHG emissions were calculated periodically, however, due to the importance of this issue, the MWRD will conduct an

annual assessment of GHG emissions to measure progress. The CAP will be placed on an update cycle of every three years to allow for developments to be incrementally assessed, considered, and incorporated.

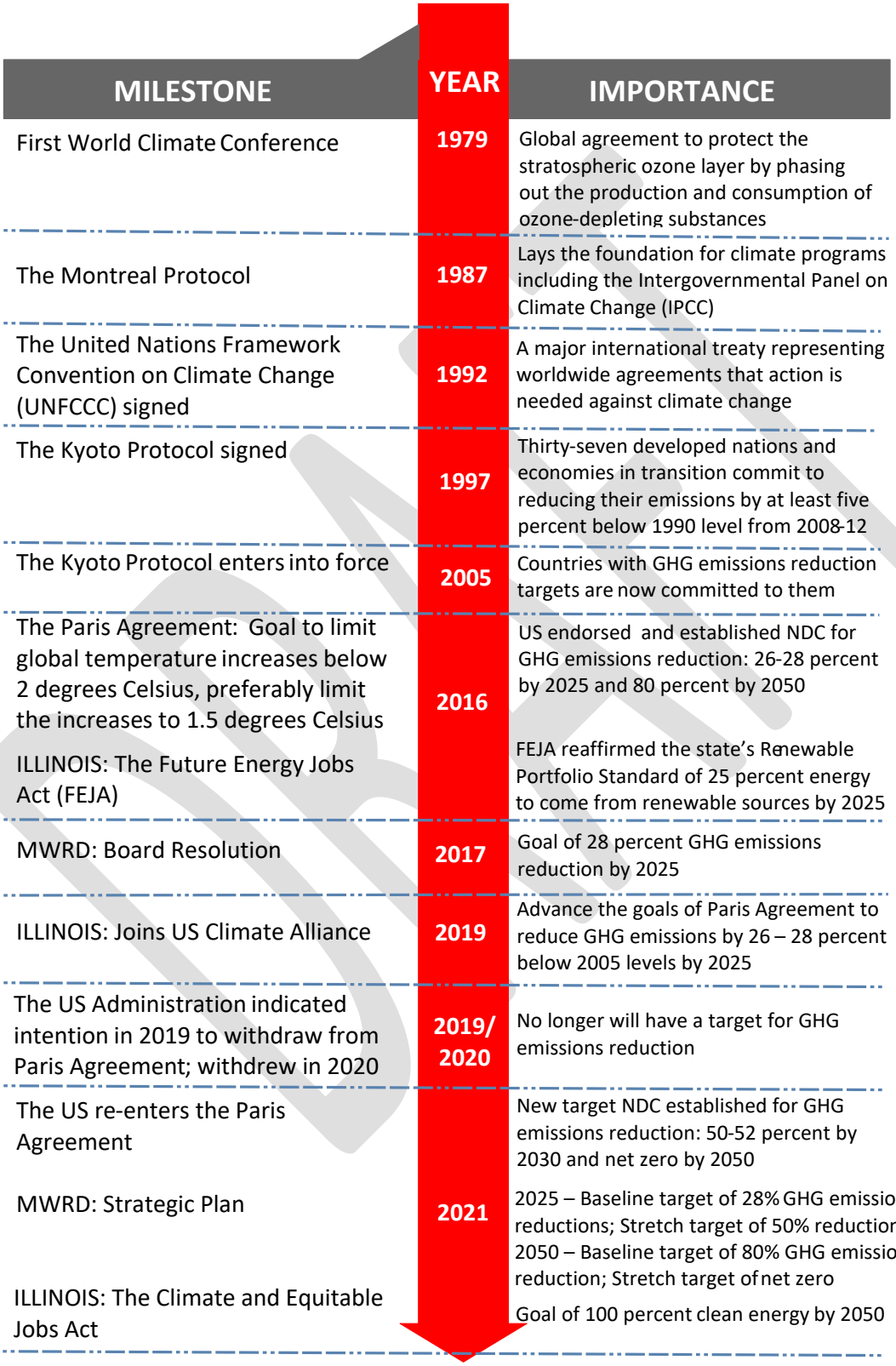
LEGISLATION, REGULATIONS, AND RESOLUTIONS

On July 7, 2017, the MWRD's Board passed a resolution that included a pledge to reduce the MWRD's GHG emissions by at least 28 percent below the MWRD's 2005 levels prior to 2025 (File #17-0728), in accordance with the Paris Agreement. The Paris Agreement required all parties to establish a nationally determined contribution (NDC), and developed countries were to take "absolute economy-wide GHG emissions reduction targets." The US signed and accepted the Paris Agreement, and in September 2016, submitted its first NDC with a target of an economy-wide 26 percent to 28 percent reduction of GHG emissions below the 2005 baseline level by 2025 and 80 percent reduction by 2050. After withdrawing under a prior administration, the US re-entered the Paris Agreement in 2021 and established a new NDC with targets of an economy-wide 50 percent to 52 percent reduction of GHG emissions below the 2005 baseline level by 2030 and a net zero emissions target by 2050. The Paris Agreement was the culmination of four decades of international climate diplomacy launched after the First World Climate Conference held in 1979 in Geneva sponsored by the World Meteorological Organization. The conference led to the establishment of the World Climate Research Program and eventually the creation of the Intergovernmental Panel on Climate Change (IPCC) in 1988. This also prompted further scientific assessments, including the UN mechanism through which governments assess the state of climate change, the IPCC, and various international and regional protocols and policy milestones as outlined in Figure 1. Detailed information on some of the important international protocols and relevant Illinois climate change legislation and commitments is provided in Appendix I. The following is a summary of the existing agreements, laws, and regulations that provide necessary context for the CAP.

In late 2016, Illinois passed the Future Energy Jobs Act (FEJA), which at the time was hailed as the most significant energy and climate legislation in Illinois history. While FEJA did not specify GHG targets, it was aimed, in part, at reducing GHG emissions in the state. For example, FEJA encouraged zero-carbon emission energy generation by creating financial incentives for installing and utilizing solar, wind, and nuclear power and reaffirmed the State's Renewable Portfolio Standard that targeted 25 percent of the State's retail energy to come from renewable sources by 2025. The financial incentives are funded by mandatory charges on consumers electricity bills. Along the same lines, the Climate and Equitable Jobs Act (CEJA) was signed into law on September 15, 2021. The law specifically states that utility procurement plans shall include "cost-effective renewable energy resources" equal to a minimum percentage of each utility's load for all retail customers as follows: 25 percent by 2025, 40 percent by 2030, 50 percent by 2040, and 100 percent clean energy by 2050.

In the Strategic Plan passed by the Board on June 23, 2021, the MWRD established ambitious stretch targets to achieve 50 percent emissions reduction by 2025 and net zero by 2050 from previously announced baseline reduction targets of 28 and 80 percent by 2025 and 2050, respectively. These new goals are consistent with the 2021 NDC submitted by the US.

FIGURE 1: GLOBAL AND REGIONAL CLIMATE CHANGE POLICY MILESTONES



SCIENCE AND ASSESSMENT

Evidence indicates that the climate is changing on both a regional and global scale. According to the World Meteorological Organization's provisional statement on the "State of the Global Climate in 2018," the 20 warmest years on record occurred in the past 22 years, with the top four in the past four years. According to the IPCC's Sixth Assessment Report (IPCC, 2021) released recently on August 9, 2021, "Each of the last four decades has been successively warmer than any decade that preceded it since 1850. Global surface temperature in the first two decades of the 21st century (2001-2020) was 1.78°F higher than 1850-1900 and was 1.96°F higher in 2011-2020 than 1850–1900, with larger increases observed over land (2.86°F) than over the ocean (1.58°F)." Many studies have attributed these changes to man-made emissions of GHGs. Low levels of GHG emissions occur naturally and keep temperatures on the earth stable; however, burning of fossil fuels, deforestation, agriculture practices, waste treatment, industrial processes, and development have produced increasing amounts of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and other GHGs which enhance heat trapping in the earth's atmosphere, resulting in global warming. The atmospheric concentration of CO_2 has risen by 25 percent in the past 50 years, and levels of CH_4, a highly potent GHG (28-36 times that of CO_2), have more than doubled. The amount of CO_2 in the Earth's atmosphere was measured to have reached its annual peak, climbing to 419 parts per million in May 2021, according to scientists from the National Oceanic and Atmospheric Administration (NOAA). With these increases in GHGs, global average temperatures are projected to increase by 1 to 1.5°F over the next few decades and reach unacceptable levels by the end of this century. The UNFCCC agreed that future global warming targets should be limited to below 3.6°F relative to the preindustrial level, with a preferable target below 2.7°F.

The IPCC is the primary international body tasked with assessing climate science. National and regional climate models are based upon the IPCC models. Every four years, the US Global Change Research Program is required to conduct a National Climate Assessment that updates data about climate science and impacts across the country. Detailed information on the science, assessment, and climate change impacts for the State of Illinois and the Chicago Region are available in two recent reports (1) An Assessment of the Impacts of Climate Change in Illinois (Wuebbles et al., 2021), and (2) Climate Action Plan of the Chicago Region (Makra and Gardiner, 2021). A brief summary of the predicted changes in the Northeastern Illinois climate are described below in Table 1; these are based on historical data and downscaled regional, state, and local projections of future conditions that the Midwest Regional Climate Center and Illinois State Climatologist have derived from the 2018 National Climate Assessment.

GREENHOUSE GAS INVENTORY ACCOUNTING

A GHG inventory quantifies information about emission and sink-related activities. The inventory uses global warming potential values to weigh the types of GHGs and sources by their effects on global warming. This allows the GHGs to be combined into one value, measured in terms of MT CO_2e (carbon dioxide equivalents).

The MWRD uses the Local Government Operations (LGO) protocol of 2010 to estimate GHG emissions, which provides specific guidance for wastewater utilities, and the US Environmental Protection Agency's (USEPA) Inventory of U.S. Greenhouse Gas Emissions and Sinks (2020), both of which are derived from the guidance of the IPCC. The USEPA's current inventory follows

the UNFCCC standards on global warming potentials (GWP) of GHGs based on IPCC's Fourth Assessment Report (AR4). In the Fifth Assessment Report (AR5), GWP of CH_4 and N_2O were increased to between 28-36 and 265-298, respectively. In future, the MWRD's GHG accounting will reflect this change after USEPA adopts these new GWPs for its inventory. The protocol was designed to provide a standardized set of guidelines to report GHG emissions associated with operations.

TABLE 1: SUMMARY OF CLIMATE-CHANGE-RELATED EFFECTS PREDICTED BY THE END OF THE CENTURY FOR NORTHEASTERN ILLINOIS

Air Temperature	Precipitation	Lake Michigan Levels
Average temperature may increase by 6 to 12°F under moderately high emissions	Total annual precipitation may increase by up to 19 percent	Majority of models predict decline in water level in Lake Michigan
Average temperature may increase by 2 to 7°F under drastically reduced emissions	Larger precipitation events are expected to be more intense and frequent	
Number of very hot days (> 100°F) and nighttime temperatures will increase	Smaller precipitation events are expected to be even smaller and less frequent	
Average temperature may increase by 6 to 12°F under moderately high emissions	Annual runoff is predicted to increase by 2 to 20 percent	
	Winter and early spring precipitation as rain instead of snow	
	Summer drought periods are expected	

Scope 1 emissions are direct emissions produced onsite from MWRD-owned sources while Scope 2 emissions are indirect emissions generated by use of purchased electricity. The emission sources for the MWRD include both Scope 1 and Scope 2 emissions and sinks (which act as emissions credits), while Scope 3 emissions are not considered (Table 2).

A few examples of Scope 3 emissions are (1) GHG emissions due to transmission and distribution losses of electricity purchased by the MWRD, (2) employee travel and commuting, and (3) purchased goods, chemicals, equipment, and construction activities. Scope 3 emissions are not included, because (1) the MWRD does not have direct control over these and (2) including Scope 3 would run the risk of double-accounting GHG emissions; for example, emissions due to the

employee travel and commuting are accounted for under transportation as part of Cook County's emissions inventory. Further, decarbonizing the transportation sector is a state or national policy issue.

The methods for estimating the annual GHG emissions or sinks from each source in Table 2 are indirect as actual direct measurements from these sources of GHGs are logistically impractical due to the resources required. The carbon sinks due to sequestration are subtracted from the combined Scope 1 and Scope 2 GHG emissions to estimate the carbon footprint. Details on the methodology used for estimating GHG emissions for each category are provided in Appendix II.

