MICRON SEMICONDUCTOR FABRICATION

CLAY, NY

Climate Leadership and Community Protection Act Analysis

Prepared for:

micron

July 2025

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
Micron	Micron New York Semiconductor Manufacturing, LLC
LLC	Limited Liability Company
WPCP	White Pine Commerce Park
NOFO	Notice of Funding Opportunity
NEPA	National Environmental Policy Act
SEQRA	State Environmental Quality Review Act
CLCPA	Climate Leadership and Community Protection Act
CRRA	Community Risk and Resiliency Act
HPM	Hazardous Process Material
CUB	Central Utilities Building
WWTP	Wastewater Treatment Plant
Trinity	Trinity Consultants
NYSDEC	New York State Department of Environmental Conservation
EHS	Environmental, Health and Safety
LEED	Leadership in Energy and Environmental Design
CY	Calendar Year
GWP	Global Warming Potential
HTF	Heat Transfer Fluid
BACT	Best Available Control Technology
REC	Renewable Energy Certificate
PPA	Power Purchase Agreement
VPPA	Virtual Power Purchase Agreement
NYPA	New York Power Authority
RNY	ReCharge New York
HLF	High Load Factor

Acronym	Definition
NYSERDA	New York State Energy Research and Development Authority
ESD	Empire State Development Corporation
EV	Electric Vehicle
POTW	Publicly Owned Treatment Works
RRR	Reuse, Recycling and Recovery
CDP	Carbon Disclosure Project
AI	Artificial Intelligence
IoT	Internet of Things
1-beta	1β
HBM3e	High-Bandwidth Memory
DAC	Disadvantaged Community
DAR-21	DAR-21: The Climate Leadership and Community Protection Act and Air Permit Applications
DEP 24-1	DEP 24-1: Permitting and Disadvantaged Communities
CO2e	carbon dioxide equivalent
PSD/NNSR	Prevention of Significant Deterioration and Nonattainment New Source Review
F-GHG	Fluorinated Greenhouse Gases
F^-	Fluorine ion
N_2O	Nitrous oxide
CF_4	Tetrafluoromethane
NF_3	Nitrogen Trifluoride
CH_4	Methane
CO_2	Carbon dioxide
CVD	Chemical Vapor Deposition
ALD	Atomic Layer Deposition
N_2	Nitrogen
F_2	Fluorine

Acronym	Definition
PEEC	Process Equipment Exhaust Conditioner
IPCC	Intergovernmental Panel on Climate Change
RCTO	Rotor Concentrator Thermal Oxidizer
POU	Point-of-Use
VOC	Volatile Organic Compound
AR5	Fifth Assessment Report
PTE	Potential-To-Emit
OCIDA	Onondaga County Industrial Development Agency
U.S. EPA	U. S. Environmental Protection Agency
LAER	Lowest Achievable Emission Rate
C_2F_6	Hexafluoroethane
TQ	Threshold Quantity
RMP	Risk Management Program
OSHA	Occupational Safety and Health Administration
PSM	Process Safety Management
SIA	Semiconductor Industry Association
OTR	Ozone Transport Region
HF	Hydrogen Fluoride
RCS	Regenerative Catalytic Systems
TSCA	Toxic Substances Control Act
PMN	Premanufacture Notice
DRE	Destruction and Removal Efficiency
BMP	Best Management Practice
CCS	Carbon Capture and Storage
EOR	Enhanced Oil Recovery
PHMSA	Pipeline and Hazardous Materials Safety Administration
ECL	Environmental Conservation Law
NSR	New Source Review

Acronym	Definition
WPCP	White Pine Commerce Park
CJWG	Climate Justice Working Group
SGEIS	Supplement to Generic Environmental Impact Statement
DGEIS	Draft Generic Environmental Impact Statement
lb	Pound
NSPS	New Source Performance Standards
UPA	Uniform Procedures Act
NYCI	New York Cap and Invest
SMP	Stormwater Management Practice

1 INTRODUCTION

Micron New York Semiconductor Manufacturing LLC (Micron), a Delaware limited liability company (LLC) and wholly owned subsidiary of Micron Technology, Inc., is proposing to construct and operate a leading-edge semiconductor manufacturing facility at the White Pine Commerce Park (WPCP) in the Town of Clay, New York. The manufacturing facility would consist of four semiconductor fabrication facilities (fabs), ancillary support facilities, ingress and egress roads, driveways, and parking, with a total footprint of approximately 1,000 acres (Micron Campus). In addition to the Micron Campus, Micron is also proposing to facilitate the construction of a childcare and health care center at 9100 Caughdenoy Road (Childcare Site) to support Micron employees who would work at the Micron Campus and a rail yard and siding track at 8852 Caughdenoy Road, adjacent to the Micron Campus (Rail Spur Site).[1] Collectively, the Micron Campus, Childcare Site, and Rail Spur Site are referred to as the "Proposed Project," consistent with the Draft Environment Impact Statement (DEIS) prepared in accordance with the National Environmental Policy Act (NEPA) and the New York State Environmental Quality Review Act (SEQRA). The Proposed Project would be built in several phases over the next 16 years and would require several improvements to local and regional electrical, natural gas, water supply, and wastewater infrastructure to support the full build-out of the Proposed Project. Micron plans to invest $100 billion to construct the Proposed Project, creating approximately 9,000 direct jobs, and nearly 50,000 indirect jobs (construction, supply chain, community jobs).

Micron is seeking Federal, state, and local financial assistance through the CHIPS Incentives Program authorized by Title XCIX – Creating Helpful Incentives to Produces Semiconductors (CHIPS) for America of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 (Pub. L. 116-283), as amended by the CHIPS Act of 2022 (Division A Pub. L. 17-167) (together referred to as the CHIPS Act), the New York State Green CHIPS Act, a state-level companion to the CHIPS Act, and several local incentives provided by Onondaga County (the County) and the Onondaga County Industrial Development Agency (OCIDA).

The construction and operation of the Micron Campus is critical to U.S. national and economic security. The Micron Campus would allow for the domestic production of the most advanced memory chips known as dynamic random-access memory (DRAM) chips. Memory chips using DRAM technology have crucial applications in military equipment, cybersecurity technology, the aerospace industry, artificial intelligence (AI) computing, and other critical areas of domestic industrial economy. Therefore, the products manufactured at the Micron Campus would assist the U.S. Government in addressing gaps and vulnerabilities in the domestic supply chain across a diverse range of technology and process nodes and would provide a secure supply of semiconductors necessary for the national security, manufacturing, critical infrastructure, and technology leadership of the United States in accordance with the purpose of the CHIPS Act.

As part of the Proposed Project's Green CHIPS Application, Micron has committed to certain sustainability measures to mitigate the Proposed Project's greenhouse gas (GHG) emissions and worker and community

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[1] Both Childcare Site and Rail Spur Site will be constructed and operated by an independent contractor.

investments. As part of the worker and community investments, Micron and NY Empire State Development (ESD) have committed to a $500 million Community Investment Fund (CIF), with $250 million provided by Micron, $100 million provided by ESD, and the remaining $150 million raised in coordination with public and private entities.

In addition to financial assistance, Micron is also seeking approval for numerous Federal, state, and local permits, authorizations, and approvals. To receive financial assistance and authorizations for the Proposed Project, Micron is currently undergoing a joint federal and state environmental review pursuant to NEPA and SEQRA.

The Proposed Project

The semiconductor industry is extremely competitive, cost intensive, and margin driven. To reshore sufficient domestic DRAM production in accordance with the intent of the CHIPS Act, a domestic manufacturing facility must achieve similar scale to global competitors, with multiple fabs grouped together to ensure efficient infrastructure costs and upstream supply. The need for larger fab clusters that co-locate large cleanrooms on a single campus is driven by the complexities of the semiconductor wafer manufacturing process that demands efficiencies of scale. Therefore, co-locating more fabs and cleanroom space on a single site reduces both the fixed and operating cost per wafer produced. This has driven a global trend towards the construction of larger fab clusters (commonly referred to as megafabs) on single campuses, with sizing of fabs dictated by the type of technology being produced at each location.

Currently, all DRAM that is produced in the US is manufactured by Micron Technology. By onshoring a globally competitive cluster of four DRAM fabs in Clay, New York, Micron Technology proposes to increase US-based DRAM production by a factor of 12 over the next two decades, bringing Micron Technology’s overall supply in line with industry demand growth.

The Micron Campus

Micron proposes to construct and operate the Micron Campus on the WPCP, an approximately 1,400-acre site located at 5171 NYS Route 31, Clay, New York. The Micron Campus would include four 600,000 sq. ft. fabs, ancillary support buildings including Central Utility Buildings (CUBs), electrical yards and substations, bulk gas yards, water and wastewater treatment facilities, probe buildings, and administrative buildings, as well as driveways, parking lots and garages.

The construction of the Micron Campus would occur in phases over approximately 16 years, starting with site clearing and associated removal, fill, and grading activities and construction of the first fab and ancillary support buildings on the western portion of the site. Thereafter, the construction of the remaining fabs would occur sequentially, from west to east with construction of each fab starting as the preceding fab is outfitted with manufacturing equipment and tools in advance of the manufacturing start date. Much of the construction over this 16-year period will occur inside the fabs and other ancillary buildings.

The Rail Spur

Due to the poor soil quality on the Micron Campus, Micron anticipates that 1.5M cubic yards (CY) of soil would need to be removed, and 9M CY of aggregate material would need to be provided on the site to construct the necessary foundation for the fabs and ancillary buildings.

The amount of aggregate material needed for the Micron Campus would require years of around-the-clock trucking with standard dump truck fleets. However, instead of transporting the majority of fill to and from the Micron Campus by truck, Micron is proposing to facilitate the construction of the Rail Spur Site to transport aggregate material by rail instead of by truck. A single rail car can transport up to five times the amount of aggregate material than a single standard dump truck. Therefore, the transport of aggregate material via rail rather than truck will significantly reduce truck traffic to and from the Micron Campus by eliminating approximately 7,300 truck trips per month, resulting in a corresponding reduction of noise and mobile air emissions during the various construction phases of the Micron Campus.

To facilitate the transportation of aggregate material by rail, Micron purchased a 38.2-acre site adjacent to the Micron Campus on the west side of Caughdenoy Road. While Micron will continue to own the 38.2-acre site, Micron will contract with a third-party to construct and operate the Rail Spur Site. The third-party operator will own all equipment needed for the operation of the Rail Spur Site, including but not limited to the rail siding, rail yards, offloading track and facility, an electrically-powered aggregate materials conveyance system, office building, and locomotive shed. The Rail Spur would have the capability to provide approximately 1,500 short tons per hour (STPH) of aggregate material to the Micron Campus. Rail cars would be offloaded at the Rail Spur Site to an aggregate conveyance system comprised of belt conveyors designed to move material up and over Caughdenoy Road to the Micron Campus. The conveyance system would remain active during site preparation phases associated with each of the four fabs. The conveyor system will be initially installed for the first phase of construction at the Micron Campus and removed once that phase is complete or the conveyor system is no longer needed for the first construction phase. Thereafter, the conveyor system will be reinstalled and removed to coincide with each subsequent construction phase. Once construction of the Micron Campus is complete, the conveyor system will be permanently removed. The Rail Spur Site may continue operations after construction of the Micron Campus is complete to bring off-site manufactured construction materials such as pre-cast concrete and facades to the Micron Campus. Unlike the aggregate material that would be transported from the Rail Spur Site to the Micron Campus via the aggregate material conveyor system, the materials needed for the structural phase of the construction will be trucked a short distance from the Rail Spur Site to the Micron Campus.

Once a fab becomes operational, the Rail Spur Site may also be used, to the extent practicable, to bring in equipment and materials required for semiconductor manufacturing. After construction of the Micron Campus is completed, the Rail Spur Site could continue to operate. However, such operations would be at the discretion of the Rail Spur Site operator.

The Childcare Site

Micron is proposing to construct a Childcare Site consisting of a childcare center, a healthcare center, and recreational areas on an approximately 30-acre site on Caughdenoy Road, a few miles north of the Micron Campus. The Childcare Site would be built out over phases, starting with the construction of the childcare center, with operations expected to coincide with operations of the Fab 1. Thereafter, a healthcare center would be constructed for use by Micron employees. Micron will contract with third-party childcare and healthcare providers for operations of the childcare center and health center. Recreational fields, such as soccer fields, will also be provided on the Childcare Site for use by Micron employees. The project components of the Childcare Site have been designed to avoid and minimize environmental effects, including the avoidance of wetlands.

Off-Site Utility Upgrades

The Proposed Project will require several upgrades to local utility infrastructure, which will be undertaken by the respective utility owners. The upgrades include an expansion of National Grid's Clay Substation and new natural gas regulator station (GRS) near the Micron Campus, upgrades to water infrastructure owned and operated by the Onondaga County Water Authority (OCWA), a new industrial wastewater treatment plan at the Oak Orchard (Oak Orchard IWWTP) owned and operated by the Onondaga County Department of Water Environment Protection (OCDWEP), and routing of fiber optic lines in the existing right of way along NYS Route 31.

1.2 Regulatory Framework

The Climate Leadership and Community Protection Act (CLCPA) was signed into law in July 2019 to reduce the state's GHG emissions and achieve net-zero emissions by 2050 (ch. 106; L. 2019). To meet this goal, the CLCPA requires the State to acquire 70 percent of its electricity from renewable sources by 2030 and 100 percent by 2040 and further requires that there be a 40 percent reduction in statewide GHG emissions by 2030 and an 85 percent reduction by 2050.

Pursuant to CLCPA Section 7(2), New York State agencies, including ESD and the NYS Department of Environmental Conservation (NYSDEC) are required to consider whether their administrative decisions, such as funding approvals or permitting actions are inconsistent or interfere with the attainment of the statewide GHG emission limits established by law.[2] Additionally, CLCPA Section 7(3) provides that state agencies shall not disproportionately burden disadvantage communities (DACs) when issuing permits, licenses, or other administrative approvals and decisions and further requires state agencies to prioritize reduction of GHG emissions and co-pollutants in DACs. Applicants seeking funding, permits, or other administrative decisions may provide agencies with an assessment of whether a project will cause a disproportionate impact on DACs.

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[2] 6 NYCRR 496.1 and 496.4

The Proposed Project will require several approvals by NYS agencies triggering the requirement for a CLCPA analysis, including but not limited to the ESD's authorization of the Proposed Project's Green CHIPS application and funding and NYSDEC's issuance of environmental permits necessary for the construction and operation of the Proposed Project.

The NYSDEC has implemented the requirements of the CLCPA through various guidance documents including NYSDEC Commissioner Policy (CP)-49, Division of Air Resources (DAR) Program Policy 21 (DAR-21), and Division of Environmental Permits (DEP) Program Policy 24-1 (DEP 24-1).

Section 17-b of the Community Risk and Resiliency Act (CRRA) requires certain permit applicants to consider future physical risks that climate change poses to their proposed projects, and whether their projects significantly affect the climate resilience of public infrastructure or services, natural resources, private property, or natural resources in the vicinity. CP-49 provides guidance to agency staff regarding the incorporation of climate change considerations into agency activities to ensure compliance with the CLCPA.

DAR-21, entitled "The Climate Leadership and Community Protection Act and Air Permit Applications" was issued to outline the requirements for analyses developed pursuant to CLCPA Section 7(2) in support of air permit applications. DAR-21 includes guidance on the applicability of a CLCPA analysis for air permit applications and what information should be included in the analysis. Under DAR-21, air permit applicants must calculate proposed project GHG emissions and, in certain cases, evaluate alternatives and mitigation measures. DAR-21, further memorializes the requirements of CLCPA Section 7(2) by providing that in instances where a project is inconsistent with or will interfere with the State's ability to meet the statewide emission limits promulgated in 6 NYCRR Part 496.4, NYSDEC must consider whether sufficient justification for the project exists. If sufficient justification exists, a statement of justification must be created before issuing a decision on an air permit application. The justification statement must include: (1) an explanation of any factors or circumstances that provide justification for the project despite the inconsistency with the CLCPA emission limits; (2) an explanation of the alternatives and mitigation measures considered, whether the mitigation measures considered were found to be feasible, and to what extent the mitigation measures will be implemented; and (3) a description of the environmental, economic, and/or social harm associated with the absence of the project and any benefits to the citizens of the state resulting from the project.

Pursuant to DAR-21, a CLCPA analysis for an air permit application typically requires identification of GHGs emitted from new or modified emission sources and quantification of emissions of individual GHGs and the total carbon dioxide equivalent (CO_2e) attributable to the project based on the 20-year Global Warming Potential (GWP) of each individual GHG emitted, including:

- Direct emissions of GHGs released from new or modified process operations at the facility;
- Direct emissions of GHGs that are generated due to the combustion of fossil fuels in new or modified combustion equipment at the facility;
- Upstream emissions of GHGs attributable to the project associated with the extraction, production and transmission of fossil fuels imported into the State;

- Downstream emissions of GHGs attributable to the project that are reasonably foreseeable as a result of the transmission and use of fossil fuel products;
- Indirect emissions of GHGs attributable to the project that are reasonably foreseeable as a consequence of the activities of the reporting facility from sources that may be outside of its control, and;
- Projected future GHG emissions for the years 2030 and 2050.

For projects that will result in actual or potential increase in GHG emissions, an analysis of any proposed new or modified GHG emission sources at the facility is required to determine if there are feasible alternatives or mitigation measures to reduce GHG emissions.

NYSDEC has also issued DEP 24-1, entitled "Permitting and Disadvantaged Communities." DEP-24-1 provides guidance for NYSDEC staff when reviewing permit applications associated with sources and activities, in or likely to affect a disadvantaged community (DAC), that result in GHG, or co-pollutant emissions regulated pursuant to Article 75 of the NYS Environmental Conservation Law. DACs are defined by the NYS Climate Justice Working Group[3] and include communities that bear the burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, and are identified using NYSDEC's Disadvantaged Communities Criteria Map[4]. Pursuant to DEP 24-1, NYSDEC must conduct a preliminary screening to determine if a proposed project would be in or likely to affect a DAC. If so, the proposed project is required to undertake a disproportionate burden report for the proposed project (DEP 24-1, Section V.6) and may require enhanced public participation consistent with CP-29.[5] If the proposed project is not located in or not likely to affect a DAC, then DEP-24-1 does not apply to the proposed project's permit applications.

