

Appendix 1: Technical Appendix. Documentation of GHG Reduction Assumptions

Maryland National Capital Region One Water Cycle Decarbonization and GHG Reduction CPRG Implementation Grant Application Washington Suburban Sanitary Commission (WSSC Water)

Note: Years presented in this appendix are calendar year.

Summary of Total GHG emission reduction

Measure/Project	2025-2030 reductions		2025-2050 reductions	
	Commutative metric tons CO2e	Average metric tons CO2e/year	Commutative metric tons CO2e	Average metric tons CO2e/year
Advanced Aeration Control	8,095	1,349	98,550	3,790
Pump Optimization	49,669	8,278	298,015	11,462
Microgrid	32,192	5,365	547,272	21,049
Anacostia Depot Sewer Solar	4,555	759	25,855	994
Total	94,511	15,752	969,693	37,296

Common Calculation for all projects/measures

Greenhouse gas emissions of current electricity used by WSSC Water is 0.00042 metric tons of CO2 equivalents per /kWh. This is based on:

- CO2 emissions per MWh from the 2022 PJM Residual Mix – 926.9 lbs/MWh
- CH4 emissions per MWh from the EPA's eGRID 2022 – 0.045 lbs/MWh
- N2O emissions per MWh from EPA's eGrid 2022 – 0.006 lbs/MWh

Global Warming Potential factor values from the 2013 IPCC AR5 Fifth Assessment Report as requested in the NOFO.

The resulting calculation is: (926.9 lbs CO2/MWh + 0.045 lbs CH4/MWh x 28 GWP factor + 0.006 lbs N2O/MWh x 265 GWP factor) / (2204.6 tonnes/lb x 1000 kWh/MWh) = **0.00042 metric tons CO2e/kWh**

Advanced Aeration Control for Water Resource Recovery Facilities (WRRF) [Western Branch and Seneca]

Common Calculations

Calculation of GHG emission per gallon of methanol (MeOH) used in the process:

- Direct emissions: 0.0041 tonnes CO2/gal MeOH used.
- Production emissions: 0.65 tonnes CO2e/tonne MeOH used (from 2022 Methanex sustainability report) = 0.00195 tonnes CO2e/gal MeOH used (assuming methanol density of 49.4 lb/cf)
- Combined emissions = 0.0041 + 0.00195 = 0.00605 metric tons CO2 per gal MeOH used.

Seneca

- Baseline (2018) energy consumption (kWh/yr): 5,399,810
- Aeration % reduction from project: 25%

- Internal recycle pump % reduction from project: 50%
- Project energy consumption reduction (kWh/yr): 1,676,536
- Seneca project metric tons CO2 emissions reductions (from energy consumption reduction): 704
- Baseline (2018) methanol consumption (gpd): 300
- Methanol % reduction from project: 100%
- Project methanol consumption reduction (gpd): 300
- Seneca project metric tons CO2 emissions reductions (methanol reduction): 662
- Total Seneca baseline (2018) project metric tons CO2e emissions reductions: 1,367

Western Branch

- Baseline (2018) energy consumption (kWh/yr): 6,640,080
- Aeration % reduction from project: 25%
- Project energy consumption reduction (kWh/yr): 1,660,020
- Western Branch project metric tons CO2 emissions reductions (from energy consumption reduction): 697
- Baseline (2018) methanol consumption (gpd): 1,400
- Methanol % reduction from project: 50%
- Project methanol consumption reduction (gpd): 700
- Western Branch project metric tons CO2 emissions reductions (methanol reduction): 1,546
- Total Western Branch baseline (2018) project metric tons CO2e emissions reductions: 2,243

	Metric tons CO2e reduced per year	
Year	Western Branch	Seneca
2025	0	0
2026	0	0
2027	0	0
2028	0	0
2029	2,502	1,525
2030	2,527	1,540
2031	2,553	1,555
2032	2,578	1,571
2033	2,604	1,587
2034	2,630	1,602
2035	2,656	1,618
2036	2,683	1,635
2037	2,710	1,651