TABLE 2: SOURCES CONTRIBUTING TO THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO'S GREENHOUSE GAS INVENTORY AND SINKS

Type of Emissions	Source
Scope 1	Methane emissions from Stickney WRP's Imhoff tanks
	Combustion sources from the MWRD's vehicle and heavy equipment use
	Emissions from biogas combustion excluding biogenic carbon dioxide
	Nitrous oxide emissions from wastewater treatment and WRP effluent discharge to receiving streams
	Emissions from biosolids processing operations[1]
Scope 2	Emissions from purchased electricity use
Sinks	Carbon sequestration by tree-covered land owned by the MWRD

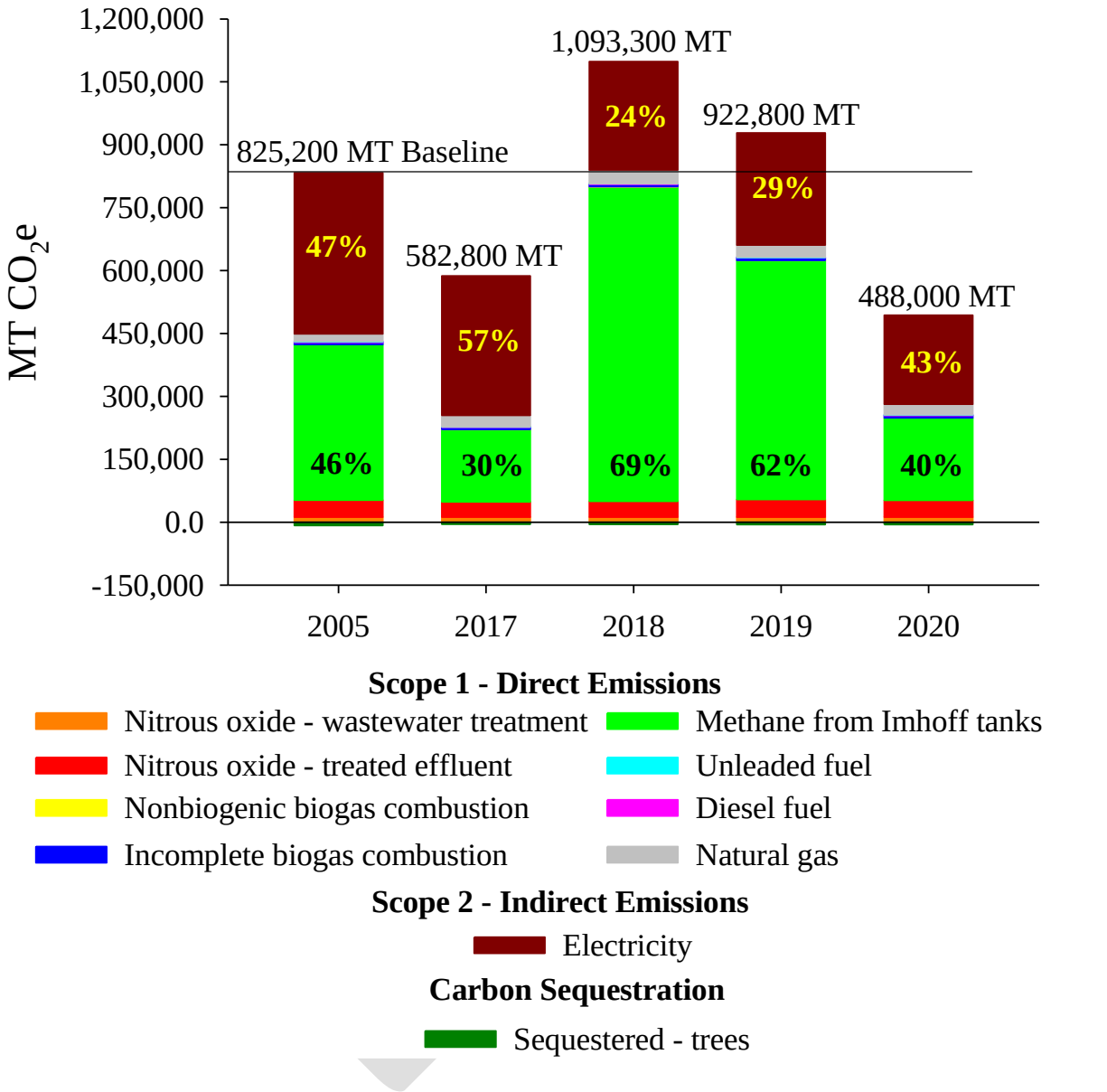
[1]Emissions from some biosolids process are included, however, some of the emissions from other biosolids process are not well understood, nor is there an approved method for estimating such emissions. This area will be studied further.

CARBON FOOTPRINT

The baseline year for carbon footprint of the MWRD is 2005, which aligns with the Paris Climate Agreement. This baseline provides a benchmark for future emission comparisons. Figure 2 below presents the MWRD's carbon footprint for the baseline year 2005 and as well as those for years 2017 through 2020. As can be seen, the largest contributors to the emissions are the MWRD's electricity usage and the methane emissions from the Imhoff tanks at the Stickney WRP, which account for 47 percent and 46 percent of baseline footprint, respectively. The baseline carbon footprint of the MWRD was 825,200 MT CO_2e. In 2017, total GHG emissions were 582,800 MT CO_2e, which is approximately 30 percent lower than the 2005 baseline. However, in 2018 and 2019 carbon footprint elevated to 1,093,300 MT CO_2e and 922,800 MT CO_2e, an increase of 32

percent and 12 percent, respectively, from the baseline. In 2020, the carbon footprint declined to 488,000 MT CO_2e.

FIGURE 2: THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO's CARBON FOOTPRINT FOR THE BASELINE YEAR 2005 AND YEARS 2017 TO 2020[ǂ]



[ǂ]Scope 2 emissions from electricity usage for 2005 and 2017 were calculated using regional United States Environmental Protection Agency (USEPA) eGRID emission factors. For 2018, 2019, and 2020, the CO_2 emission factors specific to the MWRD's procured electricity accounting for renewable electricity were available and used for calculations, and the CH_4 and N_2O emission factors were from USEPA eGRID.

Scope 1 – Direct Emissions

Contribution from Stickney Water Reclamation Plant Imhoff Tanks. The 30 percent decline in GHG emissions in 2017, as compared to the baseline year, was due to the decommissioning of Imhoff Battery A and emissions reductions associated with purchased electricity by the supplier. The 2017 emissions from Imhoff tanks were 172,000 MT CO_2e, as compared to 371,000 MT CO_2e in 2005. In 2009, the Imhoff replacement project began. The purpose of this project was to upgrade the West Side preliminary and primary treatment process at the Stickney WRP. The Stickney WRP started using Imhoff technology in 1928 and, while productive over a long lifespan, were obsolete as a treatment technology and one of the largest contributors of GHG emissions. As designed, the Imhoff tanks provided partial anaerobic digestion as part of primary treatment and resulted in significant amounts of methane being released. Nine primary settling tanks replaced the Imhoff tanks and are currently being commissioned into service. To date, 36 of the 108 Imhoff tanks have been decommissioned.

The GHG emissions from the Imhoff tanks are based on loading, which is a function of both the flow to the tanks and the organic concentration of wastewater. The loading to the Imhoff tanks had been reduced for several years; however, in 2018, the organic loading to the remaining 72 Imhoff tanks increased by over 70 percent. This increased organic loading resulted in a corresponding increase in GHG emissions close to 200 percent compared to the baseline year. The increase in organic loading was due to increased solids recycle in 2018 and the first half of 2019 that was attributed to operational difficulties in the solid's separation process, the influence of pumpback flow from the McCook Reservoir, which went into service in December 2017, and scouring of solids from the aeration batteries during the elevated flows. These higher solids were periodically diverted to Imhoff tanks, thus influencing the GHG emissions during 2018 and into 2019. Solids management has been improved since summer 2019, reducing 2019 Imhoff GHG emissions by 180,000 MT CO_2e in comparison to the 2018 levels. In 2020, these emissions further declined to 196,700 MT CO_2e, close to the 2017 levels. Decommissioning of the remainder of the Imhoff tanks is scheduled for completion by 2025, and these emissions are expected to be eliminated. This process will also help mitigate odor emissions from the Stickney WRP.

Transportation and Heavy Equipment Fuel. Overall, the MWRD's GHG emissions for combustion of transportation and heavy equipment fuel for 2020 was 1,880 MT CO_2e (approximately 0.3 percent of total emissions.) Unleaded fuel emissions are from the use of the MWRD's fleet of cars and make up approximately 70 percent of the emissions of the fuel category. The MWRD's fleet consists of 266 primarily passenger vehicles that range in age/size from a 1999 Chevy Metro to a 2019 Ford F550 platform truck. In 2020, 13 non-hybrid vehicles were replaced with new hybrid vehicles. Approximately, 49 percent of these vehicles are cross-over utility vehicles. Diesel fuel is used in heavier equipment and trucks at the WRPs to support maintenance and operations.

Natural Gas. The MWRD uses natural gas mostly during winter months to supplement biogas as a fuel in boilers to produce steam or hot water, which is then utilized to satisfy heating demands of the buildings and digesters and in adsorption chillers to cool buildings. In 2020, natural gas usage contributed 25,320 MT CO_2e GHG emissions, which is approximately 5.2 percent of total carbon footprint.

Incomplete and Nonbiogenic Biogas Combustion. Nonbiogenic emissions result from the burning of fossil fuels. Incomplete and nonbiogenic biogas combustion resulted in approximately 5,200 and 300 MT CO_2e emissions, which is approximately 1.1 and 0.1 percent of the 2020 carbon footprint, respectively.

Nitrous Oxide Emissions. Nitrous oxide is a byproduct generated during ammonia removal required to meet the National Pollutant Discharge Elimination System (NPDES) permit limits. All MWRD WRP's are currently single-stage nitrification plants, meaning that the ammonia entering the plant is oxidized to nitrate and discharged in the effluent. Two WRPs are operating enhanced biological phosphorus removal, and the process involves some level of denitrification; thus, N_2O emission factors for these WRPs will be revised in the next revision of the CAP. Currently, there are no effluent permit levels for total nitrogen. Nitrous oxide from treatment processes and treated effluent resulted in 52,000 MT CO_2e GHG emissions in 2020, which is approximately 11 percent of 2020 carbon footprint. Monitoring or predicting and understanding the behavior of N_2O emissions at full-scale WRPs remains challenging. The large number of parameters influencing the complex microbiological generation and reduction patterns of N_2O hinders the efforts to correlate the intensity of N_2O emissions to driving operational parameters for wastewater treatment processes. Accurate WRP-wide measurement of these emissions would need resource-consuming long-term measuring campaigns.

Scope 2 – Indirect Emissions

Electricity Usage. While the electricity usage has increased from 547,400-Megawatt hour (MWh) in 2005 to 675,000 MWh in 2019, and a slight decline in 2020 to 584,700 MWh, the GHG emissions from the electricity usage have decreased significantly over the years. For example, in 2005, 384,000 MT CO_2e emissions were from electricity usage and for 2019 and 2020 the emissions from electricity usage were 267,200 and 211,900 MT CO_2e, respectively. This is due to updates to the CO_2 emission factor specific to the MWRD's procured electricity, which accounts for the renewable energy proportion purchased; the USEPA Emissions and Generation Resource Integrated Database (eGRID) emissions factors for CH_4 and N_2O are still used as these are not estimated by the MWRD's electricity provider. As the proportion of renewable energy in the portfolio increases, the corresponding GHG emission factors used to convert to CO_2e emissions declines.

The USEPA's ENERGY STAR Portfolio Manager has prepared a DataTrends series to examine benchmarking and trends in energy among wastewater organizations. The DataTrends series is the first-ever analysis of aggregate data from a pool of hundreds of thousands of commercial buildings across the US. An energy use intensity (EUI) parameter was developed using data from approximately 1,400 WRPs. The average EUI for these WRPs is 10 kBTU/gallon/day. As the treatment of wastewater is a necessary function, energy will need to be expended to treat whatever volume of wastewater arrives at our WRPs. The EUI may be used to measure the efficacy of our GHG reduction strategies. For 2020, the value for the MWRD, including total electricity and total flow, was just under 4 kBTU/gal/day, 60 percent less than the national average. A second informative metric is electricity use for the treatment of wastewater normalized for flow; this factor also accounts for changes in precipitation from year to year. The MWRD's energy usage has been relatively steady for providing this essential service and is significantly below the regional average as calculated by the Smart Energy Design Assistance Center (SEDAC). According to SEDAC, the

average kWh/MG treated for WRPs assessed through their center is 2,145 kWh/MG. At the MWRD, the average from 2005 to 2020 was 1,280 kWh/MG, showing that the MWRD's operations are highly efficient with respect to energy use.