1.2.1 Applicability to the Proposed Project and Other Off-Site Utilities

This CLCPA analysis evaluates the following aspects of the Proposed Project in subsequent sections:

- Stationary sources associated with the long-term operations of the Micron Campus, including manufacturing and support equipment that will be incorporated into Micron's Title V air permit;
- Stationary sources associated with the operation of the proposed Oak Orchard IWWTP;
- Stationary and mobile source emissions associated with construction of the Proposed Project (Micron Campus, Rail Spur Site, and Childcare Site);
- Mobile source emissions associated with the long-term operations of the Proposed Project, including the transport of people and materials to and from the Micron Campus and;

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[3] New York Environmental Conservation Law (NY ECL), Article 75-0111.

[4] https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria. Accessed on April 22, 2025.

[5] Commissioner Policy 29, Environmental Justice And Permitting, https://dec.ny.gov/regulatory/guidance-and-policy-documents/commissioner-policy-29-environmental-justice-and-permitting. Accessed on February 26, 2024.

- Impacts to existing wetlands due to land use by the Proposed Project.

The Proposed Project will be a new construction, and therefore, all stationary GHG emission sources will be considered as new emission sources. The Oak Orchard IWWTP, while constructed and operated by OCDWEP, will include new GHG emission sources and will be included in this analysis. Construction of the Proposed Project will utilize mobile and stationary emission sources that will be considered as discussed in Section 3. Mobile sources, including those associated with long term operations and those associated with construction, are addressed in Section 4.

Direct and upstream GHG emission sources are described in Sections 2, 3, and 4 below. There are no downstream emissions considered in this analysis since the Proposed Project will not transmit any fossil fuels, renewable natural gas (RNG) or any other materials that would have the potential to emit GHGs upon use (DAR-21 Section V.C).

At the time of this submittal, the detailed design for the Micron Campus is still in development. Detailed design of the exterior of all four fabs and detailed design of fab processes, technologies, and raw materials for Fab 1 and Fab 2 are underway. Therefore, the best information available at this time has been used to develop this CLCPA analysis. Importantly, to ensure that the emissions estimated for the Proposed Project are conservative, the analysis uses reasonable worst-case process material usage rates and numbers of equipment (e.g., emergency generators) that reflect maximum rates/quantities understood to be possible based on the most current design information, resulting in conservatively high expected emission rates. The emission calculations in Micron's air permit application (covering Fab 1 and Fab 2 only) submitted on March 8, 2025, have been conservatively doubled to estimate emissions from all four fabs. Methodologies used to quantify emissions are described in more detail in the sections below.

As part of the air permitting process, Micron has evaluated and will implement Best Available Control Technology (BACT) for GHG emissions from Micron permitted stationary sources.

Micron will submit future CLCPA analyses, including additional emissions and mitigation of those new emissions, as attachments to Title V modification applications and permit renewals as required by DAR-21 that are not currently addressed in this analysis. Other entities operating components of the Proposed Project components that Micron does not own would be responsible for supplementing this CLCPA analysis with submission of its own permit applications for construction and operation.

1.3 Micron Sustainability Initiatives

Micron is an industry leader in semiconductor manufacturing and conducts its operations using both leading-edge technologies and intentional sustainability practices. As outlined in its 2023 Sustainability Report,[6] Micron takes a proactive approach to environmental stewardship, investing in technologies to mitigate its environmental footprint, and integrates environmental, health and safety (EHS)

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[6] "The Power of Partnership: Micron Sustainability Report 2023," Accessed February 2024, https://media-www.micron.com/-/media/client/global/documents/general/about/2023/2023_micron_sustainability_report.pdf

considerations, including energy, water and waste efficiency, Leadership in Energy and Environmental Design (LEED) criteria, and other factors into its processes, facility design, and construction. This approach is demonstrated in Micron's published goals and progress relating to emissions, energy use, water use, and waste generation worldwide.

1.3.1 Corporate Sustainability Goals

Micron builds sustainability goals into its global operations through design of its facilities around the world. The design of each facility must take into consideration various aspects of the facility's location, including weather, space constraints, local regulatory frameworks, worker safety, and other environmental, social and governance (ESG) considerations. Micron's goals for global operations are highlighted by a near-term goal of a 42% absolute reduction in Scope 1 emissions by calendar year (CY) 2030 from a CY 2020 baseline and a long-term goal of net zero Scope 1 and Scope 2 emissions by CY 2050. Scope 1 emissions roughly equate to direct emissions as described in DAR-21, and Scope 2 emissions are the subset of upstream emissions, as described in DAR-21, contributable to utilities, such as electricity. Note for consistency with the analysis completed for Micron's DEIS and sustainability goals, GHG emissions are discussed using Scopes 1, 2, and 3 with analogous DEC terminology equated referenced accordingly. [7]

Scope 1 emissions will be reduced, in part, through the abatement of process GHG emissions and the use of low GWP heat transfer fluids (HTF) where reasonably feasible. Additionally, Micron has committed to using 100% carbon-free electricity, where available, in all U.S. operations by CY 2025 to help reach the company's goal of net-zero Scope 2 emissions. Micron has already achieved 100% renewable energy for its Malaysian operations in CY 2022. Additional company-wide goals include 75% water conservation and 95% waste reuse, recycling, or recovery by CY 2030. Globally, Micron facilities have achieved 65% water conservation and 93% waste recovery through reuse, recycling, and restoration efforts.[8]

1.3.2 Clay, NY Sustainability Commitments

Micron's fab design incorporates industry best practices published by the World Semiconductor Council, including industry standards for emissions mitigation. Micron's sustainability related plans specific to the Proposed Project currently in development as part of its Green CHIPS commitments are discussed in this section. In addition to the plans outlined in this section, operations-specific plans that have been developed are addressed as alternatives or mitigation measures in the sections below.

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[7] Scope 1 emissions are analogous to direct emissions defined in DAR-21. Scope 2 emissions are analogous to indirect upstream emissions attributable to offsite fossil fuel generated electricity as required by DAR-21. Scope 3 emissions are analogous to the downstream and upstream emission calculations as required by DAR-21.

[8] Ibid.

1.3.2.1 *Electricity*

Micron plans to utilize 100% carbon-free electricity for purchased electricity during the operational phase of the Proposed Project, including but not limited to:

- Renewable energy sourced from utility providers;
- Renewable Energy Certificates or Credits (RECs) sourced from both Power Purchase Agreements (PPAs) and Virtual Power Purchase Agreements (VPPAs) for projects inside and outside of New York State; and
- Market RECs procured both independently and through energy providers.

Micron has received approval from the New York Power Authority (NYPA) for up to 140,000 kW of ReCharge New York (RNY) power (with a potential for supplementing with up to 788,000 kW of High Load Factor (HLF) power) for the Proposed Project. Pursuant to the RNY program, 50 percent of the RNY power will be NYPA hydropower. In addition, Micron will work with state entities including NYPA, ESD, and the New York State Energy Research and Development (NYSERDA) to identify reasonably feasible opportunities for new renewable or carbon-free electricity projects in New York. Micron is also currently reviewing potential opportunities for 24/7 and/or time-matching-based renewable energy sources related to storage.

Additionally, Micron will commit to the installation of approximately 4 MW of solar panels on the roofs of various buildings on the Micron Campus. Micron also plans to provide electric vehicle (EV) charging stations and related infrastructure for onsite use.

1.3.2.2 *Building & Construction*

Micron is aiming to achieve Gold LEED rating status for the proposed fabs and office buildings. LEED certification provides a framework for efficient and cost-effective green buildings which offer significant environmental benefits. Aspects such as carbon, energy, water, waste, transportation, materials, health, and indoor environmental quality are closely evaluated as part of this framework. To facilitate this goal, Micron has developed a comprehensive LEED program, including, but not limited to:

- Ensuring there are at least two LEED accredited professionals on Micron’s Global Facilities team;
- Developing a Micron Global LEED Design & Construction Standard and a LEED Scorecard strategy applicable to new Greenfield Fab Construction Projects; and
- Driving continuous improvements and evaluation efforts to target future certifications to LEED Platinum.

Where appropriate, Micron will consider the use of low-carbon building materials in the construction of the fabs. Micron will explore energy efficiency (including heat recovery efforts to reduce wasted energy), recycled construction materials, and use of materials that consider lifecycle impact as part of the design, construction, and operation of the Proposed Project as Micron aligns its building practices with LEED certification requirements.

1.3.2.3 *Operations*

Process GHG emissions are mainly emitted from Micron's etching process and the plasma chamber deposition and cleaning process. Today, few suitable low-GHG alternatives exist for these processes. Alternatives to using these materials and mitigation measures to reduce the GHG emissions from these processes are discussed in detail in Section 2.2. Micron is collaborating with suppliers to develop low-GHG emissions etch chemistries and to abate emissions more efficiently at the tool level. These efforts require close partnership with process tool suppliers, gas suppliers and academia to develop novel chemistries. In processes where complete abatement is impossible, Micron is exploring gas separation and purification technologies, as well as systems to remove as much residual gas as possible.

Micron implements continuous improvements in process emission reductions as part of its node-over-node process design. Process emissions reductions will be driven through a variety of solutions. These could include low GWP material substitutions, improved process gas usage efficiency, potential adjustments to abatement technologies (as appropriate), and other strategies that may develop over time.

HTFs are another source of Micron's GHG emissions. Micron is continuously evaluating ways to lower GHG emissions from HTFs including increasing its chemical use efficiency and transitioning to alternatives with lower GWP. Micron's efforts to reduce GHG emissions from HTFs are described in Section 2.2.

Micron also continually evaluates supplier capabilities for utilizing alternative fuel options with lower GHG capabilities. This includes exploring possible use of green hydrogen for certain applications where commercially and technically feasible.

1.3.2.4 *Water & Waste*

Water conservation and efficiency measures are among Micron's top environmental priorities. Micron has established a goal of reusing, recycling or restoring 100% of the water used in its operations, with an interim goal of 75% by the end of 2030. This goal has two components:

- Enhancing water reuse and recycling infrastructure in Micron facilities; and
- Engaging in water restoration projects that meet current and future demand for water for local ecosystems and communities.

In addition to water conservation and efficiency goals, Micron has committed to a 95% reuse, recycling and recovery (RRR) rate and zero hazardous waste to landfills by 2030. Micron is regularly reviewing its waste generation sources to identify reduction opportunities and improve waste segregation to enable onsite reuse, waste treatment systems for volume minimization and quality improvement and engaging with waste vendors to find the best opportunities to manage its waste to minimize landfill and incineration.

In New York, Micron will adopt measures to reduce, avoid, and reuse waste and commit to implementing water conservation and efficiency measures and sustainable wastewater management during the operation of the Proposed Project.

Micron will also explore possible use of a Zero Liquid Discharge plant that may be developed in cooperation with the Oak Orchard IWWTP at a future time as detailed design progresses.

1.3.2.5 *Transportation*

Micron is investing in the construction of the Rail Spur Site to significantly reduce truck traffic associated with the construction and operations of the Proposed Project. Due to the poor soil quality on the Micron Campus, a significant amount of fill would need to be removed, and new aggregate would need to be provided to support the infrastructure on site. By using standard dump trucks, the process would require trucks to run to and from the Micron Campus every two minutes, sixteen hours a day, six days a week, for two and a half years. In contrast, a single rail car can carry five times the amount of fill or aggregate as a standard dump truck. By constructing the Rail Spur Site and utilizing rail instead of dump trucks only, Micron will significantly reduce mobile emissions during the construction of the Proposed Project.

To additionally reduce mobile source emissions, Micron is also requiring shuttle services for all construction employees. Construction workers will be shuttled to and from the Micron Campus from offsite locations, reducing the number of trips to the Micron Campus during the construction period.

Micron is also partnering with Central New York Regional Transit Authority (Centro) to fund an additional express bus service (the Micron Express Route) between West Adams Street and East Adams Street in downtown Syracuse and the Micron Campus via I-81. This 16 to 28-minute express route would provide approximately 27 daily trips, spanning approximately 115 hours per week. The current route is being developed in coordination with Centro to maximize regional coverage and timing of Micron's shift schedules and construction worker schedules. In conjunction with funding the Micron Express Route, Micron will also establish the Commuter Choice Program which allows employees who use mass transit to and from work to use pre-tax dollars to purchase tickets, tokens, and passes for local public transit services. In accordance with Federal law, employees may deduct up to a maximum of $395.00 per month or $3,900.00 per calendar year.

Consistent with programs at other Micron sites, Micron will provide low and zero-emissions transportation infrastructure such as reserved parking spaces for carshare vehicles and alternative-fueled vehicles, electric vehicle (EV) charging stations, and on-site infrastructure that promotes bicycle usage (such as bicycle storage and shower rooms).

The existing bicycle and pedestrian infrastructure near the Proposed Project is limited and fragmented. Micron is supportive of an evaluation of a bicycle path network and enhancements to bicycle and pedestrian safety by the local and state transportation agencies.

Micron will provide shuttle bus options inside the Micron Campus to facilitate travel between Micron buildings and Americans with Disabilities Act-compliant access public transportation as part of its GHG emissions reductions efforts.

1.3.2.6 *Upstream Value Chain Sustainability Commitments*

Micron works with its suppliers to help suppliers understand Micron's sustainability efforts and identify and address sustainability-related risks, including those pertaining to climate change and other environmental issues. Micron surveys high-risk and critical suppliers' programs to improve energy efficiency; reduce GHG emissions; and control, treat and minimize waste, wastewater and air emissions. Micron requires its suppliers to participate in the Responsible Business Alliance audit process, which assesses these topics.

Micron encourages all suppliers to focus on GHG emissions from their own operations and energy use. Micron requires key suppliers to report details on their GHG emissions and water footprint to CDP (formerly known as the Carbon Disclosure Project) in order for Micron to evaluate performance and goals of these key suppliers. GHG commitments would factor into proposal scoring for new supplier contracts. Existing underperforming suppliers would undergo a semiannual engagement to track GHG reduction plans. If these suppliers continue to underperform, Micron will reduce their use or substitute for a supplier that meets Micron's GHG reduction goals.

Micron also partners with suppliers on emissions-reduction projects such as manufacturing equipment upgrades, efficiency improvements and renewable energy onsite generation and purchases, especially for suppliers that are expanding to meet Micron demand. Micron also has implemented initiatives to develop local workforce capabilities, local vendor supply and local support services.

1.3.2.7 *Downstream Value Chain Sustainability Commitments*

Micron is an industry leader in producing advanced, energy-efficient memory and storage, supporting sustainability along the full electronics value chain. Notably, Micron leads advancements in the memory and storage industry, as the first to market with 1β (1-beta) DRAM technology and other leading products. 1β chips deliver approximately a 15 percent power efficiency improvement over previous-generation chips. Micron is also developing the industry's most advanced and power-efficient third-generation high-bandwidth memory (HBM3e), which aims to enhance the efficiency and capability of AI by performing 2.5 times over that of previous generations.

Advancements in Micron's product technology help customers meet their power efficiency needs for applications such as AI, the Internet of Things (IoT), and cloud computing by improving battery life, reducing heat output, and mitigating environmental impacts stemming from increased computational demands. For instance, data centers alone use approximately 1% of global electricity[9] and up to 2% in the U.S.,[10] much of which comes from fossil fuel sources that contribute to climate change. Moreover, with the rapid advancements in AI, the volume of data produced and organized is projected to grow over the coming years. Therefore, these improvements in product power efficiency can yield important changes in the carbon footprint and impact on the environment.

2 LONG TERM OPERATIONS STATIONARY SOURCES

2.1 GHG Emission Sources

This section describes the operations planned for the Proposed Project that will result in GHG emissions from long term operations stationary sources at the Micron Campus. Additional details on the semiconductor manufacturing operations expected to be included at the Micron Campus is provided in Appendix A.

All four fabs will generally consist of the following operations which allow independent operation of each fab:

- A main production cleanroom space of approximately 600,000 square feet (sq. ft.) that will house a mix of process tools;
- A sub-fab area that prepares and stores raw materials (e.g., process gases, chemical mixtures/slurries in the liquid state, etc.) used in the fab processes;
- Support buildings storing bulk raw materials and waste materials (hazardous process material (HPM) building) and preparing raw materials that are transferred to the fab or sub-fab;
- A central utilities building (CUB);
- Bulk gas storage yards;
- An administrative building that includes a quality control laboratory (Admin/Probe);
- Ancillary support equipment including cooling towers and emergency generators; and
- Wastewater treatment plant (WWTP) operations, including high fluoride waste treatment and general industrial wastewater treatment housed in one building (WWT), and biological wastewater treatment housed in its own building (BIO).

Micron will manufacture semiconductors and other devices on silicon-based wafers. To remain competitive, Micron must constantly adapt to changing product mix, architecture, and functionality. The nature and rapid pace of constant technological change affects the type, number, and configuration of

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[9] Energy Innovation Policy & Technology LLC, "How Much Energy Do Data Centers Really Use?", Accessed March 18, 2024, https://energyinnovation.org/2020/03/17/how-much-energy-do-data-centers-really-use/

[10] United States Department of Energy Office of Energy Efficiency & Renewable Energy, "Data Centers and Servers," Accessed February 2024, https://www.energy.gov/eere/buildings/data-centers-and-servers.

semiconductor process equipment (also known as “tools” or “process tools” in the industry) required to fabricate devices.

Additionally, the Oak Orchard IWWTP will consist of a new biological wastewater treatment operation primarily designed to collect effluent from the Micron Campus. While OCDWEP will construct, own, and operate the Oak Orchard IWWTP, its operation will be required in conjunction with long term operations of the Proposed Project.