	Metric tons CO2e reduced per year	
Year	Western Branch	Seneca
2038	2,737	1,668
2039	2,764	1,684
2040	2,792	1,701
2041	2,820	1,718
2042	2,848	1,735
2043	2,876	1,753
2044	2,905	1,770
2045	2,934	1,788
2046	2,964	1,806
2047	2,993	1,824
2048	3,023	1,842
2049	3,053	1,860
2050	3,084	1,879

Notes: 1% rate of increase per year. Historically, WSSC Water has encountered a 1% increase in electricity usage per year, resulting from higher wastewater flows, added pumping stations, and BNR conversions. The 1% is referenced in WSSC Water's GHG Action Plan. Western Branch and Seneca expected to be completed in 2029.

Summary of emission reductions Advanced Aeration Control for Water Resource Recovery Facilities (WRRF) [Western Branch and Seneca]

	Commutative metric tons CO2e	Average metric tons CO2e/year
2025-2030 reductions	8,095	1,349
2025-2050 reductions	98,550	3,790

Asset Health and Monitoring: Pump Optimization

- Pumps Horsepower: 500 (1)
- Energy saving per pump from project: 10% (2)
- Horsepower-Hour to Kilowatt-Hour conversion factor: 0.75 (3)
- Number of Pumps Optimized per Year: 20 (4)
- Pump operation factor: 0.9 (5)
- Days per year: 8,760 (6)
- KWh/yr saved: 5,913,000 $[(1)*(2)*(3)*(4)*(5)*(6)] = (7)$
- Metric of tons of CO₂e per KWh: 0.00042 (8)
- CO₂e reduction metric tons per year: 2,483 $[(7)*(8)] = (9)$

Total Pumps Optimized	Year	Metric tons CO ₂ e reduced per year
20	2025	2,483
40	2026	4,967
60	2027	7,450
80	2028	9,934
100	2029-2050	12,417

Summary of emission reductions Asset Health and Monitoring: Pump Optimization

	Commutative metric tons CO ₂ e	Average metric tons CO ₂ e/year
2025-2030 reductions	49,669	8,278
2025-2050 reductions	298,015	11,462

Microgrid: On-site Generation of Electricity and Carbon Sequestration at Potomac WFP

Baseline Calculation: CO₂ associated with PJM Grid-supplied electricity to be replaced by onsite Natural Gas production.

- Engine Size (MW): 8.976 (1)
- Est Engine Loading: 90% (2)
- Hours per year: 8,760 (3)
- Operating Factor: 95% (4)
- Est Engine Run Hours: 7,490 $(2)*(3)*(4)=(5)$
- Engine Production (MWh): 67,228 $[(1)*(5)]=(6)$
- Metric of tons of CO₂e per KWh: 0.00042 (7)
- Baseline metric tons CO₂e emissions per year: 28,236 $[(6)*(7)*1000] = (8)$

Proposed Project: CO₂ Output from Natural Gas Engines onsite.

- CO₂ Lbs produced / hour/ engine (per engine spec): 4,376 (9)
- For 2 engines: 8,752 $[(9)*2] = (10)$
- Est Engine Loading: 90% (11)
- Est Engine Run Hours: 7,490 [8760 hours per year * 95% operating * 90% estimated engine loading] (12)
- CO₂ Lbs produced / year: 65,550,730 $[(10)*(12)] = (13)$
- Lbs/MT CO₂ conversion factor: 2,204 (14)
- New Engines metric tons produced CO₂ / year: 29,742 $[(13)/(14)] = (15)$

CO₂e Reduction from Carbon Capture

- New Engines metric tons produced CO₂e / year: 29,742 (15) = (16)
- Estimated Reduction from Carbon Capture (CC): 90% (17)
- Project metric tons CO₂e emissions year (net CC): 2,974 $[(16)*(1-(17))] = (18)$