Since 1997, the MWRD has participated in various energy curtailment programs. Through participation in these programs, the MWRD reduces the amount of energy used during the peak demand periods by shutting down some of the equipment without sacrificing the critical operations resulting in financial savings.

Sinks

Trees and vegetation are called "sinks" for CO_2 because, as they grow, they absorb CO_2 from the air and emit oxygen during photosynthesis. Currently, the MWRD owns approximately 6,000 acres of land with tree cover, which accounts for a sink of close to 5,000 to 5,500 MT CO_2e/yr. Another GHG sink is through the sequestration of carbon in soils when biosolids are applied to farmland and in urban areas. The biosolids applied to farmland and controlled solids distribution areas outside of MWRD property cover approximately 5,600 acres and account for 16,000 to 17,000 MT CO_2/yr. While this is beneficial to the environment, this GHG sink cannot be accounted for in the MWRD's GHG inventory as it does not occur on MWRD land. There is a small portion of biosolids that are applied on MWRD land at Fischer Farms at the Hanover Park WRP. This equates to 70 MT CO_2/year and is accounted for in the MWRD's GHG inventory.

MITIGATION STRATEGIES TO MEET CARBON FOOTPRINT REDUCTION TARGETS

The MWRD is working to make a positive impact on climate change by reducing its carbon footprint. In accordance with the recent Strategic Plan, the MWRD pledged to reduce its carbon footprint by 28 percent by 2025 from the 2005 baseline (below 594,000 MT CO_2e) and by 80 percent by 2050 (below 165,000 MT CO_2e) with stretch targets to reduce its carbon footprint by 50 percent by 2025 (below 412,600 MT CO_2e) and achieving net zero by 2050.

Scope 1 – Direct Emissions

The MWRD is working diligently to evaluate and reduce direct emissions from its operations, when possible, and actively collaborating with other organizations and universities to develop processes and technologies to reduce emissions for certain contributing factors that pose significant challenges. These opportunities and challenges are discussed below.

Complete Decommissioning of Imhoff Tanks

Complete decommissioning of the Imhoff tanks is expected by 2025. As more Imhoff tanks are decommissioned in the coming years and flow and loading to these tanks is reduced, there will be an incremental decline in GHG emissions from this source. Eliminating this single source will result in eliminating 371,000 MT CO_2e, which was approximately 46 percent of 2005 carbon footprint.

Transportation and Heavy Equipment Fuel

Regionally, vehicles used for transportation and freight are a major source of GHG emissions and the MWRD is working to be a leader in this area by switching to alternative fuel vehicles to improve fuel efficiency and reduce these emissions. Thus, the MWRD is purchasing 16 hybrid and 7 electric vehicles (EVs) in 2021 for its passenger fleet. The EVs will be part of a pilot program and will be assigned to the passenger fleets at the Main Office Building garage pool, and the Stickney and Calumet WRPs. Beginning in 2024, the plan is to purchase all EVs whenever current vehicles are replaced at the end of their useful life. The MWRD will work towards replacing all passenger vehicles with EVs by 2030. This will provide time to install charging stations at the MWRD's facilities. For heavy vehicles not assigned to the passenger fleet, the MWRD will work to transition to alternative non-fossil fuel vehicles by 2050. Although this initiative will reduce MWRD's GHG emissions by only a small amount (1,880 MT CO_2e, 0.3 percent of 2020 carbon footprint), this will demonstrate the MWRD's commitment towards decarbonizing transportation in our region. In addition, the MWRD is pilot testing solar recharged battery powered robotic electric lawn mowers and utilizing sustainable methods like goats/sheep for vegetation control instead of fossil fuel-based mechanical methods in the landscape management program. The MWRD has procured bicycles and tricycles for operations and maintenance staff for the ease of mobility within the WRPs and associated environmental benefits.

Natural Gas

The MWRD uses natural gas mostly during winter months to supplement biogas as a fuel in boilers to produce steam or hot water, which is then utilized to satisfy heating demands of the buildings and digesters and in adsorption chillers to cool buildings. In 2020, natural gas usage contributed 25,320 MTCO_2e GHG emissions, which is approximately 5.2 percent of organization's total carbon footprint. These emissions are anticipated to be reduced with scheduled upgrades to boilers. The emission may be further reduced by implemented recommendations identified in a planned energy neutrality study to be completed by the end of 2023.

Incomplete and Nonbiogenic Biogas Combustion

Incomplete and nonbiogenic biogas combustion resulted in approximately 5,200 and 300 MT CO_2e emissions, which is approximately 1.1 and 0.1 percent of the 2020 carbon footprint, respectively. These emissions cannot be avoided, so the MWRD has adopted best management practices to minimize these emissions. These emissions may potentially increase if the MWRD's energy neutrality goals as laid out in the Strategic Plan are met by enhancing biogas production and utilization with co-digestion of external carbon sources like food waste and fats, oil, and grease etc.

Nitrous Oxide from Wastewater Treatment and Treated Effluent

Mitigation of these emissions poses many technical and economic challenges. Despite a large amount of N_2O mitigation studies conducted in laboratories, full-scale implementation of N_2O mitigation is scarce, mainly due to uncertainties of mitigation effectiveness, validation of N_2O mathematical models, risks to nutrient removal performance and additional costs.

To prevent emissions of N_2O from receiving waters, all MWRD WRPs would need to perform total nitrogen removal which requires complete denitrification. Complete denitrification will most likely require external sources of readily biodegradable carbon. The MWRD may be able to meet its goal of 80 percent emissions reduction by 2050 without mitigating this source, however, the mitigation of these emissions is necessary to meet the target of achieving net zero by 2050. MWRD staff is collaborating with a team consisting of four universities and two utilities to develop approaches and technologies to mitigate these emissions.

These emissions may potentially increase if the MWRD's energy neutrality goals as laid out in the Strategic Plan are met by enhancing biogas production and utilization with co-digestion of external carbon sources like food waste, and fats, oil, and grease etc.

Additionally, to remove N_2O generated via wastewater treatment whether generated through nitrification or denitrification, all aeration basins would need to be covered and off gas conveyed into a chemical scrubber or catalytic treatment process. The energy needed and carbon footprint to treat the generated N_2O is unknown but must be viewed in light of the carbon footprint if the N_2O had free release to the atmosphere.

Scope 2 – Indirect Emissions

Regionally, decarbonization of the energy grid is important to meet the emission reduction goals. For the MWRD, a significant contributor to its carbon footprint is indirect emissions due to electricity usage. The MWRD's previous efforts, ongoing initiatives, and future plans also focus on reducing or eliminating this source of GHG emissions by (1) Reducing energy use in its buildings and processes, and (2) Transitioning to 100 percent renewable energy use. These initiatives are briefly discussed below.

Reducing Electricity Use by Enhancing Process Efficiencies

The electricity used and, hence, GHG emissions attributed to the MWRD, are correlated to wastewater flows. As wastewater flows to the WRP increase, energy demand increases. This has a double impact at the WRP in terms of energy demand: the increased wastewater flows require more energy not only to pump higher volumes of wastewater but also to add air to the aeration reactors to meet the treatment goals. Since most of the MWRD's service area has combined sewers, as precipitation events become more severe, the wastewater volumes to be treated at the WRPs will increase, as will energy demand. Regardless, reducing energy consumption is one of the goals of the MWRD's Strategic Plan.

Optimization of Wastewater Treatment Processes. Most of the electricity used at the MWRD is used by blowers to provide aeration in the wastewater treatment process (46 percent) followed by wastewater pumping (32 percent), and treatment of solids (15 percent.) Energy usage is related to the volume of wastewater treated, thus as flows increases, the energy required for proper treatment of wastewater increases. Between 89 to 91 percent of the electricity used for wastewater pumping and treatment is used at the Stickney, Calumet, and O'Brien WRPs.

The two main components in aeration that primarily control energy usage include the generation (blowers), and distribution/demand (diffusers). For the Stickney WRP, large, specialized blowers are necessary for the required aeration. These large blowers have minimal turndown capabilities,

so even if reductions in air demand could be made, the blower output cannot be decreased significantly, for plant-wide energy savings. Staff is watching for developments in blower technology to see if advancements are made for high-capacity equipment with turn-down capabilities to meet our process requirements at the MWRD large WRPs. At other WRPs, when it is determined that a blower can be replaced (either through end of life, or a more efficient model is warranted) energy efficiency, turn down capabilities, and output is considered when selecting the replacement. For example, energy efficient turbo blowers have been installed at the Hanover Park and Lemont WRPs and a turbo blower will be installed at the Egan WRP. The MWRD is currently investigated the installation of the largest turbo blower available on the market as pilot test at the Kirie WRP. Turbo blowers are more efficient than traditional blowers as these have advanced bearing designs which allow for higher operating speeds. However, they are only available up to a certain capacity and are not currently available in the capacities required for the large WRPs. Modern air diffuser systems are also currently being investigated and one will be piloted at the Egan WRP by 2024, which will be used to inform installations moving forward.

With respect to energy required with pumping, proper preventive maintenance is essential. One of the most common issues in pumps that causes a reduction in pump efficiency (and increased energy usage) is worn wear ring, seals, and bearings. The MWRD pumps move liquid with grit and other debris, which wear-out these consumable parts. Regularly scheduled preventive maintenance is necessary for keeping the equipment in its most efficient operating range.

The impacts equipment and processes have on energy usage cannot be overstated. While improvements through the installation of new and upgraded equipment and/or controls do have the potential to reduce energy use and GHG emissions, so does properly timed preventive maintenance. Conversely, the addition of new processes and associated equipment also affect the MWRD's GHG emissions. For example, the O'Brien WRP ultraviolet wastewater disinfection technology that was installed in 2016 resulted in an annual increase of approximately 1,700 MT CO_2e GHG emissions.

The MWRD has several ongoing initiatives and plans for infrastructure improvements to reduce electricity usage:

1. Replace current solids dewatering equipment, which is at the end of its productive life, with a new energy-efficient system at the Stickney WRP. Evaluation of technologies is ongoing, and when it is complete a contract for replacement of the current system will be issued.
2. Improve the aeration system at the O'Brien WRP by 2030. Specific improvements are to be determined and will include new diffuser plates.
3. Installation of a full floor aeration test at the Egan WRP by 2024.
4. Pilot a new turbo blower at the Kirie WRP by 2024.
5. Installation of a turbo blower at Egan WRP by 2024.
6. Evaluate alternatives for improving aeration efficiencies at other MWRD WRPs. Alternatives will consider blower capacity, aeration systems, control schemes, and mixing limitations.

Depending on the new dewatering system chosen, electricity consumption for dewatering at the Stickney WRP may decrease by up to 60 percent. As previously shown, the MWRD is relatively

energy efficient already when comparing the MWRD's electricity consumption for treatment to average values reported by USEPA's Energy Star Portfolio Manager and SEDAC. Therefore, the ability to further reduce electricity use may be limited at some WRPs or may be costly for little improvement.

Reduce Energy Usage at the Buildings and Facilities. Buildings for offices and process control facilities at the WRPs also consume electricity. The MWRD entered into an Intergovernmental Agreement with the Public Building Commission of Chicago (PBC) for the purpose of conducting an energy audit of various facilities and participating in the Multi-Agency Guaranteed Energy Performance Contracting Program. The Investment Grade Energy Audit Report identified a comprehensive list of energy conservation projects that met MWRD requirements and objectives. The projects included modernizing interior lighting to light emitting diode technology, controlling lights with occupancy sensors, upgrading heating ventilation and air conditioning controls, and installing custom blanket insulation on existing steam piping. All work was completed in 2021. The PBC measures and verifies guaranteed savings requirements for each project. The entire program covered more than three million square feet of space and is expected to reduce utility consumption at the MWRD's buildings and facilities by an estimated two percent annually. However, potential energy savings by decommissioning of downtown office buildings in favor of satellite facilities were not explored as part of this effort and is recommended to be conducted as part of a space study.

Adoption of Software as Service, Cloud Hosting Services, and Virtualization - Energy and Carbon Footprint. The MWRD Information Technology Department (IT) has made several efforts in leveraging internet-based cloud hosting providers to house essential services and applications. This approach reduces the need for systems to be purchased and hosted physically at MWRD locations that would use power, cooling, and advanced networking equipment.