The design of the Oak Orchard IWWTP is still in preliminary planning stages. Therefore, it is assumed, based on similar facilities, that the Oak Orchard IWWTP will be supported by one (1) natural gas-fired boiler and four (4) diesel fuel-fired emergency generators that are identical to those proposed on the Micron Campus.. The number of generators may decrease as the design of the Oak Orchard IWWTP progresses. An updated CLCPA analysis for the Oak Orchard IWWTP will be submitted by OCDWEP during subsequent environmental permitting required for the construction and operation of the treatment plant.

2.1.1 GHGs Used as Raw Materials and Process Gases

High-purity silicon wafers serve as the fundamental components for all semiconductor products that will be manufactured at the Micron Campus. These silicon wafers undergo numerous and complex process steps in cleanroom environments to construct intricate semiconductor devices.

Nitrous oxide (N_2O) and several fluorinated greenhouse gases (F-GHG) are utilized as process gases during semiconductor fabrication and cleaning. F-GHGs are used in semiconductor manufacturing because they are essential to the fabrication of modern semiconductors, provide uniquely effective process performance when etching wafers, and are a reliable source of fluorine ion (F^-), which is required for cleaning semiconductor process chambers. F-GHGs used in semiconductor manufacturing as raw materials or process gases include tetrafluoromethane (CF_4) and nitrogen trifluoride (NF_3). In addition, methane (CH_4) and carbon dioxide (CO_2) are used as process gases. These gases are primarily used in thin films and plasma etch process tools, and serve many different purposes in those manufacturing steps, summarized in the following subsections.

2.1.1.1 *F-GHGs and N_2O Used in Thin Films Process Tools*

In thin films tools, thin layers of material are added to wafers through several distinct processes, including chemical vapor deposition (CVD) and atomic layer deposition (ALD). Nitrous oxide and F-GHGs are used as two of the many gaseous raw materials for these processes. When N_2O and F-GHGs are used, these may be emitted directly as a result of the process, which does not consume all of the N_2O or F-GHGs used as a reactant.

Nitrogen trifluoride is used in these tools as a process chamber cleaning agent. The main use is in the “remote clean” process. The NF_3 gas is reacted or “cracked” into molecular nitrogen (N_2), fluorine (F_2), and fluorine ions (F^-) remotely, before entering the thin films chamber. In the chamber, fluorine ions react with deposited atomic ions on chamber surfaces, such as silicon, that may be left on the walls after a deposition process has been completed. A small percentage of NF_3 that is not cracked before entering the chamber will be discharged from the tool along with other process byproducts after the cleaning process. In addition, a portion of that NF_3 can generate tetrafluoromethane (CF_4) either when carbon is in chamber deposits or when combusted in a thin films process equipment exhaust conditioner (PEEC) after exiting the chamber. PEECs are required safety equipment installed alongside thin films tools to manage pyrophoric, flammable, and/or toxic materials (for more detail on PEECs see Appendix A).

When fluorine is either used directly or generated by cracking NF_3, it can react with methane used as a fuel source for a thin films PEEC to form CF_4. The Intergovernmental Panel on Climate Change (IPCC) provides a means for thin films PEEC vendors to certify that the equipment they produce avoids this reaction and CF_4 emissions from thin films process tools are minimized, see Section 2.2.3.1 for more details.

2.1.1.2 *F-GHGs Used in Plasma Etch Process Tools*

In plasma etch tools, portions of wafers are removed in strategically defined areas to create patterns that are used to form circuitry and to remove extraneous material from the wafer using the same process. F-GHGs are used as etch gases, which are introduced into tool chambers and forced into the plasma state. Free fluorine ions will react with silicon ions or metal ions on a wafer to remove them and create etched openings in wafer surface. The GHG etch gases can each be discharged from the tool if they do not dissociate in the plasma environment or can partially decompose and generate other fluorinated GHGs.

2.1.1.3 *Carbon Dioxide and Methane Used as Process Gases*

Methane is used in small quantities as processing additives in plasma etch tools. Carbon dioxide is used as a supercritical fluid to clean wafers and remove impurities. In both cases, some or all of the CO_2 and CH_4 used may be emitted directly.

2.1.2 Byproducts of Thermal Oxidation of Process Gases

Several semiconductor manufacturing processes exhaust through rotor concentrator thermal oxidizers (RCTOs), point-of-use air pollution control devices ("POU control devices"), thin films PEECs, or regenerative catalytic systems (RCS). RCTOs are designed to control volatile organic compounds (VOC) emissions from processes that use organic solvents, including photolithography and wet etching or cleaning, by oxidizing them into CO_2. RCTOs will also be installed on HPM buildings to oxidize solvent emissions from the spin-on dielectric (SOD) waste neutralization process.

POU control devices are used to control emissions of F-GHG by thermally managing exhaust streams from process tools that utilize F-GHG and nitrous oxide (N_2O). By contrast, certain process tools are required to be equipped with PEECs as a safety mechanism, which is an inherent part of the process to manage hazardous process gases (e.g., silane, which is pyrophoric) or compounds that would react within the ductwork creating fire/explosion risk or plugging the ductwork over time. However, like POUs, thin films PEECs are tool-level thermal oxidation systems, that will oxidize organic compounds used in thin films or plasma etch processes into CO_2. Some of these compounds may also be expected to generate CH_4 as a byproduct.

Micron has determined that centralized RCS are feasible to replace POUs to control F-GHGs in some cases. These units will combust natural gas but will require less fuel than POUs to accomplish equivalent destruction of F-GHGs.

As described in more detail in the emission calculation description in Appendix B, all carbon-based compounds that enter a tool-level thermal oxidation system, RCTO, or RCS are assumed to oxidize fully to CO_2 as a conservative assumption in addition to forming other potential carbon-containing byproducts. To ensure a conservative estimate of emissions, it is assumed that 100% of the carbon, nitrogen, or sulfur atoms in each primary chemical that are present in the exhaust are emitted as CO_2, NO_X, or SO_X, respectively. By also assuming that 100% of carbon, nitrogen, and sulfur, respectively, in each GHG primary chemical is converted into the oxidation byproducts in addition to other carbon, nitrogen, or sulfur containing emission chemicals, more than 100% of the carbon, nitrogen, or sulfur atoms from each GHG primary chemical is assumed to be emitted.

2.1.3 Fuel Combustion

The Micron Campus includes several types of equipment that will combust either diesel fuel, or natural gas. Thermal oxidation systems, RCTOs, and RCS will combust natural gas, and byproducts of combustion will exhaust alongside other unreacted process GHG emissions. Water bath vaporizers will combust natural gas to heat baths of water through which pipes of liquid nitrogen will flow to be vaporized for use. Natural gas-fired boilers will provide heat during construction when electricity is not available and as needed for supplemental fab heat recirculation systems during cold weather. Diesel fuel-fired emergency generators will provide backup power for the Micron Campus. A diesel fuel-fired emergency fire pump engine will operate as a backup to an electric fire pump. Maintaining fossil fuel powered emergency equipment is required to be protective of health and safety during an interruption to electricity supply.

In addition to natural gas-fired boilers, Micron will utilize electric boilers to supplement fab heat recirculation systems during cold weather. Micron will prioritize operating electric boilers before operating natural gas-fired boilers. Natural gas-fired boilers will only be utilized if the electric boilers fail to provide sufficient heat to overcome the heat differential between the exterior temperature and the interior of the fab; however, Micron does not expect this to be a common occurrence.

2.1.4 Heat Transfer Fluids

Process chillers are utilized in certain process tools to prevent equipment from overheating. These chillers use engineered HTFs, which transfer energy efficiently without undergoing a refrigerant phase change cycle which distinguishes these HTFs from refrigerants regulated by 40 CFR Part 82. The HTFs used may include fluorinated fluids, which may result in fugitive GHG emissions. These emissions are generated in a fugitive manner inside of the fab but are included in air permitting emissions calculations and this analysis since HTFs will exhaust from stacks alongside other process emissions.

2.1.5 Biological Wastewater Treatment

The BIO buildings will use aerobic biological treatment processes to destroy organic compounds in wastewater. These digestion processes will result in the formation of CO_2 from various organic compounds. The Oak Orchard IWWTP will also use aerobic biological treatment processes to destroy organic compounds in wastewater. It is assumed that the remaining organic compounds in the effluent from the Micron Campus will undergo aerobic digestion into CO_2 at the Oak Orchard IWWTP.

2.1.6 Circuit Breakers

Micron plans to install circuit breakers rated at 38 kV and 420 kV at the Micron Campus. SF_6 is the primary insulating medium used in electric switchgear, and since it is a GHG, any potential leaks would result in GHG emissions. Micron acknowledges that this Project is subject to and there must comply with the requirements set forth in 6 NYCRR Part 495 and, as part of its ongoing commitment to sustainability, remains committed to evaluating and pursuing lower GWP alternatives, when available. Micron also intends to use air-insulated circuit breakers rated at 15k kV and below which will not emit GHGs.

2.1.7 Oak Orchard IWWTP Combustion

OCDWEP is in the early stages of planning and designing the Oak Orchard IWWTP, and therefore Micron is not aware of specific plans for combustion equipment at this location. It is assumed that the Oak Orchard IWWTP will need to be supported by combustion equipment, including a boiler and four emergency generators that are assumed to be identical to those proposed on the Micron Campus. However, this analysis includes these estimates for the sake of a conservative, complete CLCPA analysis. Emissions are quantified for these theoretical combustion sources, but alternatives and mitigation measures are not evaluated. OCDWEP, as the owner and operator of the Oak Orchard IWWTP, will be responsible for obtaining all relevant authorizations for appropriate combustion equipment.

2.2 GHG Emissions Analysis

This section provides an analysis of the potential GHG emissions from long-term operations stationary sources at the Micron Campus planned for the Proposed Project.

2.2.1 Greenhouse Gases Emitted

As discussed above, several GHGs will be emitted from the Micron Campus in addition to typical products of combustion. A complete list of GHGs that will be emitted and their GWP on a 20-year basis is provided in Table 2-1 below. 20-yr GWP values based on the IPCC Fifth Assessment Report (AR5) unless indicated otherwise.

The value for Hexafluorobutadiene (listed as perfluorobuta-1,3-diene) is listed as "<1" in IPCC AR5 and is conservatively assumed to be equal to 1. Values presented in IPCC AR5 align with values encoded in 6 NYCRR 496.

In addition to the GHGs presented in Table 2-1, several HTFs will be used at the Micron Campus. The identities of these HTFs are considered confidential business information. These HTFs are discussed in the confidential copy of Micron's air permit application.

Table 2-1. GHG Emitted and their 20-Year GWP

CAS #	Chemical Name	Alternate Name(s)	Molecular Formula	GWP (20-yr)
124-38-9	Carbon dioxide	--	CO_2	1
74-82-8	Methane	--	CH_4	84
10024-97-2	Nitrous oxide	--	N_2O	264
75-10-5	Difluoromethane	HFC-32	CH_2F_2	2,430
593-53-3	Fluoromethane	HFC-41	CH_3F	427
75-73-0	Tetrafluoromethane	PFC-14	CF_4	4,880
76-16-4	Hexafluoroethane	PFC-116	C_2F_6	8,210
75-46-7	Trifluoromethane	HFC-23	CHF_3	10,800
115-25-3	Octafluorocyclobutane	PFC-318	C_4F_8	7,110
685-63-2	Hexafluorobutadiene	--	C_4F_6	1
7783-54-2	Nitrogen trifluoride	--	NF_3	12,800
2551-62-4	Sulfur Hexafluoride	--	SF_6	17,500

2.2.2 Quantification of Greenhouse Gases

2.2.2.1 Emission Calculation Methodologies

For all GHG sources at the Proposed Project, the potential-to-emit (PTE) CO_2e emissions were calculated on a 20-year GWP basis using GWPs listed in Table 2-1, along with several HTFs evaluated in Micron's air permit application considered confidential business information as described above. Upstream emissions were quantified using emission factors published by the NYSDEC in the 2024 NYS Statewide GHG Emissions Report, Table A1.[11] A detailed description of the calculation methodologies used to calculate GHG emissions is included in Appendix B to this CLCPA analysis.

DAR-21 indicates that an analysis of projected actual GHG emissions should be included in a CLCPA analysis. While Fab 1 is projected to begin operations in 2029, Micron cannot predict with any accuracy how actual emissions starting in 2029 will compare to potential emissions based on currently available information. Therefore, consistent with Micron's air permit application, PTE is based on conservative

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[11] Emission Factors for Use by State Agencies and Applicants, Appendix A to the 2024 NYS Statewide GHG Emissions Report, Table A1,

assumptions, including material use, hours of operation, and other factors and as a result, Micron expects that the PTE presented in its air permit application will be greater than actual emissions beginning in 2029. Micron will track, calculate, and report its actual GHG emissions once operational as part of any identified federal and state requirements and will revise its air permit if appropriate based on actual monitoring data.

2.2.2.2 Pre-Mitigation and Pre-Alternatives Emissions

The estimated emissions of GHGs for long term operations of permitted process-related stationary sources at the Micron Campus is summarized in Table 2-2 below. These values reflect the operation of all four fabs and do not incorporate proposed process mitigation and alternative measures. Note these emissions are not realistic of true operations of the Proposed Project. As such, please refer to the quantified emissions reductions from implemented mitigation and alternative measures in Tables 6-4, 6-5, and 6-6.

Table 2-2: Micron Campus Long Term Operations Stationary Sources GHG Emissions – Pre-Mitigation and Pre-Alternatives

Emission Source	Direct CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total PTE CO_2e (20-yr) (tpy)
F-GHGs and N_2O Used in Thin Films	636,933	-	636,933
F-GHGs Used in Plasma Etch	187,146	-	187,146
Direct use of CO_2 and CH_4	4,060	-	4,060
Byproducts of Thermal Oxidation of Process Gases	59,463	-	59,463
Fuel Combustion in PEECs, POUs, and RCS	390,649	297,322	687,971
Fuel Combustion in RCTOs	315,320	239,989	555,308
Fuel Combustion in WBVs	708,538	541,112	1,249,650
Fuel Combustion in Boilers	4,370,684	3,337,897	7,708,581
Fuel Combustion in Emergency Generators	82,512	26,117	108,628
Heat Transfer Fluids	254,094	-	254,094
Fuel Combustion in Fire Pump Engine	52	17	69
Biological Wastewater Treatment (Micron Campus and Oak Orchard IWWTP)[1]	182,294	-	182,294
Circuit Breakers	7,017	-	7,017
Oak Orchard IWWTP Combustion	18,299	2,995	21,295
Total	**7,217,062**	**4,445,448**	**11,662,509**

2.2.3 Project GHG Alternatives Analysis

DAR-21 requires projects that result in an actual or potential increase in GHG emissions to discuss the technical and economic feasibility of any alternatives or mitigation measures (DAR-21 Section V.C.6). As a new facility, the Proposed Project would increase both potential and actual GHG emissions through the construction of new air emission sources. Therefore, a detailed discussion of potential alternatives to each type of GHG emission source planned as part of the Proposed Project is provided below. Potential mitigation measures are discussed in Section 2.2.4.

The Micron Campus is a new major source of VOC and GHG (among other contaminants not included in the scope of a CLCPA analysis). As such, a VOC Lowest Achievable Emission Rate (LAER) analysis and a GHG BACT analysis have been conducted as part of the air permit application. In certain cases, the determination of VOC LAER or GHG BACT may affect reasonable alternatives and/or mitigating measures as described in this CLCPA Analysis.

2.2.3.1 GHGs Used as Raw Materials and Process Gases

As described in Section 2.1, F-GHGs and other GHGs serve a critical function in the semiconductor manufacturing process. A portion of GHG emissions from the Micron Campus will be generated as a result of using GHGs as raw materials for manufacturing processes. Potential alternatives to using these chemicals as raw materials are discussed below.

F-GHGs and N_2O Used in Thin Films Process Tools

In thin films process tools, N_2O is used with silicon-containing gases to deposit a layer of silicon dioxide creating an electrical insulator. F-GHGs are used for cleaning process tool chambers between deposition operations. Both uses are described further in this section. When F-GHGs and N_2O are used, their utilization is expected to be less than 100%, and some of the gas used will be emitted directly. Other F-GHGs may also be emitted as byproducts of F-GHGs used.

Fluorine can be generated through the plasma cracking of NF_3 and may be used directly as F_2 for cleaning process tools. Although not a GHG itself, F_2 can react with natural gas used for thermal oxidation in a thermal oxidation system to form CF_4, which is a GHG.

Nitrous Oxide as an Oxidizing Agent

Nitrous oxide is a critical raw material used when creating an insulating silicon dioxide layer on a wafer. At this time, Micron has not identified any alternatives to the use of N_2O to complete the thin films processes and is not aware of any technically viable alternatives for this process. Micron will continue to evaluate opportunities to use lower GWP materials in its manufacturing processes.

Thin Films Chamber Cleaning

Chamber cleaning is a critical step in thin films processes, as ions leftover on the walls of the chamber can contaminate the next wafer processed if not removed. The NF_3 remote chamber cleaning process is one of three main types of chamber cleaning processes commonly used to clean chamber walls using fluorine ions. The name "remote clean" refers to the fact that NF_3 is cracked into N_2, F_2, and F^- in a pre-chamber before entering the process chamber to be cleaned. Nitrogen trifluoride may also be used in "in-situ" or "thermal" cleaning, in which the NF_3 is introduced into the process chamber before being cracked into N_2, F_2, and F^-, either due to a plasma environment or high temperature. Carbon-based fluorinated GHGs can also be used for "in-situ" cleaning, including hexafluoroethane (C_2F_6).