CO₂e reduction from onsite Natural Gas production vs PJM Grid-supplied Electric

- Baseline metric tons CO₂e emissions per year: 28,236 (8) = (19)
- Project metric tons CO₂e emissions per year (net CC): 2,974 (18) = (20)
- **Project metric tons CO₂e emissions reductions per year post CC: 25,262** $(19)-(18) = (21)$
- Percentage Reduction: 89% $[(21)/19]= (22)$

CO₂e reduction calculation from 838kW DC Onsite Solar

- Estimate Avg MWh Generated/ year: 1,172 (23)
- Metric of tons of CO₂e per KWh: 0.00042 (24)
- **Project metric tons CO₂e emissions reductions per year: 492** $[(23)*(24)*1000] = (24))$

Year	Metric tons CO2e reduced per year
2025	0
2026	0
2027	0
2028	0
2029	6,438*
2030-2050	25,754

* Assumes operation begins in FY 2030 (September 2029). Only partial year reduction claimed.

Summary of emission reductions Microgrid

	Commutative metric tons CO2e	Average metric tons CO2e/year
2025-2030 reductions	32,192	5,365
2025-2050 reductions	547,272	21,049

Anacostia Depot Sewer (Wastewater) Thermal and Solar

Sewer Thermal

- Calculations of CO2 reductions are based on complex, potentially or partially proprietary information from vendors (Huber/Novanta) and specialized consulting firms (Jacobs) that use methods, assumptions, and parameters such as:
 - Conventional HVAC energy use
 - Square footage
 - Estimate demand intensity by specifying heating/cooling equipment
 - Sewer flowrate
 - Sewer temperature
 - Validated temperature assumption with WRRF data: Avg. min. temp above 55°F and Avg. max. temps are 70-75°F
 - Assumed 10% of that thermal capacity normally available
 - Seasonal efficiency
 - Peak building loads
- Various sewer thermal options are being evaluated as part of the Anacostia Depot Renovation Project and final sewer thermal engineering and design will be completed as part of the renovation project by the contractor and their subcontractors. The information presented in this grant application is based on most possible sewer thermal option in the already completed feasibility study.

Year	Metric tons CO2e reduced per year (Sewer thermal only)
2025-2026	0
2027	20*
2028-2050	60

* Assumes operation begins September 2027. Only partial year reduction claimed.

Solar

- Future Admin Building Parking Lot = 40,000 sq ft
- Future Admin Building roof = 50,000 sq ft (solar panels are proposed for part of the roof only)
- Future storage sheds roof:
 - Aggregate bins roof: 5,600 sq ft
 - Jet Truck Shed and Storage roof: 6,600 sq ft
 - Warehouse Storage shed: 4,000 sq ft
 - Future Canopy at Garage: 900 sq ft
- Total square footage = 107,100 sq ft

Assumption: 15W/sq ft solar electricity production and estimated \$1.50/W installation cost

- $15\text{W/sq ft} \times 107,100 \text{ sq ft} = 1606.5 \text{ kW} \times 8760 \text{ hrs/yr} \times .17 \text{ capacity factor} = 2,392,400 \text{ kwh/yr}$
- $2,392,400 \text{ kwh/yr} \times 0.00042 \text{ metric tons CO}_2\text{e / kWhr saved} = 1,005 \text{ metric tons CO}_2\text{/year GHG reduction}$

Year	Metric tons CO2e reduced per year (solar only)
2025	0
2026	335*
2027-2050	1,005

* Assumes operation begins September 2026. Only partial year reduction claimed

Summary of emission reductions Anacostia Depot Sewer (Wastewater) Thermal and Solar

	Commutative metric tons CO2e	Average metric tons CO2e/year
2025-2030 reductions	4,555	759
2025-2050 reductions	25,855	994