Energy Consumption - Computer Monitors. Starting in 2017 and in preparation for the rollout of Windows 10, IT made configuration changes for all computer systems that would first enter the monitor into screen saver mode (for security), and then into energy efficient mode (sleep) after set times of inactivity. In addition, IT is committed to purchasing Energy Star compliant monitors.

Energy Conservation. Recently, the MWRD developed Employee Guidelines for Energy Conservation (Appendix III). This will not only educate employees to conserve energy while at work but also at home to reduce regional GHG emissions in the context of climate change.

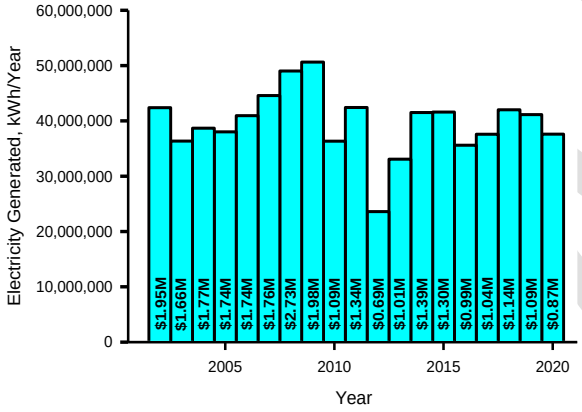
Renewable Energy Initiatives

Over the last 40 years, staff at the MWRD has investigated ways to incorporate renewable energy into its operations for environmental and economic reasons. Multiple processes have been evaluated from various perspectives and continue to be restudied to incorporate changes in technology and improved process data. Brief information on these past efforts is provided in Appendix IV.

Renewable Electricity Production. The MWRD generates renewable hydropower at the Lockport Powerhouse (Powerhouse), located on the Main Channel Extension, Lockport, Illinois, which was built in 1907 and marks the southwestern extent of the MWRD-managed Chicago Area

Waterway System (CAWS). The Powerhouse is located just before the confluence of the Chicago Sanitary and Ship Canal and the Des Plaines River. The facility is an integral part of the MWRD's task of managing the CAWS and reducing the risk of flooding throughout the service area. In addition to its role in managing the waterways, the Powerhouse also provides financial benefits from hydroelectric power generation. The water flowing through the facility is harnessed by two turbines to provide a safe and environmentally friendly energy source that is sold back to Commonwealth Edison. In 2020, the Powerhouse generated 37,609,000 kWh of electricity and $869,000 in revenue (Figure 3). Because the renewable energy certificates (REC) from this renewable energy production are sold by the MWRD to generate revenue, they cannot be counted towards our GHG reductions, however the RECs are used by the purchaser to offset their GHG emissions and contribute to decarbonizing the region. In 2020, the Powerhouse generated 37,608 RECs for an estimated value of $369,000.

FIGURE 3: GENERATION OF RENEWABLE HYDROPOWER AT THE LOCKPORT POWERHOUSE AND REVENUE GENERATED FROM 2002 TO 2020



Solar Energy Production. The MWRD studied the possibility of implementing photovoltaic solar power at our facilities in 2019 (MWRD, 2019). The study found that currently the area available for photovoltaic solar power coupled with the necessary power requirements for the MWRD operations and economics make pursuing large scale photovoltaic solar power at the MWRD not prudent as other alternatives to carbon free electricity exist and are economically favorable. As we move forward, the MWRD will continue to explore incorporation of solar power for equipment and facilities and work to find feasible ways of incorporating this technology.

Increase Biogas Utilization. The MWRD currently beneficially utilizes most of its biogas, however, staff is investigating ways to further utilize remaining excess biogas. One way to improve biogas utilization is through the installation co-firing boilers. Co-firing boilers allow for two types of fuels to be burned at the same time, compared to the MWRD's previous standard of dual-fuel boilers. While the boilers can burn natural gas or digester gas, dual-fuel boilers only allow one type of fuel source to be burned at a time. Thus, if there was not enough biogas available to produce the required heat for the process, natural gas had to be used and excess biogas was wasted. Two contracts are moving forward to improve biogas utilization with the installation of co-firing boilers at the Stickney WRP (Contract 19-155-3M) and the Hanover Park WRP (Contract 19-542-3MR (RE-BID)). The Calumet WRP has already upgraded its boilers to co-firing and is finalizing the decommissioning of the dual-fire digester boilers (Contract 18-277-3M). Staff is also designing a

combined heat and power (CHP) system to be installed at the Egan WRP by 2024. Future biogas utilization will be guided by the energy neutrality study to be completed by the end of 2023.

Renewable Electricity Use Plan. In 2020, the renewable energy portion of the MWRD's purchased electricity was 16 percent, an increase of 2 percent from the previous year. This is projected to increase to 17.5 percent in 2021 and 25 percent by 2025 as required by Illinois' FEJA (P.A. 99-0906) passed in 2016 and further increase to 100 percent by 2050, as per CEJA, which was signed into law on September 15, 2021. The law specifically states that utility procurement plans shall include "cost-effective renewable energy resources" equal to a minimum percentage of each utility's load for all retail customers as follows: 25 percent by 2025, 40 percent by 2030, 50 percent by 2040, and 100 percent clean energy by 2050.

On September 2, 2021, The MWRD Board approved item 21-0790 "Authorization to allocate $500,000.00 annually for the purchase of RECs and to authorize the Director of Procurement and Materials Management to accept pricing for the procurement of RECs for 2022 and 2023," which allows the MWRD to procure up to $500,000 in RECs in both 2022 and 2023. After which, that money will be encumbered for the direct purchase of green energy generation equipment or used for procuring more RECs.

Sinks

The MWRD plans to continue planting more trees at its properties and replace dead trees with new saplings. In addition, there is a plan to expand land under native prairies at various locations.

ENERGY NEUTRALITY

Current Status

In general, energy neutrality has been defined as "A WRP that generates one-hundred percent or more of the energy it needs for its operations solely from the energy embedded in the water and wastes it treats."

At present, energy neutrality at the MWRD is approximately 25 percent. Four of the MWRD's WRPs have anaerobic digesters; the Hanover Park, Stickney, Calumet, and Egan WRPs. A beneficial product of the anaerobic digestion process is biogas. Biogas is typically composed of 60 percent methane and 35 percent CO_2 on a dry weight basis, water vapor, and trace amounts of other compounds including particulates, siloxanes, and sulfides. The MWRD uses biogas as a fuel in boilers to produce steam or hot water, which is then utilized to satisfy heating demands of the buildings and digesters, and in adsorption chillers to cool buildings. A portion of the biogas produced at the Stickney WRP is used in the biosolids pelletizer facility. RECs sold at the Lockport Powerhouse are not included in this calculation.

In 2020, the MWRD produced 1,104,400 MMBTU of biogas and utilized over 90 percent (equivalent to heating close to 6,600 homes for a year). Across all MWRD facilities, biogas utilization accounts for roughly 25 percent of the MWRD's energy usage. If the MWRD did not utilize biogas and sold the gas, the MWRD would need to purchase natural gas, which would increase GHG emissions by close to 40,000 MT CO_2e per year. In addition, if the MWRD were to sell any of the biogas's environmental attributes (such as a REC or a renewable identification number, also called a RIN) it would require our accounting of GHG emissions and energy neutrality reflect these sales, potentially increasing the MWRD's carbon footprint and reducing the MWRD's progress toward carbon neutrality. Additionally, if selling the gas requires compression and cleaning, the environmental footprint (carbon footprint and consumables such as media) will also increase.

Future Goals

The MWRD's Strategic Plan has laid out an ambitious goal to achieve net energy neutrality by 2035 with a stretch goal to be energy positive by 2050. As ambitious as that goal is, it is important to keep this in context with the environment and recognize that carbon reduction is more important than energy neutrality. None the less, in fall 2021, a Request for Proposal was advertised to provide professional services to develop conceptual plans and cost estimates for achieving energy neutrality at one WRP by 2030 and throughout MWRD by 2035. It is anticipated that the contract will be awarded in early 2022 and work completed by December 31, 2023. The proposers will provide background information, a roadmap to achieving energy neutrality at the MWRD, identify legal complexities and ramifications that may be encountered achieving these goals, and how these goals may have complementary or adverse impacts on MWRD's carbon footprint.

Brief information on carbon footprint reduction goals and initiatives to meet those goals by MWRD's sister agencies and peer utilities is provided in Appendix V.

IMPACT OF ENERGY NEUTRALITY ON CARBON FOOTPRINT

In general, on-site biogas production and enhancements using co-digestion of sewage sludge with external carbon sources has been a path to achieve energy neutrality or energy positivity at the WRPs (Gao, et al., 2014; Maktabifard et al., 2020), however, this is very site specific, and many factors can influence this outcome. Energy is recovered by either deploying biogas driven CHP units or boilers resulting in reduced or complete elimination of indirect GHG emissions (Scope 2) related to energy consumption from the electric power grid and direct GHG emissions (Scope 1) due to natural gas use. One limitation that many utilities contend with is the amount of available infrastructure and digester feedstock to produce energy and the operational complexities associated with co-digestion. Additionally, three of the four MWRD WRPs that have digesters are located in areas that are sensitive to environmental-justice issues (per the Illinois EPA EJ Start Tool), and co-digestion and energy generation increases localize air pollution, odors, and traffic. While some of these issues could be mitigated, others cannot, and careful consideration and communication would need to be taken to mitigate its impacts on these communities. In 2020, Scope 1 GHG emissions due to natural gas use and Scope 2 GHG emissions due to electricity consisted of 5.2 and 43.4 percent of MWRD's carbon footprint, respectively.

PATHWAYS TO MEET CARBON FOOTPRINT REDUCTION TARGETS

Strategic Plan 2021-2025 Targets

The Strategic Plan has laid out carbon footprint reduction targets for 2025 and 2050. The baseline targets are 28 percent and 80 percent, and stretch targets are 50 percent reduction and net zero, respectively. The MWRD has also set up a goal of achieving energy neutrality by 2035 and energy positive by 2050, which may be complementary to carbon footprint reduction targets or may adversely impact by increasing Scope 1 direct GHG emissions depending on the chosen technologies. Potentially there are two scenarios to consider for pathways to meeting targets and internal policy decision that can be made to help ensure meeting this target.

Scenario 1: Meeting Renewable Electricity Targets Based on FEJA/CEJA

Scenario 2: Achieving Energy Neutrality/Positivity

Since the MWRD is prioritizing carbon reduction over energy production, it is recommended that the MWRD adopt a policy to retain the environmental attributes associated with renewable energy generated within its fence line where that energy could be used internally to enhance an equivalent carbon sink in carbon footprint accounting. Selling the MWRD's environmental attributes reduces the MWRD's progress towards achieving carbon neutrality and has the potential to drastically increase costs (e.g. if carbon neutrality was to ever be mandated and the MWRD was locked into a long-term agreement to sell environmental attributes). Furthermore, preparing the environmental asset (such as biogas) can increase the MWRD's carbon footprint due to the energy requirements for conditioning (cleaning, compressing, and drying) the asset for sale.

The pathways to achieving 2025 and 2050 carbon footprint reduction targets under Scenario 1 are considered in this CAP. These pathways will be reevaluated after the completion of the energy neutrality/positivity study in 2023 and will be added to the next revision of the CAP.

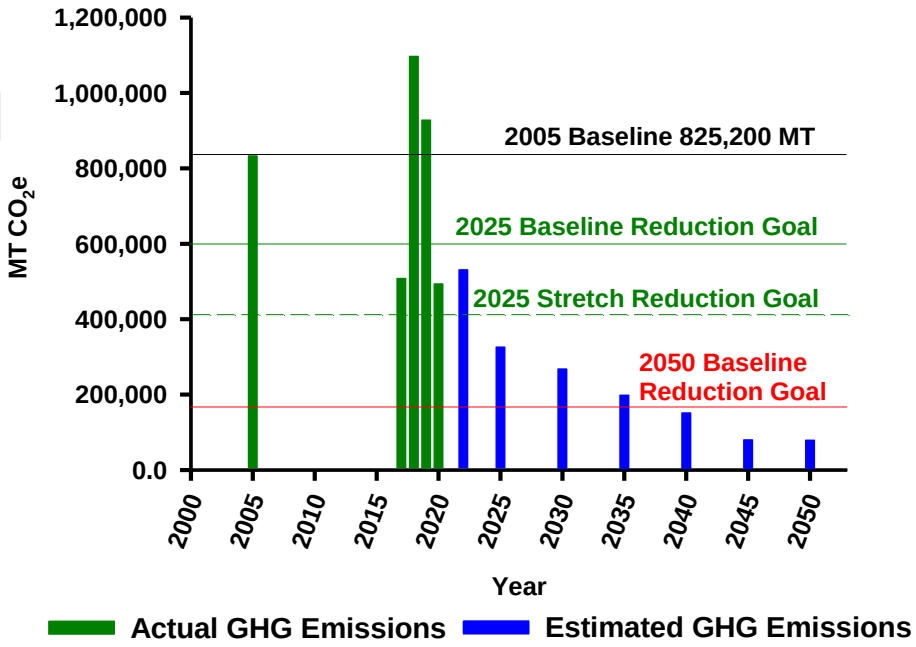
Table 3 shows that the MWRD will be able to meet both baseline and stretch targets for carbon footprint reduction by 2025 and will also meet its 2050 baseline target. It is estimated that by 2050 the MWRD will be able to reduce its carbon footprint by approximately 90 percent (Figure 4). While the pathways to achieve net zero by 2050 will be developed after the completion of the energy neutrality study, some of the options may be generating and retaining RECs, purchasing carbon credits, and increasing carbon sinks on MWRD owned land.