In-situ chamber cleaning using fluorocarbons has historically been the industry standard practice, until cleaning using NF_3, either remote or in-situ, was introduced for the purpose of reducing GHG emissions from the chamber cleaning process. In addition, thermal cleaning is used on an as-needed basis in a small percentage of process tools. When compared to fluorocarbons, using NF_3 for chamber cleaning reduces the time required to fully clean the chamber, allowing less downtime between manufacturing steps. Using remote cleaning is more efficient than using in-situ or thermal cleaning, since the utilization of NF_3 is much greater when it is cracked in advance of entering the chamber. As much as 99% of NF_3 used can be separated remotely, while the C_2F_6 in-situ process typically only utilizes about 50% of the clean gas. GHG emissions from chamber cleaning are decreased when more of the cleaning gas is destroyed before even entering the chamber.

For these reasons, NF_3 remote clean is the preferred chamber clean technology for both maximizing manufacturing efficiency and minimizing GHG emissions intensity. Micron has largely reduced in-situ cleaning and thermal cleaning in other United States production facilities and plans to use the NF_3 remote chamber cleaning process as much as possible in its operations at the Micron Campus.

As an alternative to use of NF_3 to create fluorine ions, F_2 gas could be used directly for chamber cleaning. Although this would eliminate the use of the GHG (NF_3), it would create on-site and potentially off-site safety issues. The hazard of F_2 gas is illustrated by the 1,000 pound (lb) threshold quantity (TQ) (40 CFR 68.130(b)) that would trigger potential requirements under the Risk Management Program (RMP) under U.S. EPA's Chemical Accident Prevention Provisions (40 CFR, Part 68). Only two compounds on the list have a lower TQ, further illustrating the hazard of storing fluorine on-site. Fluorine is also regulated under the Occupational Safety and Health Administration's (OSHA's) Process Safety Management (PSM) (29 CFR 1910.119) program, which also designates an applicability threshold of 1,000 lbs (29 CFR 1910.119, Appx. A). The Micron Campus intends to use over 2 million lb/yr of NF_3, which would equate to over 1.6 million lb/yr direct use of F_2 gas to replace NF_3 assuming 100% conversion to F_2 in the chamber clean. On average, this would require more than 1,000 lb/day use, which would require more than 1,000 lb storage on site. Under this scenario, the Micron Campus likely would be subject to RMP and PSM for F_2 gas, which presents potential risks that Micron aims to avoid. Due to its extreme toxicity with an Immediately Dangerous to Life or Health (IDLH) value of 25 ppm, extreme corrosivity, and reactivity as a potent oxidizer, the use F_2 gas further presents significant direct worker health and safety concerns Micron additionally aims to avoid.

Where using NF_3 is infeasible, such as on process tools that are not capable of sustaining a plasma environment, Micron intends to use small amounts of F_2 directly (usually mixed with nitrogen). However, due to the safety risks posed by storing and using large quantities of F_2, the direct use of F_2 is not a reasonably feasible alternative to NF_3 for all chamber cleaning. Therefore, Micron plans to use F_2 gas directly in small quantities supplied in cylinders containing a gaseous mixture of ~20% F_2 and 80% N_2. Large scale delivery of these cylinders to obtain the amount of F_2 that would be required to completely replace NF_3 for chamber cleaning would be impractical.

Finally, F_2 gas could potentially be generated onsite for use, but this process has not been proven at a large scale in the United States and would pose its own safety concerns and space constraints.

Although NF_3 remote cleaning results in significantly reduced emissions of GHG when compared to in-situ clean technologies, any F_2 produced remotely that is not used in the cleaning process in the chamber may react with natural gas in a PEEC to generate emissions of CF_4. The magnitude of these emissions (as CO_2e) is not great enough to negate the benefits of using NF_3 remote clean rather than in-situ clean. As indicated in the IPCC 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (the "2019 Refinement"),[12] these CF_4 emissions can be avoided if using PEECs specifically designed by the manufacturer to limit the amount of F_2 that reacts with CH_4 in natural gas to less than 0.1% of the total F_2 entering the thin films PEEC.

Micron intends to purchase thin films PEECs that are certified to reduce these CF_4 emissions and is including CF_4 emissions from this process in the Micron Campus emission calculations as a conservative measure since specific suppliers have not yet been identified. Micron cannot ensure that suppliers will, in all applications, be able to certify PEECs in this manner while meeting the performance obligations required to maintain safe operation of the fab. That being said, Micron will consider certification to minimize CF_4 formation when selecting PEEC vendors and proposes to comply with a permit condition requiring documentation of this selection process.

In summary, Micron has identified that using the NF_3 as a chamber cleaning gas and using it in the remote plasma cleaning process is viewed as a more favorable and appropriate alternative, where feasible, than other chamber cleaning gases and technologies. In addition, Micron will obtain thin films PEECs that are equipped with burners designed to minimize CF_4 formation from F_2 generated from NF_3 remote plasma cleaning where feasible. These efforts will combine to reduce GHG emissions from the Micron Campus.

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[12] IPCC 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 6: Electronics Industry Emissions, pg. 6.29.

F-GHGs Used in Plasma Etch Process Tools

Plasma etch process tools create an ionized gas (or plasma) that utilizes F-GHGs as a source of fluorine ions, which react with silicon or metal ions on a wafer to remove, or etch, specific areas of the wafer. Micron plans to use an array of several different F-GHGs in plasma etch tools, each fulfilling a specific purpose in the manufacturing process. F-GHGs can either fully or partially dissociate in the plasma environment, and the exhaust from these tools will be routed through POU control devices or RCS resulting in emissions of several different GHGs for each etch gas used.

At this time, there is no technically feasible alternative to replace F-GHGs as etch gases in the semiconductor industry. The Semiconductor Industry Association (SIA) has noted that the unique structural stability and chemical properties contribute to the usefulness of fluorocarbon compounds (including F-GHGs) and that developing and implementing substitutes for these materials could take several years, if not decades.[13] Furthermore, fluorine is one of the few materials that has the capability to convert solid silicon to a gaseous form allowing precise removal of portions of the silicon-based wafer.

Etch gases are useful for a specific application, as the structure of each F-GHG used determines the affinity of the fluorine ion to chemicals/elements on the wafer to be etched. Since this process is performed on a nanometer scale, the properties of the etch gas are critical to ensuring that the desired geometry is achieved in a precise fashion. Therefore, the etch gas must be carefully selected to ensure the proper function in the etching process.

Although Micron is not able to replace F-GHGs as etch gases at this time, Micron is actively working to increase the number of unique F-GHGs chemicals it has at its disposal to achieve certain goals in the plasma etch process. The F-GHGs that are projected to be emitted from the Micron Campus, as shown in Table 2-1 above, have a range of GWP values. The more etching process gas options available, the more feasible it may become to reduce the average GWP of etch gases used.

Direct use of Carbon Dioxide and Methane

Methane is projected to be used as an additive in the plasma etch process. Methane is used in such small quantities as a minor component of mixtures of etch gases that it is difficult to identify alternatives to its use. Its estimated usage quantity and its GWP is so low compared to the other GHG etch gases such that replacing it with another chemical would not materially impact the GHG emissions of the Micron Campus.

Carbon dioxide will be used in the wet cleaning process as a supercritical fluid. In this state of matter, its unique properties are challenging to replace with any known alternatives. When cleaning wafers, it is imperative that the material used to clean does not interfere with the structure or function of the wafer itself. Supercritical CO_2 is used since it creates no surface tension on the wafer and therefore can evaporate

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[13] "Comments of the Semiconductor Industry Association (SIA) on Draft PFAS Legislation of the Senate Environment and Public Works (EPW) Committee, July 14 2023", accessed February 3, 2024, https://www.semiconductors.org/wp-content/uploads/2023/07/SIA-Comments-on-EPW-Draft-PFAS-Legislation-7_14_23.pdf

without impacting the wafer. Micron has not identified an alternative cleaning agent that would provide similar performance.

2.2.3.2 Thermal Oxidation Byproducts

Carbon dioxide and CH_4 are emitted as a result of combustion of process chemicals in POU control devices, thin films PEECs, RCTOs, and RCS. Most semiconductor processes exhaust or are conditioned through one of these devices, and therefore CO_2 emissions are generated. Certain chemicals are assumed to form CH_4 through use and decomposition in the semiconductor manufacturing process and as a result of their molecular structure.

PEECs are necessary to mitigate safety concerns (e.g., reactive and pyrophoric gases) associated with exhaust streams from thin films process tools, such that any CO_2 or CH_4 emissions are a necessary result of achieving important safety goals. The formation of CO_2 in POU control devices and RCS is a desirable outcome of oxidation as the GWP of CO_2 is significantly less than typical F-GHGs used in etching. Therefore, it is preferrable to combust F-GHGs with natural gas than to release them directly to atmosphere. In addition, the use of thermal oxidation systems has been identified as BACT for mitigating GHG emissions for the Micron Campus.

RCTOs are the industry standard technology to reduce VOC emissions from manufacturing processes that use solvents. In those cases, the formation of CO_2 or CH_4 is a necessary result of reducing emissions of VOC, which is an ozone precursor. With the entire state of New York in the Ozone Transport Region (OTR) and considered to be in nonattainment for ozone, reducing emissions of VOC is a primary objective to maintain or improve local air quality. In addition, the use of RCTOs has been identified as technology that will achieve the LAER for VOCs for the Micron Campus.

Besides the overall benefit of emitting CO_2 and CH_4 rather than higher-GWP F-GHGs and VOC, the CO_2 and CH_4 emissions generated in this manner that are projected from the Proposed Air Permit Project will be substantially less than GHG emissions from other sources, as demonstrated in Table 2-2. For these reasons, Micron has determined that the use of these combustion devices is necessary and has not identified any alternatives to generating CO_2 and CH_4 from organic process chemicals in POUs, thin films PEECs, RCTOs, or RCS. Alternatives to combusting natural gas in these devices are discussed below.

2.2.3.3 Fuel Combustion

Different types of equipment planned for the Micron Campus will utilize natural gas or diesel fuel. A possible alternative to fossil fuel-fired equipment is electrically heated equipment. Electricity as a heat source is considered as an alternative for each equipment type discussed below. In addition, other alternatives, such as plasma-generating technology, are considered on a case-by-case basis for certain types of equipment as necessary.

Another potential fossil fuel alternative is using hydrogen gas as a fuel source. Micron continues to evaluate the opportunity to use hydrogen as a fuel source and is collaborating with NYSERDA for assistance in considering the implementation of hydrogen-fueled equipment as part of the Micron

Campus. Micron is also continuously conducting market research to assess the current availability and viability of hydrogen-fueled equipment in the industry. At this time, increased infrastructure to transport hydrogen or generate and store hydrogen at the Micron Campus would be required for any hydrogen-fueled equipment to be technically feasible. In addition, hydrogen combustion is difficult to control due to its variable flammability, and several types of planned combustion equipment, including POU control devices and RCS, need to undergo testing to determine compatibility with hydrogen. Storing and/or handling hydrogen in larger quantities would also present an increased safety risk.

Micron is also reviewing additional alternative fuels, such as green ammonia and biomethane. However, further research and testing on equipment would be required to demonstrate the feasibility of these alternative fuels. Like green hydrogen, green ammonia would require additional infrastructure for transportation and/or storage to be feasible.

Micron will continue to evaluate the feasibility of these technologies over the lifetime of the Proposed Project.

Thermal Oxidation Systems

Thermal oxidation systems planned for the Micron Project include thin films PEECs to manage process gases to render them less hazardous POU control devices used to control air emissions. These thermal oxidation systems commonly include a burner component in series with a wet scrubber component and are therefore referred to as “burn-wet” style systems. Potential alternatives to thermal oxidation systems are discussed below.

Plasma-Based Oxidation

One potential alternative to a burn-wet style oxidation system is an electrically powered “plasma-wet” oxidation system. Instead of using natural gas combustion to oxidize exhaust, plasma-wet oxidation systems create a plasma environment in which these molecules in the exhaust can dissociate.

Micron is currently evaluating installing plasma-wet units in place of burn-wet POUs and is undergoing testing that will inform the ultimate decision. Micron is planning to install plasma-wet POUs as part of the Micron Campus, pending favorable test results demonstrating performance equivalent to or exceeding that of burn-wet POUs. Burn-wet POUs are being considered part of the “as-permitted” design to conservatively estimate natural gas consumption.

Micron is also evaluating installing plasma-wet thin films PEECs, however, the plasma technology is less proven for use in conjunction with the thin films tools exhausting to PEECs than it is with the plasma etch tools routing to POUs. One of the main compounds generated in thin films tools that PEECs are intended to manage is F_2. In a burn-wet style oxidation system, F_2 is efficiently converted into hydrogen fluoride (HF) in the burner, which is then removed in the second stage of the system. F_2 gas itself is not effectively dissolved into water, so it must be managed in the burner in order to be removed from the exhaust to prevent safety issues. In a plasma-wet PEEC, there is a lack of free hydrogen ions in the plasma environment as compared to the combustion zone of a burn-wet PEEC. Therefore, F_2 is not as easily converted to HF, and can linger in the exhaust at the outlet of the system and be emitted.

For this reason, plasma-wet style thin films PEECs are not considered a feasible alternative to burn-wet style thin films PEECs for the Micron Campus at this time.

Electric Oxidation

Thermal devices that use electricity to heat exhaust streams to temperatures suitable for oxidation are another potential alternative to burn-wet oxidation systems. However, the same concerns with using plasma-wet thin films PEECs, such as reduced ability to mitigate F_2 in the exhaust and high electricity demand, apply to electric-powered thermal thin films PEECs. Electric-powered thermal thin films PEECs are not considered a feasible alternative to burn-wet style thin films PEECs for the Micron Campus.

Catalytic Oxidation

Micron has determined that centralized RCS are feasible to replace burn-wet POUs in many cases. F-GHGs used in plasma etch tools will be abated in an RCS when feasible, and in other cases, plasma-wet POUs will be evaluated for use in place of natural gas-fired POUs, reducing GHG emissions associated with natural gas combustion. Each RCS will be equipped with a small natural gas-fired burner to preheat the exhaust stream before entering a catalytic oxidizer, but the oxidation of the F-GHG will be promoted by the catalyst, requiring much less natural gas overall. Far fewer RCS will be required than burn-wet POUs to achieve the same level of reduction of process GHG emissions from plasma etch tools. Currently, Micron plans to install ten (10) RCS in each fab, as opposed to dozens, if not hundreds, of burn-wet POUs. The fewer number of RCS required and reduced reliance on natural gas usage due to the catalytic technology together represents an opportunity to reduce GHG emissions from natural gas combustion while effectively mitigating F-GHG emissions.

An RCS is not a technically feasible alternative to POU control devices for a minority of plasma etch tools that etch metal substrates, known as metal etch tools. Exhaust from metal etch tools can generate metal oxide particulate matter in ductwork, which would foul the catalytic oxidation portion of an RCS unit. Plasma-wet POUs are being evaluated for this set of tools, but it is conservatively assumed that burn-wet POUs will be installed on these tools.

Rotor Concentrator Thermal Oxidizers

RCTOs are planned to be used as the primary control device for VOC emissions from the Micron Campus and have been determined to achieve the limits Micron is proposing as LAER for VOC control for semiconductor process operations, which is a critical determination in the context of limiting GHG emissions while limiting VOC emissions within the OTR. RCTOs operate by concentrating VOCs in an exhaust stream through adsorption onto a zeolite rotor (or rotors) and desorption into a heated, much lower flowrate stream that is then thermally oxidized. This design inherently requires less natural gas than a traditional thermal oxidizer would, as the volume of exhaust required to be oxidized is minimized by concentrating the pollutants of concern using the zeolite wheel and provides more supplemental heat through exothermic reaction of higher concentration VOCs. In addition, collecting all solvent exhaust into common headers to be routed to RCTOs requires less natural gas than if each individual process tool was equipped with its own thermal oxidation system. Put simply, RCTOs reduce VOC emissions from high flowrate, low VOC concentration exhaust streams using as little natural gas as possible and taking advantage of the heating value provided by the organics in the exhaust as much as possible.

Water Bath Vaporizers

Water bath vaporizers are used to vaporize streams of liquefied nitrogen before entering the fab to be used. A bath of hot water is used to vaporize nitrogen and is heated through natural gas combustion. These are used for emergency purposes only when waste heat from the fab is not available. Micron does not anticipate that these units will need to be operated on a regular basis.

When these units are required, the water bath must be able to reach a temperature suitable to vaporize the nitrogen as quickly as possible. Electrically operated units would be unable to reach a required temperature quickly enough to satisfy the fab demand for nitrogen. Therefore, electrically heated water bath vaporizers are not considered a feasible alternative to natural gas-fired water bath vaporizers for the Micron Campus.

Boilers

Boilers will be required for the Micron Campus during construction and startup activities, and as needed to supplement fab heat recirculation during the colder months of the year. Micron has explored the use of geothermal heat to offset fossil fuel use but has determined it is not a practical solution at this time. Geothermal heat sources do not provide consistent temperatures needed for high-temperature industrial processes.

Micron plans to satisfy the demand for heat by reusing heat generated by the fab, to the extent possible, minimizing the need for boilers. Self-sufficient heating can be achieved in part by ensuring that optimal cleanroom temperatures are maintained. Heat recovery pumps will also be considered to reuse waste heat from process tools.

Micron will use electric boilers to the extent possible to meet the remainder of its heating demand. However, Micron will still require natural gas-fired boilers to be available on the coldest days of the year and in the event of a loss of power.

Emergency Generators

The operations of the Micron Campus will require a significant amount of electricity from the grid and will need appropriate backup power sources in the event of a grid outage. Micron plans to install state-of-the-art diesel fuel-fired emergency generators compliant with Tier IV emission standards.

No technically feasible alternative exists that would result in lower GHG emissions when operating to match the reliability provided by these emergency generators. Micron has considered installing larger natural gas-fired combustion turbines, larger natural gas-fired engines, dual fired engines, natural-gas fuel cells, and methane fuel cells to replace diesel engines in providing emergency power. All of these alternatives require a greater amount of time to start up than diesel engines, and in the case of combustion turbines, could have significantly higher emissions during startup and shutdown events. In addition, natural gas, which would power these alternatives, is not guaranteed to be available in the event of an emergency, unlike diesel fuel stored on site. In addition, National Fire Protection Agency (NFPA) codes require uninterrupted power supply, which cannot be accommodated by natural gas-fired combustion turbines, natural gas-fired engines, dual-fired engines or methane fuel cells. Many of these alternatives would be feasible for continuous operation, but not for the immediate and intermittent emergency response required in this application.