TABLE 3: PATHWAYS TO MEET CARBON FOOTPRINT REDUCTION TARGETS

Pathway	Emissions Reduction Categories	Potential Emissions Reduction (MT CO_2e)	Meet Baseline Target	Meet Stretch Target
	2025 Targets		**28%**	**50%**
1.	Reduce 100% Imhoff Tank Emissions	370,900	Yes	No
2.	Renewable Electricity (FEJA)[1]	233,900	Yes	No
3.	50% Pathway 1 + 50% Pathway 2	302,400	Yes	No
4.	50% Pathway 1 + 100% Pathway 2	419,350	Yes	Yes
5.	100% Pathway 1 + 100% Pathway 2	604,800	Yes	Yes
	2050 Targets		**80%**	**Net Zero**
6.	Renewable Electricity (CEJA)[2]	383,900	No	No
7.	Pathway 1 + Pathway 6	754,800	Yes	No
8.	Reduce 100% Transportation Fuel Emissions	1,400	No	No
9.	Pathway 1 + Pathway 6 + Pathway 8	756,200[3]	Yes	No

[1]Future Energy Jobs Act Renewable Energy Goal of 25 percent by 2025; [2]The Climate and Equitable Jobs Act Renewable Energy Goal of 100 percent by 2050; [3]Estimated 90 percent reduction from 2005 baseline.

FIGURE 4: ACTUAL AND PROJECTED CARBON FOOTPRINT THROUGH 2050



OVERARCHING ACTIONS TO BUILD REGIONAL CLIMATE RESILIENCE

Overarching actions to build community resilience requires cooperation across the region. These actions must reduce regional GHG emissions and develop adaptation plans equitably to changes that are inevitable (Marka and Gardiner, 2021). The MWRD has always worked with many regional and national agencies to tackle environmental challenges and is ready to invest in the sustained efforts that are required to address the climate challenge in front of us. The MWRD plans to take a leadership role to set an example for peer utilities on overarching actions they can take to develop regional climate resilience.

Community Engagement and Education

Increasing investment in citizen and community engagement is a key element in strategies to improve regional climate resilience through informed public debate and actions. Adaptation to climate change impacts will require well informed, rapid, coordinated, and decisive actions at global, national, regional, local, and household levels, and with an equitable approach to climate change mitigation and adaptation. The MWRD will develop strategies and educational materials to engage its staff and the public in climate change discussions on the following topics:

- Promote green infrastructure (GI) and disconnecting downspouts from sewers
- Promote water efficiency and conservation behaviors
- Inform the public about weather hazards, flood risks, and flood mitigation projects
- Promote the Illinois Department of Public Health standards for post-flood clean up
- Foster community spirit to recover, adapt, and "bounce-forward" after disaster
- Promote information from other agencies about changing heat hazards and risks
- Promote information from other authorities and organizations that support health and wellness
- Promote information from other authorities on air pollution action days

Modernize Telecommuting Practices and Rules

Studies have shown that transportation and stationary energy consumption are large contributors to GHG emissions (Makra and Gardiner, 2021). On the surface, it could appear that a logical step for the MWRD to make an impact to regional transportation emissions would be to increase work from home flexibility to reduce vehicle use; however, this is only an assumption. Most employees at the MWRD are "hands-on" employees, where they physically must be present at their required job location to accomplish their required duties. Also, the employees that are not "hands-on" typically work from the downtown offices which are in an area that is widely accessible by public transit. Public transit makes a significant reduction in transportation related GHG emissions, and support programs exist that encourage public transportation use to the downtown office such as the flexible spending program for transportation and a reduced 7-hour workday (compared to an 8-hour workday for personnel that works in the field) to accommodate commuting difficulties downtown. Further exploration of expanding a work from home program for non-essential employees could provide some value and a minor offset of regional GHG emissions; however, care must be taken to avoid a reduction in productivity and creating inequities between employees

based on different work locations. Staff is currently conducting a survey to gather data and inform a decision on this.

Reducing Emissions for Business Travel

The MWRD will commit to reducing business related climate impacts by joining the major airlines' programs to reduce airplane emissions and/or invest in carbon offsets that compensate for these emissions. Examples of a few of these programs are: (1) The Eco-Skies Alliance program of United Airlines allows corporate customers the opportunity to pay the additional cost for sustainable aviation fuel. This contribution goes beyond traditional carbon offsets and will show there is demand for low emissions fuel solutions; (2) American Airlines has partnered with the nonprofit "CO_2OL Effect" to help flyers offset the carbon emissions of their flight. A small added fee allows for high-quality verified carbon offsets to help protect and conserve our planet's resources; and (3) Beginning in March 2020, Delta Airlines announced that their flights will be carbon neutral. Delta addressed 13 million MT CO_2e emissions from March 1 to December 31, 2020, through verified offsets. Delta Airlines is developing a new program for its customers to actively participate and supports its efforts on carbon neutrality. For example, the current carbon offset (0.3 MT CO_2e) cost for a return flight from Chicago, IL to New Orleans, LA for attending the Water Environment Federation's Technology Exhibition Conference covering approximately 1,700 miles will be approximately only $3 to $5.

Employee Recognition for Purchasing Electric Vehicles, Using Environmentally Friendly Commuting Options, and Installing Solar Panels for Home Energy

The MWRD will develop an "Employee Recognition Program" to encourage staff to purchase EVs and install solar panels for their household energy needs. For employees, the MWRD will install charging stations at employee parking lots with the capacity to charge 25 vehicles by 2025 and increase the vehicle charging capacity to 50 by 2027. Employees will pay the cost of electricity for charging their vehicles. In addition, facilities will be upgraded to accommodate environmentally friendly means of commuting including bicycles and electric scooters, safe storage of these and providing shower/changing facilities and use of public transit and car-pooling to replace trips using single occupancy vehicles.

Enhance Carbon Sinks

The restoration of trees remains one of the most effective strategies for climate change mitigation. The MWRD is working to revitalize the urban forest through the "Restore the Canopy" program, which was launched in April 2016 to replenish Cook County's tree canopy that was decimated due to the emerald ash borer and extreme weather events. The MWRD is distributing trees to community groups, municipalities, schools, and residents throughout Cook County. Since the program began, the MWRD has partnered with approximately 180 different entities and has distributed more than 93,900 red oak, pin oak, swamp white oak, black oak, and pecan saplings. These trees may potentially sequester 250 and 5,200 MT CO_2e at 10 years of age and maturity, respectively. In addition, MWRD's Beneficial Biosolids Use program sequesters approximately 16,000 to 17,000 MT CO_2e carbon annually in soils where biosolids are land applied in the region. The biosolids applied to farmland and controlled solids distribution areas outside of MWRD property cover approximately 5,600 acres. The MWRD's Exceptional Quality Compost is a

sustainable and environmentally beneficial product derived from the water reclamation process. The MWRD partners with the City of Chicago and other organizations by collecting woodchips from routine tree trimming programs and blending this with MWRD biosolids in open windrow machines. Woodchips, grass clippings and leaves are used as a bulking agent. These programs do not increase the MWRD's carbon sinks but do help towards the mitigation of regional GHG emissions and realize other benefits like stormwater management, mitigation of pollution and urban heat island effect, urban wildlife protection, water quality improvements, and enhances streetscape appearance.

Procurement of Low Carbon-intensity Materials

A survey of peer utilities and sister agencies will be conducted on their policies and methods to procure materials with lower carbon-intensity. Information from the survey will be used to develop action plans to procure low-carbon alternate materials.

PREPARING FOR CLIMATE CHANGE IMPACTS

Even if global and local GHG emissions decrease dramatically, many climate impacts are now inevitable, and preparation for these changes is essential. As the regional authority for wastewater collection and treatment and stormwater management, the MWRD is impacted by climate change on many levels. The MWRD must anticipate and prepare for these predicted changes. To do so, the MWRD must adopt a risk-management approach and evaluate vulnerabilities that threaten existing and planned infrastructure and operations. The objectives of this analysis are to help the MWRD in: (1) Decision-making on capital improvements, (2) Operational strategies to deal with predicted climate change impacts, and (3) Developing adaptation strategies.

Rising temperatures and increasing concerns for flooding have significant consequences on the work of the MWRD. Created 81 years before the USEPA, the MWRD has an impressive history of environmental protection and stands equipped to tackle this next chapter. The MWRD aspires to take multiple actions to do its part to help to reduce impacts of future extreme weather events, protect the water environment, and engage and educate residents and businesses. The agency is making these plans all under the firm commitment of connecting with and supporting climate justice initiatives that address stormwater management partnerships and community engagement. By prioritizing inclusive climate justice and actions, the MWRD is working to improve equity and ensure no Cook County community is left behind in this daring and unpredictable encounter with climate change.

Argonne National Laboratory held a workshop titled "Assessing Climate Risks to Midwest Infrastructure" to understand the hazards and impacts of climate change and share information needed to manage risk in 2019 (Kotamarthi et al., 2021). Tables 4 and 5 capture some of the major impacts discussed at the workshop that have potential to affect the MWRD's infrastructure and operations.

TABLE 4: POTENTIAL IMPACTS ON THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO'S FACILITIES AND OPERATIONS DUE TO PREDICTED TEMPERATURE REGIME CHANGES

Temperature Regime	Impact
Increased Air Temperatures	Increased wastewater odor potential Increased wastewater corrosion potential Increased pavement maintenance Changes to wastewater treatment Overheated electronics in monitoring and control systems Increased maintenance of roofs Reduced air quality
Increased Heat Waves	Increased air conditioning use in buildings Increased incidences of external power outage Increased staff time off
Warmer Soil Temperatures	Shifts in vegetative communities may impact streambank stabilization Increased disease and vector control Increased vegetative growth leading to increased landscaping costs
Warmer Water Temperatures in Receiving Streams	More stringent receiving stream water quality standards Alter the growth, survival, and reproduction of aquatic and wildlife species, as well as predator-prey relationships

TABLE 5: POTENTIAL IMPACTS ON THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO'S FACILITIES AND OPERATIONS DUE TO PREDICTED PRECIPITATION REGIME CHANGES

Precipitation Regime	Impact
Increased total annual precipitation	Increased volume of wastewater to treat Increased operations, wear, and tear of mechanical systems Increased volume of stormwater to treat Increased energy usage
Increased intensity and frequency of extreme Rainstorm Events	Increased incidences of external power outages Increased Combined Sewer Overflow (CSO) volume and frequency Increased flood damage to buildings and equipment Increased treatment plant operator's attention Increased flooding of transportation infrastructure delaying response and access to critical infrastructure Changes in floodplains adversely impact habitat availability for some aquatic and wildlife species
Winter and early spring precipitation as rain instead of snow	Increased energy usage for pumping and treatment Reduced biological treatment and settling efficiency due to cooler wastewater Increased CSO volume and frequency during winter and early spring Increased operations, wear, and tear of mechanical systems
Increased occurrence of freezing rain	Increased needs for deicers on sidewalks and parking lots Increased incidences of roof damage Damage to vegetation both physical and due to road salt Increased concentration of chlorides in runoff ending up at WRPs affecting treatment processes and adverse impacts on receiving streams water quality Increased hazards to employee health and safety
Increased occurrence of summer droughts	Low-flow treatment operational challenges Increased sewer odor potential Increased corrosion potential Increased damage to landscape vegetation Vegetation shifts towards species adapted to summer droughts More stringent receiving stream water quality standards due to low flow

IMPACTS, ONGOING RESPONSE, AND LONG-TERM DIRECTION

The following section outlines likely climate change impacts, ongoing responses, and priority actions, along with long-term direction for a few focus areas.