As part of Micron's air permit application, the NYSDEC requested that Micron evaluate hydrogen-fueled equipment and renewable energy generation paired with battery storage as alternatives to diesel engines . Hydrogen-fueled equipment is not yet feasible due to both supply chain deficiencies and the stage of development of the technology. Infrastructure is not yet readily available to provide a steady supply of hydrogen to the Micron Campus in a way that would ensure reliability during emergencies. In addition, hydrogen is less energy dense than other fuels, and its combustion is more difficult to control. Micron is aware of pilot tests underway studying hydrogen combustion for emergency use but has no assurance that the technology would be reliable when needed.

Battery storage of power for emergency use is not feasible on the Micron Campus largely due to space constraints and lack of supply of large scale batteries in the market. Batteries would have to be significant in size to satisfy the power demand needed during an emergency and any additional footprint due to battery storage would risk additional impacts to on-site wetlands. Even if size could be accommodated, battery storage cannot provide the sustained power supply needed to ensure safety through the duration of an emergency. This request would ultimately create a tradeoff of impacting additional on-site wetlands in return for large batteries that only increase safety risks and do not accommodate the power supply of the facility. Additionally, National Fire Protection Agency (NFPA) codes require uninterrupted power supply, which cannot be accommodated by batteries and poses significant risk to power loading if switching between batteries to emergency generators. Therefore, Micron is not pursuing battery storage at this time.

In an emergency event, Micron must have the option that is the quickest to start up and provides the most reliable sustained power supply due to the need for ensuring safe shutdown of fab tools. Micron has determined that this option is diesel engines. Micron has also considered a secondary power supply that could come online in place of diesel engines after their initial startup in the event of an emergency. The logistical challenges associated with this design were determined to be prohibitive to its implementation for many of the same reasons described above.

Emergency Fire Pumps

Micron will use electric fire pumps as its primary means of fire water distribution, a favorable alternative to diesel fuel-fired fire pumps. Still, Micron will require one (1) diesel fuel-fired emergency fire pump per 2 Fabs for a total of two (2) total diesel fuel-fired emergency fire pumps across the entire Micron Campus that can operate in the event of a fire during a loss of power. Other than periodic testing, these diesel emergency fire pumps will not operate unless the electric fire pumps are unavailable.

2.2.3.4 Heat Transfer Fluids

HTFs are used to regulate the temperature of semiconductor process tools and are a necessary component of safe and effective manufacturing in the industry. Historically, fluorinated fluids have been used as HTFs in the semiconductor industry due to their unique chemical and physical properties. Micron is actively evaluating and incorporating alternative HTFs with lower global warming potentials into its operations. While Micron remains committed to reducing GHG emissions, for conservatism, high-GWP HTFs have been assumed in the design and included in the air permit application and CLCPA analysis calculations. Micron plans to submit permit modifications as lower GWP alternatives are adopted. Minimizing the GWP of HTFs used is a core component of Micron's global sustainability goals and therefore Micron is continuously evaluating the opportunities to replace HTFs with lower GWP alternatives that have equal technical capabilities. Lower GWP HTFs are currently being developed for implementation, but the speed of development and implementation is limited by technical and regulatory challenges. For example, pursuant to the Toxic Substances Control Act (TSCA), U.S. EPA must review and approve any new chemical compounds manufactured or imported into the U.S. (including new HTFs) via the Premanufacture Notification process or similar approvals (e.g., Significant New Use Requests). Typically, HTFs are fluorinated compounds, a class of chemicals that has been under intensifying scrutiny by the U.S. EPA in recent years. A Premanufacture Notice (PMN) for a new fluorinated chemical triggers U.S. EPA review that can take over a year to complete. To reduce GHG emissions from HTF, Micron is continuing to make improvements like use of new connection hardware between process tools, chillers and other equipment, increasing efficiency of HTF usage.

At this point, Micron cannot determine the specific HTFs that will be used as part of the Micron Campus operations, in part due to pending PMN processes for chemicals it is evaluating. Usage of traditional HTFs is projected based on current operations at other Micron facilities. Any technically feasible alternatives available will be considered throughout the design process to optimize the combination of HTF performance and the GWP of HTFs used. Throughout the life of the Micron Campus, Micron will reassess the available HTFs and consider if lower GWP alternatives are viable.

2.2.3.5 Biological Wastewater Treatment

Wastewater from the fabs at the Micron Campus will undergo biological treatment at both the BIO buildings on the Micron Campus and the Oak Orchard IWWTP. GHG emissions from these processes were conservatively estimated assuming that all carbon present in the wastewater is digested. As Micron will pursue only aerobic digestion, the emissions estimates are based on aerobic digestion of organic compounds, leading to the formation of both CO_2 and CH_4. The choice of aerobic digestion compared to anaerobic digestion will minimize the CH_4 generated. Therefore, Micron will implement a favorable alternative for biological wastewater treatment on a CO_2e basis.

2.2.3.6 Circuit Breakers

In December 2024, the NYSDEC adopted 6 NYCRR Part 495, Sulfur Hexafluoride Standards and Reporting (Part 495), which includes a program to phasedown the use of SF_6 in gas insulated equipment used by the electricity sector, an emissions limit for gas insulated equipment owners, limitations on the use of SF6, and reporting requirements for certain users and suppliers of SF_6 and other F-GHGs. Part 495 sets a periodic phase out plan for SF_6 gas insulated equipment starting January 1, 2027, for equipment rated less than 38kV and continuing through January 1, 2033, for equipment rated above 245kV. The delayed phase out of high voltage equipment aligns with the determination made at the time of Micron's air permit application, submitted March 8, 2025, that alternative insulating mediums are not technically feasible. Micron is working closely with Original Equipment Manufacturers to perform feasibility studies as soon as one becomes available. Micron will continue to evaluate SF_6 alternatives available in the future and will comply with the applicable phase out requirements.

2.2.4 Project GHG Reduction Measures

In the sections above, Micron has evaluated potential alternative equipment and technologies to reduce GHG emissions from the Micron Campus. For cases where Micron has determined that no technically feasible alternatives exist, mitigation must be undertaken at the project site or in the surrounding community whenever possible. As such, Micron has considered additional mitigation measures that could reduce GHG emissions in ways other than replacing the equipment or technologies that result in emissions of GHGs.

2.2.4.1 GHGs Used as Raw Materials and Process Gases

As discussed in section 2.2.3.1, Micron is continuously evaluating potential alternatives to GHGs used as raw materials and process gases in its manufacturing processes, but the highly specific demands of semiconductor manufacturing make it extremely difficult to identify replacement materials in all cases.

F-GHGs and N_2O Used in Thin Films Process Tools

Potential mitigation measures for processes identified in Section 2.1.1.1 are included in this section.

Nitrous Oxide as Oxidizing Agent

Emissions of N_2O are reduced by thermal oxidation in thin films PEECs. The quantity of N_2O used to form layers on wafers is dictated by the wafer size, extent of oxidation required, and other process parameters such that it cannot easily be decreased for the sole purpose of reducing GHG emissions. Although Micron is continuously evaluating opportunities to optimize use of GHG process gases, no other viable mitigation measures have been identified.

Thin Films Chamber Cleaning

The NF_3 remote chamber cleaning process that Micron plans to use in most cases is designed to maximize the utilization efficiency of the cleaning gas, NF_3, and minimize GHG emissions from thin films tools. It is a preferred alternative to in-situ cleaning and thermal cleaning because less CO_2e is released from the chamber following the cleaning process. No additional mitigation measures have been identified.

F-GHGs Used in Plasma Etch Process Tools

The use of POU control devices and RCS to control exhaust from plasma etch tools that use F-GHGs mitigates emissions of F-GHGs by oxidizing the F-GHGs into acid gases, carbon dioxide (if the GHG is carbon based), and non-GHG gases. Oxidation has been demonstrated as the most suitable mitigation measure for these gases and has been determined to be GHG BACT for the Micron Campus. As part of meeting BACT, POUs and RCS will be maintained according to work practice standards required to certify that default destruction and removal efficiency (DRE) values are achieved according to the IPCC.[14]

General Mitigation of GHG Emissions from Raw Materials and Process Gases

Micron strives to increase utilization efficiency as much as possible for all chemicals and gases used at its facilities. Minimizing the amount of raw materials and process gases used reduces operational costs and assists Micron to achieve its overall sustainability goals by reducing releases of potential air contaminants, water contaminants, and generation of waste. For certain GHG process gases, such as supercritical CO_2, there have been no alternatives or mitigation measures identified other than efficient use of the material by properly maintaining and operating equipment and implementing other good manufacturing process measures.

2.2.4.2 Thermal Oxidation Byproducts

The Micron Campus will result in emissions of CO_2 and CH_4 as a result of thermal oxidation of process materials. These emissions are generated as a result of necessary safety measures or required control of GHG and VOC emissions. Micron considers this source of emissions to be negligible when compared to the overall GHG emissions profile of the Micron Campus and a necessary result of installing required safety or air pollution control devices. Micron has not identified any mitigating measures to reduce these emissions.

2.2.4.3 Fuel Combustion

In general, all combustion equipment installed as part of the Micron Campus will operate using good design and combustion practices as measures to mitigate GHG emissions which has been identified as GHG BACT. Efficient design in combustion equipment can significantly reduce GHG emissions by ensuring

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[14] IPCC 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3, Chapter 6, Table 6.17

that a higher percentage of the fuel use is converted into usable energy. Good combustion practices include but are not limited to the following:

- Optimizing the air-fuel ratio;
- Using insulation;
- Establishing proper combustion zone temperature control;
- Conducting operator training; and
- Conducting periodic maintenance.

In addition to operating using good combustion practices, additional mitigation measures for each type of combustion equipment, including reducing the hours of operation and/or fuel demand when operating, are considered in the sections below.

Thermal Oxidation Systems

Thermal oxidation systems can be operated to mitigate natural gas consumed and associated GHG emissions by adjusting the inlet flow of natural gas when required. These devices can be equipped with a "high-fire" mode of operation in which the flow of oxygen and natural gas is increased in order to increase the temperature in the combustion zone when process chemicals are actively flowing into the process tool. For the purpose of determining PTE of GHGs from these devices, it is assumed that "high-fire" mode is always on. Micron will minimize GHG emissions from natural gas combustion in thermal oxidation systems by ensuring that "high-fire" mode is used only as needed to achieve necessary safety and air pollution goals; however, there are no viable formal mitigation measures available for these systems.

Operation of thermal oxidation systems in lower-firing modes when high-fire mode is not necessary is the most effective way to reduce natural gas consumption. These devices need to operate at all times in order to ensure proper operation of the fab and to mitigate safety risks from process tool exhausts. Waiting for these devices to initiate operation and come up to temperature for every cycle of a process tool is not viable. To ensure safe operation of equipment, it is common for PEECs to be interlocked with tools such that these will always operate if a tool is operating. POU control devices play a critical role in reducing overall GHG emissions by destroying high-GWP GHGs used in plasma etch tools. There is little to no opportunity for these devices to shut off without compromising the DRE of F-GHGs. Therefore, limiting hours of operation is not a viable mitigation measure for thermal oxidation systems.

Rotor Concentrator Thermal Oxidizers

RCTOs are important and necessary air pollution control devices that must operate at all times to ensure proper operation of the fab and control of air emissions. RCTOs concentrate and oxidize VOCs in the fab exhaust, and as discussed in Section 2.1.2, must quickly respond to changes in VOC inlet concentration. In addition, the burner needs to maintain a high temperature to achieve the required destruction efficiency of VOCs that are more difficult to oxidize. For these reasons, reducing the natural gas input or hours of operation of the RCTOs are not viable mitigation measures.

In addition, Micron will mitigate GHG emission from the RCTOs by following the practices identified as GHG BACT that apply to their operation, which include the use of efficient design and combustion practices.

Water Bath Vaporizers

Water bath vaporizers are required in certain scenarios to provide the necessary supply of liquified gases to the fab when demand cannot be met by routing gas directly from an on-site air separations unit. As a mitigating measure, Micron will seek to minimize the operation of water bath vaporizers to times when their operation is required to supply process gases to limit the amount of natural gas combusted for this purpose. A limit of 8,000 hours per year for all water bath vaporizers combined, with no more than four units operating at a time is proposed. Micron proposed the use of efficient design and combustion practices as GHG BACT for natural gas combustion devices such as water bath vaporizers.

Boilers

As discussed in section 2.1.3, natural gas-fired boilers will be required in the coldest weather conditions and in the event of a power loss. A limit of 6,000 hours of operation per year for each boiler is proposed, but Micron will make every effort to operate these boilers as infrequently as possible. Micron proposed the use of efficient design and combustion practices as GHG BACT for natural gas combustion devices such as boilers.

Emergency Generators

While required to ensure reliability of power supply for the Micron Campus, emergency generators will operate on an as-needed basis for no more than 100 hours per year, consistent with the operational limit established in the Air Permit Application. In addition, Micron has proposed limits on the duration of operation for certain emergency generators. 38 of the proposed generators will be limited to four (4) hours of operation in a 24-hour period, and an additional 34 of the proposed generators will be limited to eight (8) hours of operation in a 24-hour period. These proposed limits will mitigate GHG emissions from emergency generators by ensuring that as little diesel fuel as possible is used to support life safety equipment in the event of a power loss. In addition, Micron will use good design and combustion practices, proposed as part of GHG BACT.

Notably, in Micron's recent submission of its air permit application Micron is proposing a significantly reduced quantity of emergency generators as compared to the quantity proposed in earlier design considerations. This reduction is the result of efforts to maximize the efficiency of the emergency systems in ongoing design work while ensuring that life safety systems can operate as needed in the event of an emergency.

Emergency Fire Pumps

Micron will operate the two diesel emergency fire pumps only in emergency situations when the primary electric fire pumps are unavailable. To maintain emergency status, these engines will operate for no more than 500 hours per year. Therefore, GHG emissions will be mitigated by limiting operation of these fire pumps as much as possible, outside of routine testing.

2.2.4.4 Heat Transfer Fluids

HTF losses from process chiller systems components (valves, connectors) may result in emissions. As discussed in section 2.2.3.4, Micron is continuously evaluating alternative HTFs that have lower GWPs and minimize the overall GWP of unplanned losses. Because HTF losses cannot easily be collected and controlled, Micron will minimize HTF losses through real-time monitoring and expeditious equipment adjustments.

Micron's HTF detection system is designed to provide continuous, real-time monitoring and to ensure early identification and response to potential leaks. HTF levels are tracked at each piece of equipment. When triggered for an out of spec condition, an automatic alarm is reported to the control room. Upon receiving the alert, equipment teams are dispatched to leak check the system with handheld point of use detectors and remedy leaks as needed. Both HTF levels and the associated alarm systems are monitored locally and through a centralized global tracking system, ensuring multiple layers of oversight and rapid response capabilities. The HTF loops are typically customized to fab design and each loop may be different. Therefore, there are no standardized manufacturer recommendations for this type of maintenance.

Additionally, while there are recommendations from manufacturers on fittings and hoses for HTF loops, following these recommendations may still result in minor fugitive emissions. Manufacturers only provide recommendations for the HTF systems within their equipment; however, Micron will design bespoke systems to transfer HTF throughout the fab. Micron's global program has been devised and implemented to further mitigate and respond quickly to potential losses in addition to abiding by manufacturers' recommendations.

Micron is proposing GHG BACT for the proposed HTFs to be the use of good design and maintenance practices and is evaluating the opportunity to use the low-GWP HTFs that are technically viable to meet the heat transfer needs of each desired application. Good operating and maintenance practices include regular evaluation of consumption records to confirm efficient usage, evaluation of transfer lines and equipment to identify areas of potential inefficient use, and maintenance and repair of those areas. No other mitigating measures have been identified.

2.2.4.5 Biological Wastewater Treatment

As discussed in the alternatives section above, Micron will minimize the CO_2e emitted from the combined biological treatment operations by implementing aerobic digestion as opposed to anaerobic digestion. Due to the need to comply with effluent limitations on organic compounds Micron cannot commit to further reductions in the GHG emissions from biological wastewater treatment, as CO_2 generation is an inherent aspect of biological treatment.

2.2.4.6 Circuit Breakers

SF_6 losses from circuit breakers may result in emissions. As discussed in 3.3.4, Micron is continuously evaluating alternative insulating gases that have lower GWPs and minimizing the overall GWP of unplanned losses. Micron will minimize SF_6 losses through real-time monitoring and expeditious equipment adjustments. Micron will operate manufacturer-guaranteed circuit breakers with SF_6 leak rate less than 0.5% and the use of leak detection systems (with alarms), as proposed in the GHG BACT analysis. Specific methods of compliance with 6 NYCRR Part 495 are addressed within the Air Permit Application.

2.2.4.7 Carbon Capture and Storage

In addition to the mitigation measures directly related to the equipment planned for the Micron Campus, Micron has also considered the feasibility of carbon capture and storage (CCS) as a GHG mitigation measure. An effective CCS system would require three elements:

- Separation technology for the CO_2 exhaust stream (i.e., "carbon capture" technology);
- Transportation of CO_2 to a storage site; and
- A viable location for long-term storage of CO_2.

These three elements work in series. For CCS to be a feasible mitigation measure, all three elements must be feasible.

CO_2 Capture

CCS involves post-combustion capture of CO_2 from the emission units and sequestration of the CO_2 in some fashion. Carbon capture is typically accomplished with low pressure scrubbing of CO_2 from the exhaust stream with solvents (e.g., amines and ammonia), solid sorbents, or membranes. CO_2 must be compressed from near-atmospheric pressure in the stack to pipeline pressure (around 2,000 psia) prior to transportation to an appropriate sequestration site. CO_2 capture is likely feasible for sources emitting CO_2 in large amounts and high-purity CO_2 streams, such as fossil fuel-fired power plants, cement plants, and ammonia production facilities.