IMPACT 1: INCREASED URBAN FLOODING DUE TO EXTREME STORM EVENTS AND EXTREME HEAT EVENTS IN SUMMER

In the Chicago region, there is widespread concern with flooding and heat impacting neighborhoods, transportation networks, and aging infrastructure in the combined sewer areas designed to convey stormwater. In general, neighborhoods with lower green cover have lower capacity to absorb rainfall, thus, these areas are more prone to flooding and most often located in the disadvantaged communities (Makra and Gardiner, 2021; Wuebbles et al., 2021); this disparity needs to be addressed for regional climate resilience. The impact of urban heat island effect also needs to be addressed for these communities as extreme heat poses a serious concern to public health, particularly for children, the elderly, people with respiratory illnesses, and those who work outdoors. Lack of trees or natural green areas, lack of air conditioning, and older homes exacerbates the impact of urban heat island effect in these communities (Makra and Gardiner, 2021).

Ongoing Response

While separate from our Stormwater Management Program, one of the MWRD's largest projects is its Tunnel and Reservoir Plan (TARP), or "Deep Tunnel." As one of the country's largest public works projects for pollution and flood control, TARP is a system of deep, large diameter tunnels and vast reservoirs designed to reduce flooding, improve water quality in Chicago area waterways and protect Lake Michigan from pollution caused by sewer overflows. Although the TARP program was not developed to address climate change *per se*, the system is important infrastructure that provide climate-change-related resiliency in the region (https://mwrd.org/tunnel-and-reservoir-plan-tarp).

The MWRD's countywide Stormwater Management Program's mission is to provide Cook County with effective rules, regulations and capital improvement projects that will reduce the potential for stormwater damage to life, public health, safety, property, and the environment. The MWRD's stormwater management is continuing to evolve into a multifaceted multilayered innovative program.

For years, stormwater management in Cook County was a patchwork of efforts by local, regional, state, and federal agencies. Then in November of 2004, the Illinois General Assembly enacted Public Act 93-1049, allowing for the creation of a comprehensive stormwater management program in Cook County under the supervision of the MWRD. The Act required the MWRD to develop the Cook County Stormwater Management Plan (CCSMP), which provides the framework for the stormwater management program. This includes the program's mission, goals, and program elements. The MWRD's Board of Commissioners adopted the plan in February of 2007. With the adoption of the CCSMP and the implementation of the MWRD's countywide stormwater management program, Cook County began to address a range of stormwater management issues through proper watershed regulations and watershed planning.

Under this plan, the MWRD established Watershed Planning Councils and completed Detailed Watershed Plans for all six major watersheds in Cook County; initiated a Stormwater Management Capital Improvement Program; initiated a Small Streams Maintenance Program; and adopted and implemented the Watershed Management Ordinance (WMO). The CCSMP was amended in July of 2014 to be consistent with P.A. 98-0652, which grants the MWRD authority to acquire flood-prone properties and to plan, implement, finance, and operate local stormwater management projects. The MWRD entered a Consent Decree with the USEPA in January 2014, which prompted establishment of a GI Program. Additionally, the Infiltration/Inflow Control Program was incorporated into the WMO in 2014. The MWRD's recent National Pollutant Discharge Elimination System Permits Consent Decree 2020 Annual Report is available on the MWRD's website (www.mwrd.org). Through a variety of engineered solutions, both green and gray, and flood-prone property acquisitions, the MWRD's Stormwater Management Program addresses both regional and local flooding problems throughout Cook County. Stormwater Management Program Annual Reports are also available on the MWRD's website.

Climate Justice and Equity in Managing Stormwater. In this pursuit of climate justice and inclusion, the MWRD aims to bridge the gap and address community flooding and stormwater management in low-income disadvantaged communities. Recently, The Nature Conservancy created Chicago Greenpoint, a mapping tool to identify where nature-based solutions may help alleviate challenges due to climate change, especially in communities which are more vulnerable. The mapping tool considers data like demographics with a high concentration of youth, older adults, and low to moderate income families who are at greater risk from impacts of urban flooding, poor air quality, and excessive heat island effects. The MWRD currently considers the environmental-justice aspects of climate change as well as economic capacity when making decisions on projects to fund through its Stormwater Management Program. For example, annual proposals submitted to the MWRD through its GI program are evaluated based on the household median income of the project area/community in addition to technical criteria. Other examples of the MWRD's consideration of the impacts flooding have on economically disadvantaged communities and communities of color include stormwater projects underway in Robbins and Ford Heights. Another example is MWRD's popular Space to Grow program, showing how partnerships can improve educational opportunities while building resilient communities. Space to Grow prioritizes communities with the greatest need for opportunities for physical activity and green space. Low-income communities with high rates of obesity are prioritized, as are schools that are at risk for flooding, geographic equity and schools that express a commitment to the program. Space to Grow is a collaboration between the MWRD, Openlands, Healthy Schools Campaign, Chicago Department of Water Management, and the Chicago Public Schools. Space to Grow has converted 30 schoolyards into vibrant places for children to play and learn, taking asphalt lots and rehabbing them into attractive, permeable surfaces that can retain a combined 5.6 million gallons of water per rain event. The MWRD is considering expanding similar programs to suburban communities with the purpose of providing educational opportunities in GI and climate change for students, by reducing flooding, especially in vulnerable communities.

Long-Term Direction

- Prioritize and retrofit completed projects based on increased flow trends.

- Collaborate with the Chicago Park District, the Chicago-Calumet River Watershed Council, and Metropolitan Mayors Caucus to identify areas where nature-based solutions can help alleviate challenges related to climate change in Cook County and surrounding communities, especially in vulnerable neighborhoods. These collaborations aim to satisfy multiple overlapping benefits for the people, water quality, and biodiversity of our region.

- Conduct trend analyses every few years to assess changes in local rainfall to address predicted increased flood sizes and frequencies.

- Work with climate scientists to model long-term regional climate changes and impacts.

- Work with other agencies and utilities to develop resilient infrastructure for flood protection.

IMPACT 2: EXTREME CLIMATE-RELATED OR MAN-MADE DISASTERS

Ongoing Response

To fulfill its mission, the MWRD must be prepared to quickly respond to various natural and man-made disasters. This includes floods, tornados, earthquakes, materials incidents, power outages, resource shortages, cyber events, terrorism, pandemic, and other catastrophic types of emergencies. To support organizational sustainability and resiliency, the MWRD's emergency response plans are updated annually, and refresher training is conducted for Business Continuity staff. The MWRD purchases excess insurance in the event of catastrophic claims, but it is primarily self-insured for the "working layer" of losses. The MWRD maintains a Reserve Claim Fund for payment of certain losses and expenses related to MWRD business.

- The MWRD's Emergency Operations Plan provides a framework for managing all types of larger-scale emergencies.

- The Incident Command System provides a means to coordinate response efforts within the MWRD and outside entities working to stabilize an incident and protect life, property, the environment, and organizational sustainability.

- The MWRD's Business Continuity Plan is designed to support the overall mission of the MWRD and to provide guidance, tools, and procedures to maintain viable strategies for business continuity and continuity of services in the wake of an event that poses an unacceptable risk of business or operational disruption to the MWRD, and where the time required for full recovery is (typically) anticipated to be more than 30 days.

- For security purposes, separate Critical Operational Guidance documents have been created to provide additional information by Area/WRP/Support Service Departments.

In addition, tabletop exercises are conducted each year so that staff can practice the required functions and procedures in non-threatening environments. In 2015, 2017, and 2019, the MWRD tested its Emergency Response Plans through participation in "Operation Power Play," a Statewide, multi-jurisdictional and multi-disciplinary collaborative effort sponsored by Commonwealth Edison Company, the city of Chicago's Office of Emergency Management and Communications, the Illinois Emergency Management Agency, the Department of Homeland Security and Emergency Management, and a variety of other partners. Operation Power Play is an operations-based exercise simulating response to low probability/high risk scenarios. For these exercises, the MWRD's Emergency Operations Center is activated, and key staff gathers to evaluate and respond to the simulated emergency event, which typically requires progressive responses to the incident from initial discovery through response efforts, reconstitution, and demobilization. In addition, in 2019 the Cook County Department of Public Health conducted a workshop on pandemic risk for the MWRD's Incident Management Team.

Long-Term Direction

The MWRD will work with local communities, utilities, cities, and county government to assess regional climate impacts, identify vulnerabilities, and map out climate preparedness actions. Employment opportunities, transportation networks, and disaster recovery planning efforts span jurisdictional boundaries; with upcoming updates to local comprehensive plans being developed by Greenest Region Compact: Collaborating for Sustainable Communities - Metropolitan Mayors Caucus, there is an opportunity to pool expertise and resources and coordinate regionally. Regional coordination will allow for more efficient and strategic use of resources for research on local climate impacts, support more effective and consistent communication with the public, and support better integration across planning disciplines.

IMPACT 3: INCREASED ODOR AND CORROSION POTENTIAL

Ongoing Response

The MWRD has an ongoing program for mitigating odors. Existing processes that generate significant odors have been identified and projects to mitigate those odors are being designed and constructed. All new infrastructure includes odor mitigation, as necessary. The MWRD carries out odor monitoring at multiple locations. In addition, the public can report incidences of odors through the MWRD's Citizen Incident Report System. All reported incidences are recorded by location using Geographic Information System tools and mapped. The odor data and odor incidence reports are an important tool for the MWRD to address issues as part of MWRD's resiliency program.

Long-Term Direction

The MWRD will incorporate design modifications for future sewer or force main replacements with corrosion-resistant materials or lining and continue assessment and implementation of odor control measures and protect concrete surfaces in areas where corrosion potential is high.

IMPACT 4: WASTEWATER TREATMENT PROCESSES

Climate changes like winter and early spring precipitation as rain instead of snow may reduce biological treatment and settling efficiency due to cooler wastewater. These impacts have been observed in the recent years at the Calumet and Stickney WRPs when the Thornton Composite Reservoir and McCook Reservoir went online. The cold stormwater when pumped from these reservoirs to the WRPs negatively affected treatment performance.

Ongoing Response and Long-Term Direction

The MWRD's efforts are always focused on increasing efficiency and performance by being adaptable and strategic in the face of change. The MWRD embraces research as the means through which we acquire information to address challenges and take advantage of opportunities through innovative solutions. Staff is conducting research and developing strategies to mitigate this impact.

The MWRD will evaluate treatment technologies and regulatory framework for treating stormwater and direct discharge to receiving streams from reservoirs rather than pumping back to WRPs for treatment.

IMPACT 5: ADVERSE EFFECTS ON WATER QUALITY MAY RESULT IN MORE STRINGENT REGULATIONS

The impacts of climate change on water quality have received less attention than the impacts on quantity, but for wastewater utilities, impacts on water quality also raise several concerns such as an increase in the frequency of extreme weather conditions that can modify the normal balance of water bodies and ecosystems leading to the degradation of water quality. This may result in more stringent water quality standards. Some concerns specific to the MWRD include:

Predicted Changes in Temperature Regime. Warmer temperatures may result in decreased water quality and more stringent standards. Water quality standards of receiving streams are tied to temperature. For example, as temperature increases, the standard for un-ionized ammonia becomes more stringent. In addition, warmer temperatures decrease the amount of oxygen that can dissolve in water and may also increase algal activity, further reducing dissolved oxygen.

Predicted Prolonged Droughts. Increased and more severe droughts are another water quality concern related to climate change. The lowest seven-day average flow occurs (on average) once every ten years (7Q10), and the lowest single-day average flow occurs (on average) once every ten years (1Q10) in the waterways; these flows may change to a lower value, and thus NPDES and total maximum daily load limits will have to be recalculated by the Illinois Environmental Protection Agency (IEPA). These will become more stringent, because the stream will provide less dilution to the effluent, and the Clean Water Act (section 402(o)) expressly prohibits backsliding from certain existing effluent limitations. The WRPs that may be impacted by a changed 10-year

low flow are Calumet, Stickney, and Lemont. The other MWRD plants (Kirie, Hanover Park, O'Brien, and Egan) will not be impacted as they discharge into streams which have low flows of zero.

Predicted Changes in Precipitation Regime. Increased frequency of freezing rain in winter will result in the use of more road salt which will be eventually washed to storm sewers and the WRPs. This may result in effluent exceeding the 500 mg/L water quality standard for chloride. Increases in the number and severity of wet weather storms will likely cause increases in large runoff events, leading to soil erosion, channel erosion, sediment and nutrient transport, increased eutrophication, habitat degradation, and mobilization of contaminated sediment, all reducing surface water quality.