Another challenge to carbon capture at the Micron Campus is the batch nature of the process and the large number of relatively small combustion devices. As such, the CO_2 emissions generated are not consistent in volume or flow, which has been the basis of projects using existing technology.

CO_2 Transport

CO_2 that has been captured and compressed is subsequently transported to a site designated for long-term geologic storage or use in enhanced oil recovery (EOR). Pipelines are expected to be the most economical and efficient method of transporting CO_2 for commercial purposes. Once constructed, pipelines reduce uncertainty associated with logistics, fuel costs, and reliance on other infrastructure that could increase the cost of CO_2 transportation. The history of transporting CO_2 via pipelines in the United States spans over 40 years.

As of 2019, there were approximately 32 liquid CO_2 pipeline operators under USDOT regulatory authority in the United States according to the Pipeline and Hazardous Materials Safety Administration (PHMSA). This distribution network consists of approximately 5,200 miles of pipe transporting supercritical fluid CO_2 and a significantly smaller amount (~60 miles) of gas CO_2 pipelines. A recent report delivered to Congress by the Council of Environmental Quality on CCS identifies priorities including the establishment of an interstate CO_2 pipeline network modeled by the Princeton Net-Zero America study covering portions of the Central States and Midwest regions, but there are no proposed routes in New York.[15]

CO_2 Storage

CO_2 storage refers to the process of injecting CO_2 into subsurface formations for long-term sequestration. CO_2 storage is currently happening across the U.S. and around the world. To be considered suitable for sequestration, sites must have suitable geology. For stable storage of CO_2, sequestration reservoirs must be at least 2,500 feet below the ground surface and generally must have a porosity greater than 5 percent with adequate permeability to allow for flow between pores. Additionally, there must be a layer of impermeable rock above the sequestration reservoir, referred to as a “cap rock” to prevent migration and potential escape of CO_2.

The feasibility of carbon capture is assessed for each stationary source type below.

Fab Process Exhausts

CCS has been demonstrated in practice and is generally considered to be available for facilities emitting CO_2 in large amounts, and for facilities with high-purity CO_2 streams. These facilities include fossil fuel-fired power plants, cement plants, ammonia production, ethanol production, and iron and steel manufacturing. While CO_2 is emitted from the fab process exhausts as a result of either direct use, byproduct formation, or combustion of natural gas, the majority of GHG emissions on a CO_2e-basis from the fab process exhausts are from N2O, CF_4, and NF_3. The CO_2 concentration will be significantly lower than the CO_2 exhaust concentration expected from sources currently utilizing CCS. The membranes used in the CCS technology are very sensitive to chemicals and could potentially be fouled when used for these exhausts.

Recovery and purification of CO_2 from the exhaust gas would require significant additional processing to achieve the necessary CO_2 concentration and purity for effective sequestration. The compression of CO_2 requires a large auxiliary power load, which is expected to result in the use of additional fuel (and associated additional CO_2 emissions) to generate this needed electricity.

As such, CCS is not considered technically or environmentally feasible for reducing GHG emissions from fab process exhausts.

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[15] Council on Environmental Quality Report to Congress on Carbon Capture, Utilization, and Sequestration (2021, June). Retrieved from https://www.whitehouse.gov/wp-content/uploads/2021/06/CEQ-CCUS-Permitting-Report.pdf [no longer available]

Boilers

The boilers at the Micron Campus will operate intermittently to maintain precise temperature control for various stages of production, ensuring the efficient operation of machinery, and are not considered electric generating units. While the technology for the post-combustion capture of CO_2 may be available in some applications, the process has not been demonstrated for natural gas-fired boilers rated at less than 50 MMBtu/hr as proposed. Recovery and purification of CO_2 from boiler flue gas would require significant additional processing to achieve the necessary CO_2 concentration and purity for effective sequestration. The compression of CO_2 requires a large auxiliary power load, which is expected to result in the use of additional fuel (and associated additional CO_2 emissions) to generate this needed electricity.[16]

As such, CCS is not considered technically or environmentally feasible for reducing GHG emissions from the natural gas-fired boilers.

Water Bath Vaporizers

The water bath vaporizers at the Micron Campus will operate intermittently to provide a reliable and efficient source of high-purity nitrogen gas. The water bath vaporizers provide the necessary supply of liquified gases to the fab when demand cannot be met by routing gas directly from an on-site air separations unit. The intermittent nature of the operation increases inefficiencies associated with the potential capture of CO_2 from the exhaust stream.

Additionally, while the technology for the post-combustion capture of CO_2 may be available in some applications, the process has not been demonstrated for natural gas-fired water bath vaporizers. Recovery and purification of CO_2 from water bath vaporizer flue gas would require significant additional processing to achieve the necessary CO_2 concentration and purity for effective sequestration. The compression of CO_2 requires a large auxiliary power load, which is expected to result in the use of additional fuel (and associated additional CO_2 emissions) to generate this needed electricity. [17]

As such, CCS is not considered technically or environmentally feasible for reducing GHG emissions from the natural gas-fired water bath vaporizers.

Emergency Generator Engines

The emergency generator engines operate infrequently to support the safe shutdown of fabs in the event of loss of power and to reduce process gases vented to the atmosphere. The intermittent nature of the operation increases inefficiencies associated with the potential capture of CO_2 from the exhaust stream.

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[16] EPA. (2010, August). Report of the Interagency Task Force on Carbon Capture and Storage.

[17] Ibid.

Additionally, while the technology for the post-combustion capture of CO_2 may be available in some applications, the process has not been demonstrated for diesel-fired emergency generator engines as proposed in the Micron Campus. Recovery and purification of CO_2 from emergency engine flue gas would require significant additional processing to achieve the necessary CO_2 concentration and purity for effective sequestration. The compression of CO_2 requires a large auxiliary power load, which is expected to result in the use of additional fuel (and associated additional CO_2 emissions) to generate this needed electricity.[18]

As such, CCS is not considered technically or environmentally feasible for reducing GHG emissions from the diesel-fired emergency generator engines.

Emergency Fire Pumps

The emergency fire pump engines will operate infrequently to supply fire water in the event of an emergency during a power outage. The intermittent nature of the operation increases inefficiencies associated with the potential capture of CO_2 from the exhaust stream.

Additionally, while the technology for the post-combustion capture of CO_2 may be available in some applications, the process has not been demonstrated for diesel-fired emergency fire pump engines as proposed in the Micron Campus. EPA's RBLC database does not include any CCS GHG BACT determinations for emergency fire pump engines of any size. Recovery and purification of CO_2 from emergency engine flue gas would require significant additional processing to achieve the necessary CO_2 concentration and purity for effective sequestration. The compression of CO_2 requires a large auxiliary power load, which is expected to result in the use of additional fuel (and associated additional CO_2 emissions) to generate this needed electricity. As such, CCS is not considered technically or environmentally feasible for reducing GHG emissions from the diesel-fired emergency fire pump engines.

As carbon capture is not feasible for any of the proposed stationary sources, carbon transport and storage are not evaluated in this analysis.

2.2.4.8 HFCs in HVAC-R

Micron will minimize leaks of HFCs in HVAC-R equipment by using practices that exceed required legal standards. Such practices may include using automatic leak detection systems and following best practices for installation, operation and repair. Additionally, Micron will reclaim HFCs to the extent practicable at the end of life of HVAC-R equipment and systems. Micron will also make its best efforts to select ultra-low GWP substances or non-HFC alternatives wherever these substances are available.

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[18] EPA. (2010, August). Report of the Interagency Task Force on Carbon Capture and Storage.

3 CONSTRUCTION STATIONARY SOURCES

This section discusses GHG emissions from stationary sources associated with the construction of the Proposed Project, including equipment used for construction located on the Micron Campus. This section does not include potential GHG emissions from stationary sources associated with the Rail Spur Site or Childcare Facility, as neither location is expected to use stationary GHG sources during construction or operation. Potential GHG emissions from mobile construction sources associated with the Rail Spur Site and Childcare Facility are presented in Section 4.2.

Micron will neither own nor operate any of the equipment discussed in this section and intends to contract with one or more third parties that will independently obtain the appropriate authorization to construct and operate these sources. Therefore, all information presented in this section is preliminary and subject to change once said contractor(s) are retained. The GHG emissions presented in this section are intended to be conservative estimates based on current preliminary plans.

3.1 GHG Emission Sources

This section provides a description of the potential GHG emissions from stationary sources associated with the construction of the Micron Campus.

3.1.1 Fuel Combustion – Micron Campus

Micron projects that the following combustion sources will be operated at the Micron Campus to facilitate its construction. Information on these sources is preliminary and subject to change.

- Eight (8) diesel fuel-fired space heaters, each rated at 1.75 MMBtu/hr;
- Two (2) propane-fired boilers, each rated at 1.53 MMBtu/hr;
- Two (2) propane-fired steam generators, each rated at 6.0 MMBtu/hr, and;
- One (1) diesel fuel-fired engine rated at 416 horsepower.

Each of the equipment above will have direct GHG emissions through combustion, and upstream GHG emissions associated with the extraction and transmission of fuel. No other stationary GHG emission sources are expected to operate on the Micron Campus to facilitate its construction.

3.2 GHG Emissions Analysis

This section provides an analysis of the potential GHG emissions from stationary sources associated with construction of the Micron Campus.

3.2.1 Quantification of GHG Emissions

3.2.1.1 Emission Calculation Methodologies

The PTE CO_2e emissions from the construction-related stationary sources were estimated on a 20-year GWP basis using 40 CFR Part 98 emission factors.[19] Upstream emissions for all sources were quantified using emission factors published by the NYSDEC in the 2024 NYS Statewide GHG Emissions Report, Table A1.[20]

3.2.1.2 Potential to Emit

The estimated PTE of GHGs for construction-related stationary sources at the Micron Campus is summarized in Table 3-1 below. These values reflect maximum annual emissions while construction is occurring. Operation of these construction-related stationary sources following construction of the Micron Campus may continue depending on the commercial viability as determined by a third-party operator.

Table 3-1: Micron Campus Long Term Operations Stationary Sources GHG PTE

Emission Source	Direct CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total PTE CO_2e (20-yr) (tpy)
Micron Campus Diesel Fuel-Fired Heaters	4,591	1,453	6,044
Micron Campus Propane-Fired Units	4,202	1,758	5,960
Micron Campus Diesel Fuel-Fired Engine	347	110	457
Total	**9,140**	**3,321**	**12,461**

3.2.2 GHG Alternatives Analysis

Since the stationary sources associated with construction of the Proposed Project will be new sources of GHG emissions, an analysis of alternatives is required (DAR-21 Section V.C.6). Since the final design of the Rail Spur Site and construction operations will be completed by the contractor(s) retained by Micron, the contractor(s) may pursue alternatives that do not specifically correspond with certain aspects of the assumed approach stated above and will be responsible for supplementing this CLCPA analysis addressing those alternatives.

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[19] 40 CFR Part 98, Table C-1: Default CO_2 Emission factors and High Heat Values for Various Types of Fuel, Table C-2: Default CH_4 and N_2O Emission Factors for Various Types of Fuel

[20] Emission Factors for Use by State Agencies and Applicants, Appendix A to the 2023 NYS Statewide GHG Emissions Report, Table A1,

3.2.3 GHG Mitigation Measures

At this time, Micron cannot identify potential alternatives to the equipment discussed in this section, and therefore mitigation measures must be considered. Again, Micron will neither own nor operate the construction-related stationary sources and does not intend to obtain authorizations to operate them. However, Micron plans to request that contractor(s) operate these combustion sources only to the extent necessary and only during the periods of time when needed to support construction activities. The contractor(s) will be responsible for identifying potential operational limits in their air permit application(s) with DEC and complying with all potential requirements relating to the CLCPA for the sources they will own and operate, in addition to supplementing this CLCPA analysis.

4 MOBILE SOURCES

This section discusses GHG emissions from all mobile sources associated with the Proposed Project, including non-road mobile equipment necessary for construction of the Proposed Project and traffic to and from the site due to construction and long-term operations. Each subset of mobile sources is described in detail below.

4.1 GHG Emission Sources

4.1.1 Long Term Operations Mobile Sources

Mobile sources associated with long term operations of the Proposed Project include both passenger vehicle and truck traffic to and from the Micron Campus. Indirect GHG emissions will be attributable, in part to combustion of gasoline in passenger vehicles transporting employees and others to and from the site. Additional indirect GHG emissions will be attributable to combustion of diesel fuel in trucks delivering materials to the site and transporting product and waste from the site. Upstream emissions associated with the extraction and transmission of fuels combusted in mobile sources are included in this analysis.

4.1.2 Construction Mobile Sources

Mobile sources associated with the construction of the Proposed Project include heavy-duty diesel fuel-fired mobile equipment such as bulldozers, loaders, trucks, and cranes, support equipment such as engines, welders, and pumps, and potentially diesel fuel-fired material handling equipment including crushers and conveyors. In addition, traffic to and from the Micron Campus will increase during periods of construction, leading to additional mobile source combustion of gasoline and diesel fuel. Upstream emissions associated with the extraction and transmission of fuels combusted in mobile sources are included in this analysis.

4.2 GHG Emissions Analysis

This section provides an analysis of the potential GHG emissions from mobile sources associated with the Proposed Project.

4.2.1 Quantification of GHG Emissions

4.2.1.1 Emission Calculation Methodologies

Long Term Operations Mobile Sources

GHG emissions from mobile sources associated with long term operations of the Proposed Project were estimated for the years 2027, 2031 and 2041 to align with the scope of the traffic analysis conducted for the Proposed Project's NEPA/ SEQRA Draft Environmental Impact Statement (DEIS).[21] Traffic associated with the Proposed Project will include a mix of delivery trucks and worker commute vehicles. The quantity of vehicles that will be owned by Micron and used around the Micron Campus is anticipated to be relatively insignificant, and GHG emissions from these vehicles are not included in this analysis. GHG emissions were estimated for the regional traffic network evaluated in the traffic analysis conducted for the DEIS. Regional GHG emissions from traffic associated with the Proposed Project were calculated using the "No Build" scenario, which evaluates conditions in the absence of the Proposed Project, which were subtracted from the "Build" scenario, which evaluates the conditions assuming construction and operation of the Proposed Project. Mobile source GHG emissions are considered indirect GHG emissions in this analysis. Upstream GHG emissions from the extraction and transmission of fuel used by the vehicles considered in this analysis were estimated from emission factors published in the 2024 New York State GHG Emission Report Appendix Table A1.

Construction Mobile Sources

GHG emissions from mobile sources associated with construction of the Proposed Project were estimated based on the current projected construction schedule, phases, construction equipment, and duration of use. GHG emission factors were obtained from the non-road module in the U.S. EPA MOVES4 model for on-site construction activity, from the U.S. EPA Greenhouse Gas Emission Factor hub and from the 2022 U.S. EPA National Emission Inventory (NEI). Locomotive emission factors were obtained from the NEI and U.S. EPA 2009 "Emission Factors for Locomotives". The analysis also includes mobile source emissions associated with worker commutes and hauling of materials, which used on-road emission factors from the on-road module in the MOVES4 model. The analysis considers the overall construction schedule, staging, equipment, utilization, and load factors to determine mobile source construction GHG emissions. The MOVES4 model provided estimates of energy consumption from diesel fuel combustion during

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[21] Year 2027 represents the ramp-up of construction activity at the Micron Campus, Year 2031 represents the peak activity associated with construction and operations of two fabrication facilities, and Year 2041 represents the peak activity associated with the construction and operations of the full build-out of four fabrication facilities.

construction. Upstream GHG emissions from the extraction and transmission of fuel used by the mobile sources considered in this analysis were estimated from emission factors published in the 2024 New York State GHG Emission Report Appendix Table A1.

4.2.1.2 Potential Emissions

The estimated potential GHG emissions from mobile sources associated with the Proposed Project are shown in Tables 4-1 and 4-2 below. Table 4-1 shows long term operations mobile source GHG emissions as estimated consistent with the traffic analysis years of 2027, 2031 and 2041. Table 4-2 shows construction mobile source emissions for the year of maximum construction emissions (2029) and total for the 16-year construction period. Construction is projected to end in 2042.

Table 4-1: Long Term Operations Mobile Sources GHG Emissions

Emission Source	Indirect CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total CO_2e (20-yr) (tpy)
Mobile Sources – 2027	5,389	1,814	7,203
Mobile Sources – 2031	31,216	11,137	42,354
Mobile Sources – 2041	14,688	5,623	20,311

1. The mobile source emissions in 2041 account for implementation of Mitigation Scenario C as described in the mobile source traffic analysis of Micron's DEIS report.

Table 4-2: Construction Mobile Sources GHG Emissions

Emission Source	Indirect CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total CO_2e (20-yr) (tpy)
Construction Mobile Sources – Max Emission Year	54,340	8,165	62,506
Construction Mobile Sources – Total Over 16 Years	327,815	66,238	394,052

4.2.2 GHG Alternatives Analysis

Since mobile sources associated with the Proposed Project represent new sources of GHG emissions, an analysis of alternatives is required (DAR-21 Section V.C.6).

4.2.2.1 Long Term Operations Mobile Sources

The majority of mobile source GHG emissions associated with long term operations are due to worker commutes and vendor delivery (i.e., non-Micron owned vehicles). GHG emissions from these vehicles are affected by general fuel, emissions control and vehicle technology programs directed in part by New York State and Federal agencies. An alternative for workers individually commuting is the option to provide ride sharing or bus transportation, such as Micron's partnership with Centro to fund an additional express bus service and Micron's Commuter Choice Program for employees, in order to reduce the number of single occupancy vehicle trips and associated GHG emissions. The DEIS traffic analysis, which forms the basis of this emissions analysis incorporates bus activity for employee transport.