Ongoing Response and Long-Term Direction

The MWRD will continue to reduce impervious surfaces in urban/riparian areas, retain and treat stormwater runoff by enhancing infiltration using GI and other stormwater management practices. It will also continue the "Restore the Canopy" program, as trees not only act as sinks for carbon but also help in stormwater management and reduce the urban heat island effect.

In the future, there may be a need for more floodplain restoration to allow high flows to spread out and slow down so that they are less damaging to the stream and adjacent property. Efforts will be made to enhance and restore shoreline habitat (coarse wood, littoral, and riparian vegetation, bio-engineered erosion control) to withstand variations in water levels.

Understanding the influence that climate change could have in exacerbating nutrient-driven water quality issues and associated costs is going to be challenging for the water utilities. The USEPA is developing a step-by-step framework and tools for utilities to account for the cost of climate change influences on nutrient management (USEPA, 2021). The MWRD participated in the development of this document. The document is a framework to help small utilities and organization develop plans and estimate financial commitments that may be needed in the future.

IMPACT 6: OVERHEATED ELECTRONICS IN MONITORING AND CONTROL SYSTEMS

Ongoing Response and Long-Term Direction

The MWRD provides adequate system backups and invests in rugged technologies to withstand higher temperatures. It also provides proper ventilation to critical electronic equipment and conducts periodic inspections.

IMPACT 7: POTENTIAL INCREASE IN WEAR AND TEAR ON ENERGY-INTENSIVE PUMPS AND BLOWERS

Ongoing Response and Long-Term Direction

The MWRD uses a proactive approach in preventive maintenance of all critical equipment to keep disruptions to a minimum and to ensure maximum operating efficiency. The MWRD is researching various sensors and artificial-intelligence-based technologies to optimize asset management and improve functional efficiencies to reduce operational costs.

IMPACT 8: VEGETATION SHIFTS TOWARDS SPECIES ADAPTED TO WARMER CLIMATE IN CHANNELS, FLOOD MANAGEMENT FACILITIES, AND GREEN INFRASTRUCTURE

Long-term Direction

There will be increased monitoring and maintenance to improve performance of vegetation to provide ecosystem services and support biodiversity.

IMPACT 9: EMPLOYEE HEALTH EFFECTS DUE TO HEAT WAVES AND VECTOR-BORNE DISEASE

Ongoing Response and Long-Term Direction

The MWRD will continue to provide safety training to staff to manage various stresses due to heat waves and work with regional Public Health Departments to develop strategies to control vector-borne diseases.

FUTURE STEPS

The MWRD remains committed to reducing its carbon footprint to lead by example to show that climate solutions for individual organizations ultimately drive broader environmental, economic, and health benefits. The MWRD has set milestones of a 28 percent reduction by 2025 and an 80 percent reduction by 2050 with additional stretch targets of 50 percent reduction and achieving net zero by 2025 and 2050, respectively, as laid out in the Strategic Plan. These targets are aligned with the federal government's April 2021 announced economy-wide target of 50 - 52 percent reduction in GHG emissions by 2030 and a net zero emission economy by 2050. As a recognized leader in its industry, the MWRD will continue to be proactive in planning and preparing for the anticipated impact of local climate events, such as increased record-breaking flooding, heat, drought, and nutrient-driven water quality issues on its ability to serve its communities and fulfill its mission.

In addition, the MWRD will work to further strengthen its collaboration with other regional agencies in areas, such as emergency management, public health, and waste reduction to support development of renewable energy resources. Working together, we can make an even greater impact by reducing our collective carbon footprint and the deleterious impact on our communities and the world. Recommended action items to mitigate GHG emissions and enhancing regional climate resiliency are shown in Appendix VI. As the MWRD is constrained by a limited budget and staff, efforts to maintain and manage current and future regulatory compliance needs has taken a priority over proactive thinking about climate influences in the past. However, the planning for and management of the new set of challenges that climate change will bring is important due to heightened risk of harmful ecological conditions, and the associated social and financial implications. It is recommended that the MWRD prepares an implementation cost report for the listed actions to mitigate GHG emissions and regional climate resilience.

APPENDIX I

Global Climate Agreements

The United Nations' member states have entered into several global agreements, protocols, and accords to address different environmental concerns. While the US approved some of these agreements, it has not joined all of them.

The Montreal Protocol. In response to the discovery of the effects of ozone-depleting substances (ODS) on the planet's atmosphere, in 1987 the United Nations developed the Montreal Protocol on Substances that Deplete the Ozone Layer (the Montreal Protocol). The US has fully adopted this protocol. The Montreal Protocol established a phase-out plan to eliminate the development, production, and use of certain specific compounds which were shown to deplete the earth's ozone layer. After several amendments, the Montreal Protocol now limits 11 different categories of ODS with various targeted compliance dates.

Since its adoption 30 years ago, the Montreal Protocol has led to a 99 percent phase-out of ODS. As a result, the planet's ozone layer is recovering with a hope of reaching 1980 levels during this century.

While the focus of the Montreal Protocol was on the effect on the ozone layer, the Montreal Protocol also provides a climate change benefit. The ODS phased out by the agreement are also known to be powerful GHG producers. The elimination of the production and use of these compounds is estimated to have eliminated 10–12 gigatons of CO_2e emissions in the past 25 years.

As a result of its universal adoption and the recovery in the ozone layer, the Montreal Protocol has been called the most successful international environmental agreement in history. Unfortunately, it is also one of the few international climate change agreements with specific targets which the US has adopted.

The United Nations Framework Convention on Climate Change. In 1992, the United Nations enacted the UNFCCC. The US signed the UNFCCC on June 12, 1992, and it was approved by Congress on October 15, 1992. The UNFCCC's goal is to achieve "stabilization of GHG concentrations in the atmosphere" at levels that would prevent human-caused interference with the climate system. The GHGs targeted by this agreement were those not already addressed by the Montreal Protocol.

The Convention sought to achieve stabilization of GHG emissions "within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner." In particular, the Convention required countries to (1) inventory human-caused GHG emissions and removal of GHG sinks; (2) develop national and regional programs to mitigate human-caused GHG emissions and removal of GHG sinks; (3) promote and cooperate in the development and use of technologies to reduce human-caused GHG emissions; (4) promote sustainable management, conservation, and enhancement of GHG sinks; (5) prepare for climate change adaptation including water resource plans; and (6) promote and support communication of relevant scientific information.

Unlike the Montreal Protocol, the Convention contained no firm targets or bans on GHGs. The Convention intended member nations to adopt firm targets based on later protocols or accords. As a result, the Convention merely requires developed nations like the US to develop a national policy on climate change mitigation with the aim to return GHG emissions to their 1990 levels. Because the US failed to adopt any future protocol or accord under this Convention, it provides no legal requirements which the MWRD, or any other US government or company, must meet.

The Kyoto Protocol. The first agreement under the Convention was the Kyoto Protocol, which was adopted in 1997 and went into force in 2005. The Kyoto Protocol required parties to establish targets for the level of emissions of the six primary types of GHGs, namely CO_2, CH_4, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The general baseline emission was set at 1990 with a targeted compliance date of 2012. This was termed the first commitment period.

During the first commitment period, the Kyoto Protocol required certain countries to reduce their emissions, while others could increase the emissions above that baseline amount. The US was targeted to reduce its GHG emissions by seven percent below the 1990 baseline level by 2012.

While the US signed this agreement in 1998, it was never ratified; therefore, the US was never required to comply with the terms of the Kyoto Protocol or the GHG emission reduction target.

At the end of the first commitment period, most countries that chose to ratify the agreement had not met its goals, and those that did chose not to further limit emissions during the second commitment period of 2013 to 2020. As such, the Kyoto Protocol is generally considered a failure.

The Paris Climate Agreement. In 2016, the United Nations again attempted to build upon the UNFCCC through the Paris Agreement. The Paris Agreement's goal is to limit global temperature increase this century to well below 2°C above pre-industrial levels, while attempting to further limit the increase to no more than 1.5°C above those levels. To do so, the Paris Agreement seeks to achieve peak GHG emissions as soon as possible with eventual climate neutrality by 2050. The Paris Agreement requires all parties to each establish a nationally determined contribution (NDC), and developed countries are to take "absolute economy-wide reduction targets." The US signed and accepted the Paris Agreement, and in September 2016, the US submitted its first NDC with a target of an economy-wide 26 percent to 28 percent reduction below the 2005 baseline level by 2025. The NDC also targeted an economy-wide 80 percent reduction of GHG emissions by 2050. However, on November 4, 2019, the US indicated its intention to withdraw from the Paris Agreement on November 4, 2020, and formally went through that process. As of that date, the country no longer had a target for reduction of GHG emissions. However, in early 2021, the new administration re-entered the Paris Agreement and issued a new NDC. The April 2021 NDC established an economy-wide target of 50 percent reduction in GHG emissions by 2030 and a net zero emission economy by 2050.

Even prior to the federal governments' recent re-entry in the Paris Agreement, the MWRD's 2017 Resolution set a 28 percent goal for GHG reduction, and the MWRD has aggressively sought to reach that goal. In addition, the MWRD's Strategic Plan imposed additional stretch goals of 50 percent GHG emission reduction by 2025 and 100 percent by 2050, which align with the April 2021 NDC issued by the federal government. While the MWRD is well on its way to reducing

GHG emissions, the MWRD must approach this reduction in a manner that considers its obligations under existing state and federal law.

Relevant Illinois Climate Change Legislation and Commitments. On August 15, 2019, Governor J.B. Pritzker repealed the Illinois Kyoto Protocol Act of 1998, removing the primary barrier to passing specific GHG emissions legislation in Illinois. The Illinois Kyoto Protocol Act prohibited the IEPA or the Illinois Pollution Control Board from setting rules to address climate change beyond the goals set for the US in the Kyoto Protocol. However, when the US withdrew from the Kyoto Protocol in 2001, the Act effectively prohibited the state from setting direct GHG limits, and the Illinois State legislature had to encourage clean energy in other ways. The repeal of the Act now allows Illinois to set its own restrictions on GHG emissions.

The Future Energy Jobs Act. In late 2016, Illinois passed the Future Energy Jobs Act (FEJA), which at the time was hailed as the most significant energy and climate legislation in history. While FEJA did not specify GHG targets, it was aimed, in part, at reducing GHG emissions. In fact, several of its features have the potential to assist in lowering Illinois' economy wide GHG emissions. For example, FEJA encouraged zero-carbon emission energy generation by creating financial incentives for installing and utilizing solar, wind, and nuclear power. The act also required major utility companies to expand energy efficiency programs for their customers and create additional renewable energy sources by 2030. Finally, FEJA reaffirmed the State's Renewable Portfolio Standard that targeted 25 percent of the State's retail energy to come from renewable sources by 2025.

The Climate and Equitable Jobs Act. The Climate and Equitable Jobs Act (CEJA) was passed on September 15, 2021, by the Illinois General Assembly. The law specifically states that utility procurement plans shall include "cost-effective renewable energy resources" equal to a minimum percentage of each utility's load for all retail customers as follows: 25 percent by June 2025, 40 percent by 2030, 50 percent by 2040, and 100 percent clean energy by 2050.

Illinois' Membership in the United States Climate Alliance. On January 23, 2019, the governor of Illinois signed an executive order committing the state to join the US Climate Alliance (USCA) and adhere "to the principles of the Paris Climate Agreement." The USCA is a group of 25 governors committed to reducing GHG emissions consistent with the Paris Agreement. By joining the USCA, Illinois has committed to "implement policies that advance the goals of the Paris Agreement" by reducing GHG emissions by 26 percent to 28 percent below 2005 levels by 2025. While this Executive Order and the USCA do not require any specific activities from units of local government like the MWRD, additional state legislation or rulemaking intended to reach the statewide GHG emission targets can be expected.

APPENDIX II

Methodology of Estimating Emissions

The methods for estimating the annual GHG emissions or sinks from each source are indirect as actual direct measurements from these sources of GHGs are logistically impractical due to the resources required. Brief information on the methodology is provided below.

Direct Stationary Combustion of Natural Gas. GHG emissions are an estimate of the natural gas combusted in MWRD boilers multiplied by a stationary combustion emission factor for natural gas (USEPA, 2018).

Transportation Fuel. GHG emissions are an estimate of the unleaded and diesel gasoline used in MWRD vehicles (both passenger and heavy duty) multiplied by the mobile combustion emission factors for the respective fuels (USEPA, 2018).

Emissions from Biogas Combustion Excluding Biogenic Carbon Dioxide. GHG emissions are: 1) an estimate of the biogas combusted (used and flared) multiplied by the stationary combustion emission factor for landfill gas which is similar to our digester biogas (USEPA Emission Factors for Greenhouse Gas Inventory, Table 1, March 2018); and 2) an estimate of non-combusted biogas due to inefficiencies in the combustion process. This fugitive gas includes CO_2, CH_4, and N_2O (LGO, 2010).

Methane Emissions from Stickney Water Reclamation Plant Imhoff Tanks. GHG emissions are an estimate of the organic load captured by the Imhoff tanks multiplied by the maximum production of CH_4 from wastewater and a correction factor for anaerobic systems (LGO, 2010). This approach is based on an open lagoon anaerobic system as a surrogate for the Imhoff tanks.

Nitrous Oxide Emissions from Wastewater Treatment and Effluent Discharge to Receiving Streams. GHG emissions are: 1) an estimate of the population served by the MWRD multiplied by an industrial-commercial and emission factor of N_2O per person; and 2) an estimate of total nitrogen discharged to the MWRD WRP receiving waters multiplied by an emission factor (LGO, 2010).

Emissions from Purchased Electricity Use. GHG emissions are an estimate of the electricity used by the MWRD multiplied by a supplier-based emission factor (currently Dynegy Energy Services).

Carbon Sequestration by Tree-Covered Land Owned by the Metropolitan Water Reclamation District. The GHG sink is an estimate of the tree-covered land owned by the MWRD multiplied by the CO_2 sequestration factor for forested land (USEPA, 2020).

APPENDIX III

Employee Guidelines for Energy Conservation

EMPLOYEE GUIDELINES FOR ENERGY CONSERVATION

- Turn off all office and building lights if you leave the room for more than 15 minutes. Switch off all unnecessary lights when leaving meeting rooms and work spaces.
- Use natural lighting or day lighting whenever possible.
- Use task lighting instead of overhead lighting, and light only those areas that are needed at the time.
- Turn off your computers, monitors, printers and any other office equipment when not in use, especially overnight and on weekends. Ensure energy saving features are activated.
- Don't use or let water run unnecessarily.
- Report leaky faucets. One drop per second can add up to 165 gallons a month!
- Save paper. Print and photocopy only when necessary. Use the second side of paper, either by printing on both sides or using the blank side as scrap paper.
- Cancel printed magazines and subscribe to the on line versions.
- Carpool, bike, or use mass transit when commuting to work.
- Increase usage of phone and web conferencing to reduce business travel. Contact the IT Help Desk for details on these capabilities and training.
- Use coffee mugs instead of disposable cups and silverware instead of plastic utensils.

FOLLOW THESE GUIDELINES AT HOME AND ENCOURAGE CO-WORKERS, FAMILY, AND FRIENDS TO DO THE SAME.

APPENDIX IV

Renewable Energy at the Metropolitan Water Reclamation District Of Greater Chicago

Over the last 40 years, staff at the MWRD has investigated ways to incorporate renewable energy into its operations for environmental and economic reasons. Multiple processes have been evaluated from various perspectives and continue to be restudied to incorporate changes in technology and improved process data. Currently there are four known technologies that are feasible for generating renewable energy, but all have limitations. A breakdown of how each of these technologies would meet the MWRD's electricity demand is listed below. The estimates are based on 2019 total electricity usage – 675,495,822 kilowatt hours per year and an assumed average demand of 77 megawatts (MW). It is important to note that peak demands may be higher due to the nature of the MWRD's business.

Biogas. The MWRD anaerobically digests biosolids which produces biogas at four of its WRPs: Stickney, Calumet, Hanover Park and John E. Egan WRPs. The MWRD currently beneficially utilizes over 90 percent of the biogas generated at its WRPs for process heat and heating/cooling buildings. To provide 100 percent of the energy needs (which is predominantly electricity) at those four WRPs, digester capacity at each WRP would need to increase between 38 percent to 117 percent and CHP generators would be required to generate electricity from biogas. In addition to the required infrastructure, additional high strength organic matter would need to be fed to the digesters on the order of hundreds of tanker-trucks a day. The Stickney and Calumet WRPs are located in environmental justice communities (per the IEPA EJ Start Tool), and significant infrastructure would need to be included to reduce odors, mitigate the strain on the transportation systems and address increased hyper-localized air pollution from the feedstock delivery, co-digestion, and additional onsite energy generation. The life of the CHP generators is expected to be 20 years.

Hydropower. The MWRD generates hydropower at the Lockport Powerhouse. In 2019, the amount of electricity generated was equivalent to six percent of the MWRD's total electricity use, however, this electricity and the renewable energy credits associated with it are sold. Therefore, the MWRD cannot claim the renewable energy as its own. It is not possible to increase the electricity generated at Lockport Powerhouse due to the MWRD's requirement to maintain navigable waterways upstream. There are no other significant sources of differential head within the MWRD's service area to generate additional hydropower.

Solar. Outside of small, remote instruments, the MWRD does not have photovoltaic (PV) solar power systems for electricity generation. An evaluation was completed in 2019 that evaluated potential MWRD locations for solar, but the areas available would provide a relatively small amount of electricity, on the order of one to five MW (MWRD, 2019). Generation of 77 MW using solar PV panels is expected to require a footprint of 385 to 539 acres based on industry experience. For reference, the footprint of the Stickney and Calumet WRPs are 570 and 470 acres, respectively. Outside of land requirements, another limitation is proximity to electrical transmission facilities. Solar PV systems typically have life spans of 20 to 25 years and at this age generate roughly 80 percent of their original electrical capacity. Consideration must be given to decommissioning the old equipment at the end of its useful life and replacing with new equipment if continued electricity generation is needed.

Wind. The MWRD does not have any wind turbines. Wind turbines are not suited for urban environments and are primarily constructed on land types such as shrubland, forest, grasslands/herbaceous, pasture/hay, row crops, and small grains. Land area requirements for wind power plants are not uniform and vary by project developer, state, land type use/terrain, and turbine layout. If using wind turbines to generate 77 MW, 190 acres are needed for direct impact (foundations, turbines, roads, staging, etc.) and 6,470 acres for total wind power plant area. Outside of land requirements, proximity to electrical transmission facilities is also a limitation in a system this large. Utility-scale wind turbines typically have an operating life of 20 to 30 years, but they can be refurbished to extend the operating life another 15 years or more. Like solar, consideration must be given to decommissioning the old equipment which requires transporting decommissioned equipment to recycling, remanufacturing facilities, or landfill and installing new equipment if continued electricity generation is needed.

APPENDIX V

Carbon Footprint and Renewable Energy Targets of Sister Agencies and Peer Utilities

While the City of Chicago and Cook County can be considered sister agencies, they have vastly different operations than the MWRD. According to the published Cook County Sustainability Advisory Council Recommendations and the Cook County Annual Sustainability Reports, Cook County has committed to an 80 percent reduction in its GHG emissions from County facilities by 2050 and has committed to 100 percent renewable energy but has not provided many details or timelines regarding renewable energy. Former City of Chicago Mayor Rahm Emanuel committed to 100 percent renewable energy in all municipal buildings as part of the "Chicago Renewable Energy Challenge" by 2025. The City of Chicago resolution R2019-157 clarified that this commitment to transition to "100 percent clean renewable energy community-wide would begin with 100 percent renewable electricity in buildings by 2035 and complete electrification of Chicago Transit Authority's bus fleet by 2040."

Among wastewater treatment utilities, only a few have published goals, and the concrete steps to achieve their goals may not be available. Some examples include:

- The City of Columbus, Ohio operates two wastewater treatment plants. While they have developed their Climate Change Adaptation Plan and Inventory of GHG emissions, at this time they have not set a goal for the mitigation of GHGs.
- The Great Lakes Water Authority in Detroit, Michigan has a zero net energy goal; however, the agency does not yet have any concrete plans or timeline.
- The Milwaukee Metropolitan Sewage District has a goal to meet net 100 percent energy needs with renewable sources by 2035 and meet 80 percent energy needs with internal renewable sources.
- The Wastewater Treatment Division of King County (Washington State) has a goal to consume 85 percent renewable energy by 2025. They have signed a 10-year agreement to purchase renewable wind energy. They have a goal to maximize the production of biogas and incorporate solar and wind in all capital improvement projects, like wet weather treatment systems and pump stations.
- District of Columbia Water and Sewer Authority has a goal to reduce GHG emissions by 80 percent by 2050 from a 2008 baseline with an interim goal of 50 percent reduction by 2032. They also have a goal of reducing their reliance on traditional fossil fuels by 75 percent by 2050, targeting a 50 percent reduction by 2032.
- Hampton Roads Sanitary District (State of Virgina) adopted a goal in 2017 to reduce their GHG emissions by 30 percent 2018 onwards. They achieved this goal by purchasing green RECs equivalent to 43,200,000 kWh in 2018 and 44,280,000 kWh in 2019 at a cost of $86,400 and $112,400, respectively. It should be noted that the HRSD purchase of RECs represents approximately 6 percent of the MWRD yearly electricity requirement in kWh.

APPENDIX VI

Climate Action Plan Actions

Action	Anticipated Results	Responsible Departments	Supporting Departments	Deadline
Decommission Imhoff's at Stickney WRP	Reduction in GHG	Engineering	Maintenance and Operations	By 2025
Pilot of new aeration technology at Egan WRP	Reduction in electricity and inform decisions for improvement at other WRPs	Monitoring and Research	Maintenance and Operations	By 2024
Install Co-Firing Boilers at Stickney and Hanover Park WRPs	Increase biogas utilization and reduce natural gas consumption	Engineering		By 2024
Improve aeration at O'Brien WRP	Reduction in electricity through aeration efficiency (GHG reduction)	Engineering	Maintenance and Operations, and Monitoring and Research	By 2030
Develop aeration system improvements at Hanover Park WRP	Reduction in electricity (GHG reduction)	Monitoring and Research	Engineering, and Maintenance and Operations	By 2025
Pilot new dewatering equipment to inform replacement at Stickney WRP	Reduction in electricity (GHG reduction)	Engineering	Maintenance and Operations, and Monitoring and Research	By 2025
Pilot new blower system at Kirie WRP	Improved aeration efficiency	Maintenance and Operations		By 2024
Install CHP at Egan WRP	Bio-gas powered electricity	Engineering	Maintenance and Operations, and Monitoring and Research	By 2024

Climate Action Plan Actions (Continued)

Action	Anticipated Results	Responsible Departments	Supporting Departments	Deadline
Install turbo blower at Egan WRP	Improved aeration efficiency	Maintenance and Operation		By 2024
Adopt policy of not selling environmental attributes	Meeting net zero goals	Law	Monitoring and Research	By 2022
Continue practice of increasing electric vehicles fleet	Reduced gasoline consumption (GHG reduction)	General Administration	All Departments	On Going
Expand employee access to charging stations	Demonstrate MWRD commitment towards decarbonizing scope 3 GHGs	General Administration	Maintenance and Operations	By 2025
Energy neutrality RFP	Identify additional areas for energy neutrality not previously identified	Monitoring and Research	Engineering, Maintenance and Operations, and Law	By 2024
Purchase renewable energy credits	Commitment to exceeding GHG reduction targets	Maintenance and Operations	Procurement and Material Management	Ongoing
Study impact of decommissioning downtown office	Reduce energy usage	General Administration	Engineering, and General Administration	By 2025
Report estimating implementation cost of actions	Planning for capital and operations budget	General Administration	Engineering, Maintenance and Operations, and Monitoring and Research	By 2025

Climate Action Plan Actions (Continued)

Action	Anticipated Results	Responsible Departments	Supporting Departments	Deadline
Procurement of low carbon intensity materials	Support lower carbon alternative of products	Procurement and Material Management	All Departments	By 2023
Modernize telecommunication practices and rules	Demonstrate MWRD commitment towards decarbonizing scope 3 GHGs	Human Resources	All Departments	By 2022
Study the GHG generation from the MWRD Biosolids Program	Accounting of GHG in MWRD carbon footprint	Monitoring and Research	Maintenance and Operations, and Engineering	By 2024
Employee recognition for carbon reduction efforts	Larger participation/efforts at individual level	Human Resources	General Administration	By 2022
Reducing emissions for business travel	Demonstrate MWRD commitment towards decarbonizing scope 3 GHGs	General Administration	All Departments	By 2022
Framework to collaborate with Chicago Metropolitan Agency for Planning /Metropolitan Mayors Caucus on regional resilience	Stormwater management in cook county, environmental justice, and adaptation to climate change	Engineering	Monitoring and Research, and Public Affairs	By 2022

APPENDIX VII

Resources

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