4.2.2.2 Construction Mobile Sources

Construction of the Proposed Project requires the use of heavy equipment that inherently constitutes mobile sources of GHG emissions. Alternatives to fossil fuel-fired construction equipment rely on alternative sources of energy for power. Electrically powered construction equipment is beginning to appear in the construction equipment market. However, availability of battery electric powered equipment is currently limited for use in small equipment applications with limited operating duration per charge and therefore is not feasible for the Proposed Project. Alternative combustion fuel for diesel fuel-fired equipment primarily consists of conventional diesel fuel blended with biodiesel fuel. A blend of 80% conventional diesel with 20% biodiesel can provide a 15% reduction in GHG emissions. Micron will promote this fuel preference with its contractors to reduce GHG emissions during the construction phase.

By proposing the Rail Spur Site, Micron is adopting an alternative that will reduce the potential GHG emissions from transporting fill and aggregate material to the Micron Campus. By bringing in fill material and aggregate by railcar to the Rail Spur Site and transporting it to the Micron Campus via the proposed conveyance system, Micron is eliminating the need for approximately 7,300 truck trips per month.

4.2.3 GHG Mitigation Measures

Since the proposed alternatives above would not completely offset mobile source GHG emissions, mitigation measures must be considered.

Micron aims to further reduce mobile source GHG emissions by encouraging commuting using an EV, carpooling, or bicycle. Micron will provide low and zero-emissions transportation infrastructure such as creating reserved parking spaces for carshare vehicles and alternative-fueled vehicles, adding EV charging stations, and providing infrastructure that promotes bicycle usage (such as bicycle storage and shower rooms). These incentives will aim to reduce the number of trips to and from the Proposed Project that result in GHG emissions.

5 WETLANDS LAND USE

Projected GHG impacts resulting from the loss of wetlands are discussed in detail in a separate analysis attached as Appendix C.

5.1 Summary of Wetlands GHG Emissions Analysis

The Proposed Project will be constructed on sites that include wetlands. The construction and operation of the Childcare Site will avoid all wetlands and therefore result in no impacts to on-site wetlands. The

Rail Spur Site does not contain state jurisdictional wetlands and therefore the construction and operation of the Rail Spur Site will also not result in impacts to state wetlands. 176.44 acres of state jurisdictional wetlands will be permanently impacted due to the construction and operation of the Micron Campus. As part of the development of the Micron Campus, additional utilities and their associated infrastructure ("Connected Actions") will need to be built to support the operation of the Micron Campus, which would additionally permanently impact 0.11 acres of wetlands. Micron will offset this loss of wetlands at mitigation sites, where wetlands will be created and/or restored. Known permanent impacts to wetlands as a result of Connected Actions will be mitigated by the responsible party in a separate mitigation plan. Both the remaining wetlands on the Micron Campus and the wetlands at the mitigation sites will have the potential to sequester CO_2 and produce CH_4.

The change in land use of the site from wetlands to a developed site was analyzed by evaluating changes in net carbon emissions. For wetlands that are replaced with hard infrastructure, all carbon that was stored in soils and above- and below-ground biomass is assumed to be converted to CO2 as a single pulse emission at the time of conversion. Wetlands would be disturbed in phases, with Phase 1 including Connected Action wetlands disturbed over a 4-month period in 2025/2026, and that the remaining Phase 2 wetlands of the remaining wetlands onsite disturbed over a 4-month period beginning in 2030. Land use changes would also affect the ability of the soil to sequester CO_2 and generate CH_4. Additionally, creation of wetlands for mitigation and preservation of existing wetlands would contribute to CO_2 sequestration and CH_4 generation.

The loss of wetlands onsite would result in the loss or pulse emissions of 48,700 tons CO_2 in wetland soil directly following disturbance in the Phases discussed above and total foregone sequestration of 10,803 tons CO_2 in tree and litter biomass through 2050. Accounting for maturation timelines for created wetlands as part of mitigation packages beginning in 2027, it is projected the mitigated wetlands would sequester a total of 14,578 tons of CO_2 and generate 524 tons of CH_4 through 2050. The GHG sequestration and production impacts of each area of wetlands is summarized, consistent with Micron's technical approach approved by NYSDEC, in Table 5-1 below.

Table 5-1: Summary of GHG Impacts from Wetlands Land Use

Area of Impact	(tons)	(tons CO_2e, 20-yr)	(tons CO_2e, 100-yr)
Land Use Change Loss/Pulse CO_2 Emissions	48,700	48,700	48,700
CH4 Emissions – From Restored Wetland through 2050	524	44,011	14,670
Total Gross Emissions (through 2050)	**-**	**92,711**	**63,370**
Net CO_2 Emissions (Loss/Pulse Emissions, Total Foregone Sequestration by Removed Wetland, Total Sequestration by Restored Wetland, through 2050)	44,925	44,925	44,925
Net CH4 Emissions (Avoided Emissions from Removed Wetlands, Emissions from Restored Wetlands, through 2050)	280	23,489	7,830

Total Net Emissions (through 2050)	**-**	**68,415**	**52,755**

By 2050, the amount of CO2 sequestration and CH4 generation from the preserved wetlands onsite, the preserved wetlands at the mitigation sites, and the mitigation wetlands that have been constructed will amount to more than 3 times the losses seen from the full build out of the Micron Campus. See Appendix C for the full wetlands evaluation.

6 SUMMARY OF TOTAL IMPACTS

DAR-21 requires facilities to project future GHG emissions for the years 2030 and 2050, which are the years for which statewide GHG emission reduction requirements have been set by the CLCPA. The alternatives and mitigation measures considered as feasible in the sections above are reflected as appropriate in the projected GHG emissions from the Proposed Project in Tables 6-1 and 6-2.

Micron currently projects that Fab 1 will be operational in 2030 and that all four fabs will be operational in 2050. Therefore, the projected 2030 emissions from long term operations stationary sources are one-quarter of the total emissions projected in 2050. While emissions estimates are based on current HFC usage for the Proposed Project, the American Innovation and Manufacturing (AIM) Act authorizes EPA to phase down production and consumption of HFCs, maximizing reclamation and minimizing releases from equipment, and facilitating transition to next-generation technologies through sector-based restrictions on HFCs. As such, it is anticipated that each successive fab is likely to have lower GHG emissions due to changes in HFC usage. Both stationary and mobile construction sources are assumed to operate at maximum capacity in 2030. By 2050, construction will have been completed and therefore there would be no GHG impacts from construction sources. For long term operations mobile sources, 2030 emissions are assumed to equal 2031 DEIS model year projected emissions, and 2050 emissions are assumed to equal 2041 DEIS model year projected emissions.

Table 6-1: Proposed Project Projected 2030 GHG Emissions

Emissions Sources	Direct CO2e (20-yr) (tpy)	Upstream CO2e (20-yr) (tpy)	Indirect CO2e (20-yr) (tpy)	Total CO2e (20-yr) (tpy)
Long Term Operations Stationary Sources	512,819	172,305	-	686,999
Construction Stationary Sources	9,140	3,321	-	12,461
Long Term Operations Mobile Sources	-	11,137	31,216	42,354
Construction Mobile Sources	-	8,165	54,340	62,506
Total	**521,959**	**194,928**	**85,556**	**804,320**

Table 6-2: Proposed Project Projected 2050 GHG Emissions

Emissions Sources	Direct CO2e (20-yr) (tpy)	Upstream CO2e (20-yr) (tpy)	Indirect CO2e (20-yr) (tpy)	Total CO2e (20-yr) (tpy)
Long Term Operations Stationary Sources	2,051,274	689,218	-	2,747,995
Construction Stationary Sources	-	-	-	-
Long Term Operations Mobile Sources	-	5,623	14,688	20,311
Construction Mobile Sources	-	-	-	-
Total	**2,051,274**	**694,841**	**14,688**	**2,768,306**

Table 6-3, Table 6-4, and Table 6-5 additionally reflect the pre-mitigation and alternative GHG emissions, avoided GHG emissions due to mitigation and alternatives considered feasible for the Proposed Project, and GHG emissions accounting for mitigation and alternatives considered above projected in 2050 (for more detail, see Appendix D).

Table 6-33: Proposed Project Projected 2050 GHG Emissions – Pre-Mitigation and Pre-Alternatives

Emissions Sources	Direct CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total CO_2e (20-yr) (tpy)
F-GHGs and N_2O Used in Thin Films	636,933	-	636,933
F-GHGs Used in Plasma Etch	187,146	-	187,146
Direct use of CO_2 and CH_4	4,060	-	4,060
Thermal Oxidation byproducts	59,463	-	59,463
Fuel Combustion in PEECs, POUs, and RCS	390,649	297,322	687,971
Fuel Combustion in RCTOs	315,320	239,989	555,308
Fuel Combustion in WBVs	708,538	541,112	1,249,650
Fuel Combustion in Boilers	4,370,684	3,337,897	7,708,581
Fuel Combustion in Emergency Generators	82,512	26,117	108,628
Heat Transfer Fluids	254,094	-	254,094
Fuel Combustion in Fire Pump Engine	52	17	69
Biological Wastewater Treatment (Micron Campus and Oak Orchard IWWTP)	182,294	-	182,294
Circuit Breakers	7,017	-	7,017
Oak Orchard IWWTP Combustion	18,299	2,995	21,295
Total	**7,217,062**	**4,445,448**	**11,662,509**

Table 6-44: Proposed Project Projected 2050 GHG Emissions – Avoided due to Mitigation and Alternatives

Emissions Sources	Direct CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total CO_2e (20-yr) (tpy)	Mitigation	Alternative
F-GHGs and N_2O Used in Thin Films	129,617	-	129,617	-	X
F-GHGs Used in Plasma Etch	-	-	-	-	-
Direct use of CO_2 and CH_4	-	-	-	-	-
Thermal Oxidation byproducts	-	-	-	-	-
Fuel Combustion in PEECs, POUs, and RCS	21,919	16,683	38,602	-	X
Fuel Combustion in RCTOs	-	-	-	-	-
Fuel Combustion in WBVs	627,655	479,341	1,106,996	X	-
Fuel Combustion in Boilers	4,231,772	3,231,809	7,463,582	X	-
Fuel Combustion in Emergency Generators	66,009	20,894	86,903	-	X
Heat Transfer Fluids	31,551	-	31,551	-	X
Fuel Combustion in Fire Pump Engine	-	-	-	-	-
Biological Wastewater Treatment (Micron Campus and Oak Orchard IWWTP)	175,494	-	175,494	-	X
Circuit Breakers	-	-	-	-	-
Oak Orchard IWWTP Combustion	-	-	-	-	-
Solar Panel	504	-	504	X	-
EV Chargers	2,032	898	2,930	X	-
Total	**5,286,553**	**3,749,625**	**9,036,179**	**-**	**-**

1. Results in this table represent annualized emissions at full build-out and are inclusive of non-stationary source mitigation and alternative measures.

Table 6-55: Proposed Project Projected Construction-Related GHG Emissions – Avoided due to Mitigation and Alternatives

Emissions Sources	Direct CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total CO_2e (20-yr) (tpy)	Mitigation	Alternative
Transportation of Aggregate Material – Rail Spur Rail Car	7,006	2,221	9,226	X	-
Construction Worker Transportation	8,928	4,385	13,312	X	-
Total	**15,934**	**6,606**	**22,538**	-	-

1. Transportation of aggregate material via rail spur and rail car avoided emissions are annualized across the approximately 16-year construction period. Construction worker transportation emissions are representative of 2041 emissions consistent with the traffic analysis complete for the DEIS.

Table 6-66: Proposed Project Projected 2050 GHG Emissions – Post-Mitigation and Alternatives[1]

Emissions Sources	Direct CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total CO_2e (20-yr) (tpy)	Mitigation	Alternative
F-GHGs and N_2O Used in Thin Films	507,315	-	507,315	-	X
F-GHGs Used in Plasma Etch	187,146	-	187,146	-	-
Direct use of CO_2 and CH_4	4,060	-	4,060	-	-
Thermal Oxidation byproducts	59,463	-	59,463	-	-
Fuel Combustion in PEECs, POUs, and RCS	368,730	280,639	649,370	-	X
Fuel Combustion in RCTOs	315,320	239,989	555,308	-	-
Fuel Combustion in WBVs	80,883	61,771	142,654	X	-
Fuel Combustion in Boilers	138,912	106,087	244,999	X	-
Fuel Combustion in Emergency Generators	16,502	5,223	21,726	-	X
Heat Transfer Fluids	222,544	-	222,544	-	X
Fuel Combustion in Fire Pump Engine	52	17	69	-	-
Biological Wastewater Treatment (Micron Campus and Oak Orchard IWWTP)	6,799	-	6,799	-	X
Circuit Breakers	7,017	-	7,017	-	-
Oak Orchard IWWTP Combustion	18,299	2,995	21,295	-	-
Solar Panel[2]	-504	-	-504	X	-
EV Chargers[2]	-2,032	-898	-2,930	X	-
Total[2]	**1,930,506**	**695,823**	**2,626,331**	**-**	**-**

1. Results in this table are calculated where avoided emissions due to mitigation or alternative measures from Table 6-4 are subtracted from the pre-mitigation and pre-alternatives emissions from Table 6-3.
2. Negative (-) GHG emissions represented for certain alternative or mitigation measures are the result of a net reduction in GHG emissions due to the implementation of measures unrelated to stationary emission sources. As such, they are subtracted from the totals. Note construction-related GHG emissions avoided due to mitigation and alternative measures as presented in Table 6-5 are not accounted for in this table as construction will have been completed before 2050.

7 DEP 24-1 PRELIMINARY SCREENING

Pursuant to DEP 24-1, NYSDEC requested an evaluation of the applicability of the Proposed Project on DACs. DEP 24-1 outlines the requirements for project analyses per CLCPA Section 7(3) and is intended to apply to permit applications subject to the Uniform Procedures Act (UPA), Article 70 of the Environmental Conservation Law (ECL). All major permit applications under Article 19 of ECL (Air Pollution Control) that have the potential for direct or indirect GHG emissions fall within the scope of this policy. As such, the Proposed Project is subject to this policy since it has the potential to emit GHGs and will trigger major source thresholds (federal New Source Review (NSR) and Title V Permit).

DEP 24-1 requires that an applicant ensure that the requirements of Section 7(3) of the CLCPA are met and prioritize emission reductions in any impacted disadvantaged communities (DACs), as defined by the New York State Climate Justice Working Group (CJWG).[22] NYSDEC will conduct a preliminary screening and if a proposed project is determined to be within or likely impact a DAC, NYSDEC will require a disproportionate burden report for the proposed action as described in DEP 24-1, Section V.6 and may require enhanced public participation consistent with Commissioner Policy 29.[23]

The Micron Campus will be located at the WPCP in the Town of Clay, New York, which is not designated as a DAC. The Rail Spur Site and the Childcare Site are also not designated as DACs. The closest DAC is five (5) miles south of the Proposed Project (North Syracuse area). Because the Proposed Project is not located within a DAC or within a half-mile of a DAC, the Proposed Project is not expected to result in a disproportionate impact or burden to a DAC. Therefore, the Proposed Project is not subject to the requirements of Section 7(3).

8 CONSISTENCY WITH CLCPA

As new construction, the Micron Campus would create a new source of GHG emissions in New York State and therefore must undergo a review of whether the Proposed Project, which includes the Micron Campus is consistent with New York State's ability to meet the statewide emission limits. If a project is found to be inconsistent with the attainment of statewide GHG emissions limits, state agencies responsible for administrative decisions related to the project must issue a statement of justification when issuing a permit based on the benefits of the project. As outlined more fully below, there is significant and overwhelming justification for the Proposed Project (DAR-21, Section V.D).

8.1 Justification for the Proposed Project

Despite potential inconsistency with the State's GHG emission limits, the Proposed Project is a once-in-a-generation economic development project designed to meet the economic and national security needs of the U.S. by manufacturing "semiconductors necessary to address gaps and vulnerabilities in the domestic supply chain" and "provide a secure supply of semiconductors necessary for the national security, manufacturing, critical infrastructure, and technology leadership of the United States".[24]

The Proposed Project will also meet the needs outlined in New York's Green CHIPS Act by providing the largest private investment in New York, cementing New York as the nation's leader in the domestic reshoring of semiconductor manufacturing. Micron will invest $100 billion to construct the Proposed

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[22] https://climate.ny.gov/en/Resources/Disadvantaged-Communities-Criteria. Accessed on February 26, 2024.

[23] Commissioner Policy 29, Environmental Justice And Permitting, https://dec.ny.gov/regulatory/guidance-and-policy-documents/commissioner-policy-29-environmental-justice-and-permitting. Accessed on February 26, 2024.

[24] 15 U.S.C. 4652(a)(2)(D)

Project, resulting in the creation of approximately 9,000 direct high-paying jobs and nearly 50,000 indirect jobs (construction, supply chain, community jobs).

As part of the Green CHIPS program as discussed in Section 1, Micron will commit to sustainability and community investment initiatives, further demonstrating Micron's proactive approach to sustainable manufacturing and commitment to being a meaningful community steward and partner.

Micron's global company policies demonstrate a proactive approach to sustainability in all its facilities, including its Proposed Project in Clay, New York, that is consistent with New York's own commitments and environmental regulations.

Importantly, justification for the Proposed Project must confront the difficult reality of reshoring domestic semiconductor manufacturing and must consider the efforts to reshore this industry in the context of highly competitive and complex global markets. As observed over the last two decades, the globally emerging trend of mega campus design is discussed in the section below.

8.1.1 Reshoring Domestic Semiconductor Manufacturing

On December 10, 2024, the U.S. Department of Commerce announced a final award of up to $6.165 billion in direct funding to Micron under the CHIPS Incentives Program to support Micron's plans to invest in the U.S., including in the Proposed Project.[25] [26] The CHIPS funding awarded recognizes Micron's role in increasing domestic supply of advanced leading-edge semiconductor manufacturing. The Proposed Project will manufacture the most advanced DRAM technology for memory applications used in military equipment, cybersecurity technology, the aerospace industry, and other critical areas of the domestic industrial economy.

The importance of this investment in the Proposed Project reflects a recognition by the U.S. government that the global structure of the semiconductor supply chain is vulnerable to single points of failure that create risk of large-scale supply interruptions and geopolitical tensions that could impair access to suppliers or customers. For example, South Korea has a 44 percent share of the global market in memory. In contrast, the U.S. produces only one percent of global DRAM, all of which is currently manufactured by Micron. Therefore, expanding or onshoring domestic advanced semiconductor manufacturing capacity in key areas such as memory is critical to enhancing the resilience of the U.S. semiconductor supply chain to potential global disruptions. With the U.S. investments made by Micron, the U.S. will increase its DRAM

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25 U.S. Department of Commerce, "Department of Commerce Awards CHIPS Incentives to Micron for Idaho and New York Projects and Announces Preliminary Memorandum of Terms for Virginia DRAM Project to Secure Domestic Supply of Legacy Memory Chips" (Dec. 10, 2024), https://www.commerce.gov/news/press-releases/2024/12/department-commerce-awards-chips-incentives-micron-idaho-and-new-york.

[26] International Trade Council, "US CHIPS and Science Act (2022) & Semiconductor Supply Chain Security" (Jan. 23, 2025), https://tradecouncil.org/us-chips-and-science-act-2022-semiconductor-supply-chain-security/.

production to represent 12 percent of the total market.[27] Accordingly, incentivizing expanded domestic DRAM production to a level sufficient to offset potential disruptions to U.S. economic and national security is a key responsibility under the CHIPS Act.

The semiconductor industry is extremely competitive, cost intensive, and margin driven.[28] To reshore sufficient domestic DRAM production in accordance with the intent of the CHIPS Act, a domestic manufacturing facility must achieve similar scale to global competitors, with multiple fabs grouped together to ensure efficient infrastructure costs and upstream supply. The need for larger fab clusters that co-locate large cleanrooms on a single campus is driven by the complexities of the semiconductor wafer manufacturing process that demands efficiencies of scale. Therefore, co-locating more fabs and cleanroom space on a single site reduces both the fixed and operating cost per wafer produced. This has driven a global trend towards construction of larger fab clusters on single campuses, with sizing of fabs dictated by the type of technology being produced at each location.

For the U.S. to compete with other global regions, domestic semiconductor manufacturers must be able to construct and operate fabs at a similar scale and cost as it would in other countries. As part of its merits review of Micron's application, the Department of Commerce determined that the Proposed Project which includes the construction of four fabs on a single site would achieve globally competitive domestic memory production scale capable of enhancing U.S. economic and national security. The scale of the Proposed Project also aligns with the vision and commitments made by Governor Kathy Hochul in her signature Green CHIPS program and as memorialized by the State in its Term Sheet with Micron (September 22, 2022) and its corresponding Incentive Proposal (dated April 19, 2023). There is a clear and urgent need for domestic leading-edge memory production. Given this need, if the Proposed Project was not to go forward in New York, the U.S. government would likely need to reestablish the project in another state to ensure the increase in domestic supply of DRAM over the next two decades. New York's leadership and commitment to reducing GHG emissions may not be replicated elsewhere. Thus, development of the same or similar project at another domestic site outside of New York would result in less stringent GHG reduction requirements.

8.1.2 New York State's Environmental Regulation Infrastructure

New York is one of few states in the U.S. that has proposed and enacted policies focusing on climate protection, creating the potential for leakage of emissions "in excess of emissions from the project" were the Proposed Project to be built elsewhere in the country.

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[27] Congressional Research Service, "Semiconductors and the CHIPS Act: The Global Context" (Sep. 28, 2023), https://www.congress.gov/crs_external_products/R/PDF/R47558/R47558.5.pdf.

[28] National Institute of Standards and Technology, U.S. Department of Commerce, "Vision for Success: Facilities for Semiconductor Materials and Manufacturing Equipment" (Jun. 23, 2023), https://www.nist.gov/chips/vision-success-facilities-semiconductor-materials-and-manufacturing-equipment.

As noted earlier in this analysis, New York State leads the nation in environmental protection policies. With DAR-21 and DEP 24-1 in place, New York State has created policies to reduce GHG emissions and protect DACs across the State. As a recognized leader in greenhouse gas reduction, New York continues to advance progressive climate initiatives and implement programs aimed at achieving long-term emissions reductions. By constructing the Proposed Project in New York State, Micron will comply with regulations and policies that focus on the reduction of statewide carbon emissions. Therefore, placement of the Proposed Project in New York is inherently mitigating environmental impact that may have occurred otherwise elsewhere in the U.S, which would constitute "leakage in excess of emissions from the project" per DAR-21.

In addition to driving direct GHG emission reduction at industrial facilities, the CLCPA also sets statutory targets to decarbonize New York State's electric grid. With the achievement of its 2040 goal for 100% zero-emissions electricity, New York State would become one of the first states with a 100% clean grid. This goal will ensure that the Proposed Project, which will initially rely on VPPAs and RECs to offset its electricity use, can eventually meet its entire electrical demand through 100% zero-emissions electricity, consistent with Micron's goal of 100% renewable energy use across all U.S. fabs.

8.1.3 Evaluation of Alternate Sites

The siting of a modern semiconductor fab requires analysis of several many factors including availability of reliable power, a significant source of fresh water, access to transportation corridors to ship raw material and products, availability of a reliable workforce and several other factors. In arriving at the selection of the WPCP as the location for the Micron Campus, Micron completed an 18-month review of potential construction and operation sites and analyzed 14 properties before selecting the present location as the most suitable for the Proposed Project. Micron's selection of this location is summarized in their public announcement of the project in October 2022.[29]

Separately, over the last two decades, New York State has undertaken an evaluation to identify candidate sites for semiconductor manufacturing. That process identified four sites throughout New York State as "shovel ready" sites for semiconductor manufacturing, including in Onondaga County's WPCP.

In 2018, the New York State Economic Development Council (NYSEDC) prepared a "Competitive Site Location Benchmarking for Semiconductor Manufacturing" study (also known as "Project Rhino"). The purpose of the benchmarking study was to assess and compare four (4) sites in New York State, including WPCP, for their readiness to support semiconductor manufacturing. The 2018 benchmarking study evaluated the NY sites against five categories, each of which had several factors including: site quality and suitability; workforce and community alignment; utilities capacity, quality, and reliability; economic development and regulatory context; and incentive capacity and capability. WPCP ranked second nationally for access to utilities and readiness of those utilities to serve the site, and on balance, the study

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[29] Micron Announces Historic Investment of up to $100 Billion to Build Megafab in Central New York, https://investors.micron.com/news-releases/news-release-details/micron-announces-historic-investment-100-billion-build-megafab, Accessed February 18, 2024.

concluded that New York State led all competitors in terms of the capacity, capability, and probability of delivering a meaningful incentives package.

In addition, over the last several decades, OCIDA has continued to review potential sites for economic development in Onondaga County, including a commissioned Industrial Park Feasibility Study to identify potential candidate sites for locating industrial businesses in Onondaga County. OCIDA ultimately selected WPCP as its preferred site to attract private industrial and commercial development because of its size, potential for industrial zoning, access to transportation, proximity of utilities, as well as a history of Town of Clay efforts to facilitate industrial development at the property.

In their 2021 Supplement to Generic Environmental Impact Statement (SGEIS), OCIDA revisited their previous evaluation to address the question of whether WPCP was still the preferred alternative to attract industrial and commercial development to Onondaga County, and compared it to the same alternative candidate sites that were assessed in the 2012 Draft Generic Environmental Impact Statement (DGEIS), concluding that “[n]one of the previously considered alternative locations would be able to accommodate the large-scale industrial use that the [White Pine Commerce] Park is promoting due to size limitations and proximity to services and necessary infrastructure.” The 2021 SGEIS further concluded that significant expansion of WPCP was feasible and more likely to attract leading edge manufacturing, such as semiconductor manufacturing.

Therefore, the WPCP is an ideal location for such a project, by both state and national standards.

8.1.4 Alternate Project Scales Evaluated

While Micron is seeking a Title V air permit for the construction and operation of two 600,000 square foot fab operations, associated support buildings, and equipment, the rapid growth of the demand for memory-based semiconductors warrants the Proposed Project’s four fab facility.[30] Specifically, the industry is projected to double in the next 10 years driven by the growth in AI and the data economy. The semiconductor industry of today focuses on economies of scale; the need to build fewer, larger fabs; and the managerial and economic benefits regarding workforce and reducing operational downtimes during expansions. The alternative of building fewer fabs at the WPCP location and instead building the remaining fabs at a different site is not feasible. Moreover, splitting fabs among two or more sites within New York is in direct contradiction to the goal of the CHIPS Act and Green CHIPS Act as it will jeopardize Micron’s ability to compete at a global scale with other megafab sites of its competitors, resulting in significant economic and operational impacts that include:

- Additional infrastructure cost associated with building the other two fabs needed for the market growth at a different site;
- Loss of operational efficiencies that increase with co-located scale; and

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[30] Note while Fabs 1 and 2 are being permitted currently due to the planned construction schedule, emissions as represented in this analysis are intended to cover all four fabs.

- Reduced supplier eco-system.

Importantly, for this analysis, splitting the four fabs among two or more sites within New York would result in increased environmental impacts. Construction of all four fabs at the WPCP reduces the environmental impact by minimizing the operations infrastructure necessary. This approach is consistent with a growing industry trend to co-locate multiple fabs on a single site to achieve economies of scale and efficient supply chain and feedstock management in addition to minimizing total project footprint and environmental effects (other, older chip manufacture locations in the State tend to include only a single fab with ancillary facilities). Maintaining efficient process flows through the manufacturing steps (fabrication to packaging) is represented on the site by close-fitting manufacturing elements (e.g., Fab, CUB, gas yard, material storage, etc.) and by having the 4 Fabs close to each other as they will be connected to allow efficient material flow between them. Each respective phase is represented by a replicated, independent layout. Synergies are afforded by shared supporting facilities, which are located around the center core or spine of the manufacturing process. These elements include administrative, ultra-pure water (UPW) purification, wastewater treatment/recycling, stormwater management, warehousing, and parking.

For example, the National Grid substation that will service the first two fabs will also provide service to the Fabs 3 and 4 and thus reduce the impact of electricity transport equipment related to Micron operations. Additionally, all four fabs will be linked to centralized services including offsite wastewater treatment and recycling system which would otherwise need to be copied at a secondary site. All fabs will further be linked to the installations for heating and operations currently included in the Proposed Project's Air Permit Application. By providing for the potential development of all four fabs at the WPCP, Micron is reducing the potential for leaks in refrigerant and gas systems as well as reducing the energy and combustion necessary for startup of Fabs 3 and 4.

Therefore, pursuing a facility that embodies economies of scale principles reflects a GHG minimization approach in that development of similar production capacity across multiple smaller facilities would likely result in a greater overall GHG footprint.

8.2 Community Risk and Resiliency Act (CRRA) Analysis

CRRA, as enacted in 2014 and amended by the 2019 CLCPA includes several major provisions including consideration of climate hazards and future physical climate risk on the facility and surrounding communities.

The annual statewide average temperature in New York has risen by 3°F since 1970 and another 5.1–10.9°F rise is anticipated by the 2080s, with the most significant impact occurring in the northern parts of the State.[31] As a result of an overall warming trend, warmer winters across the State would result in less snow and an earlier snowmelt. Rising annual temperatures would have cascading effects on aquatic

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[31] NYSDEC, New York State Department of Environmental Conservation. (2024). Climate Change Effects and Impacts. Accessed November 2024. https://dec.ny.gov/environmental-protection/climate-change/effects-impacts.

ecologies of lakes and ponds surrounding the Great Lakes, which are sensitive to snowmelt and subsequent algal growths. Creeks and rivers, especially those which lack or have lost connection to floodplains, forested buffers, or contact with groundwater and headwaters, are more vulnerable to altered biodiversity and flows of riverine ecosystems due to extreme heat.

With the total number of hot days, as well as frequency and duration of heat waves expected to increase, urban areas may be even more intensely impacted due to the "heat island effect." The Proposed Project would result in many changes to land use, including the construction of concrete, pavement, and other dark-colored impervious surfaces, and built environment consisting of building structures. Additional heat-generation at the Proposed Project would originate from energy consumption, construction, industrial operation, and mobile source emissions from transportation.

Increases in surface temperatures in the areas where the Proposed Project and Connected Actions would be located may further exacerbate already existing adverse effects of extreme heat. Impervious surfaces such as concrete and pavement can reach temperatures 40˚F or more above grass temperatures under the same conditions.[32] Increased pavement temperatures during or immediately after precipitation events can heat stormwater runoff that drains into sewers, further raising water temperatures when released into bodies of water, negatively affecting aquatic ecosystem productivity.

Increased surface temperatures are expected to adversely impact the levels and extent of groundwater availability. Higher surface temperatures would lead to increased evaporation and evapotranspiration, leading to a decline in groundwater levels as more water is pulled from the aquifer to compensate for lost water at the surface. There are no withdrawals of groundwater expected for the operation of the Proposed Project, and therefore no direct effects to groundwater due to withdrawals.

The increase of impervious surfaces associated with the Proposed Project would reduce the surface area in which precipitation may infiltrate into the ground, which could lead to long-term reductions in groundwater recharge. However, post-construction Stormwater Management Practices (SMPs) will be used for both treatment and infiltration of stormwater captured on the Micron Campus. SMPs will include wet extended detention ponds, infiltrations basins, and filtration bioretention controls. These SMPs will be utilized to detain, store, and filter stormwater before releasing it underground to aid in infiltration. Other SMPs that are being considered include stormwater planters with underdrains, dry swales, rainwater harvesting systems, green roofs, rooftop disconnection, and porous pavement. Information gathered from all 43 groundwater monitoring wells would be incorporated into operational design considerations in an adaptive manner once construction of the Proposed Project is complete.

Future projects in Onondaga County and the four surrounding counties may impact groundwater by requiring the storage and handling of chemicals of potential groundwater pollutants, dewatering, or other groundwater withdrawals. Groundwater depletion, in turn, will negatively impact water supply, as extreme

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[32] Knox, P. (2022). How Hot Does Pavement Get in Summer? UGA Cooperative Extension. Accessed April 2025. https://site.extension.uga.edu/climate/2022/05/how-hot-does-pavement-get/#:~:text=You%20can%20see%20from%20the,still%20hotter%20than%20the%20air.

heat will increase the demand for water used for drinking, recreation, and cooling. However, all future projects will need to comply with relevant Federal, State, and local environmental laws and regulations, including New York State programs that require municipalities to consider climate change and climate change resilience in their planning efforts, construction stormwater permits and, in some cases, operational effluent limitations associated with CWA Section 402 and ECL Article 17 which would minimize direct and/or indirect impacts to groundwater, including contamination. Due to Federal, State, and local regulations that are intended to protect groundwater supplies, groundwater impacts associated with induced growth are not anticipated to be significant. The impacts of each future development action that might be considered induced growth associated with the Preferred Action Alternative would be specifically assessed during the permitting process for each new development action/project.

Increases in heat index (which pairs temperature with relative humidity), are expected to affect temperatures at the Proposed Project and Connected Action locations. High heat and moisture can cause structural weakening, corrosion of metal parts, shortening of roof lifespans, and wood damage through swelling and rotting. Air temperature and changes in humidity can impact building materials such as drywall, brick, and electrical systems. The Proposed Project will be engineered to withstand these temperature increases, and there is no reason to believe that the public utilities responsible for constructing and operating the Connected Actions would fail to engineer the structures to withstand anticipated changes in climate, including heat index. Micron’s Business Continuity process ensures that infrastructure is constructed with resiliency for natural disasters, climate change, and other factors in mind. In addition, the buildings will primarily be steel and concrete structures, not wood and drywall.

Climate change is also intensifying the frequency and strength of extreme weather events in New York State and includes impacts to the intensity and frequency of extratropical cyclones (including nor’easters), tropical cyclones, thunderstorms, drought, snowfall, extreme cold, and Great Lakes ice cover. An increased number of extreme precipitation events are likely, which is consistent with the expectation that warmer air, warmer bodies of water, and increased evaporation will contribute to the formation of more intense storms.[33] However, these climate impacts are not anticipated to have any significant effect on the Proposed Project. The Proposed Project’s structures are made of industrial-grade concrete and steel, which should be unaffected by projected weather events in Upstate New York. The infrastructure associated with the Proposed Project is also protected from anticipated extreme weather events because it is similarly constructed, and much of it buried and cased in concrete or other material that would withstand heat and weather (e.g. water/wastewater, fiber, natural gas, and electrical lines are all underground). Even the electrical substation has $150 million in lightning protection invested in it over the last seven years. As explained above, natural disasters are contemplated in Micron’s Business Continuity plans, and part of the reason Micron chose Upstate New York as the location for the Proposed Project was the low risk of natural disaster impacts to Proposed Project operations.

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[33] NYSDEC, New York State Department of Environmental Conservation. (2024). Climate Change Effects and Impacts. Accessed November 2024. https://dec.ny.gov/environmental-protection/climate-change/effects-impacts.

Although no regulated floodplains are located within the property boundaries of the Micron Campus Site, the Childcare Site, or the Rail Spur Site,[34] heavy precipitation events can lead to flooding and damage to infrastructure in urban areas with impervious surfaces that are like those located at the Proposed Project and Connected Action sites. This increase in impervious surface coverage may decrease groundwater recharge and increase stormwater runoff and flooding events as excess water can potentially overwhelm the ability of the natural landscape and the built environment to absorb it or carry it away in a timely manner. Changes in hydrology during project operations and from climate change would be minimized through the creation of a stormwater management system strategically designed around the Proposed Project's sites (Micron Campus, Childcare Site, Rail Spur Site). These systems are specifically designed to accommodate, slow, and hold stormwater runoff created from the buildings, roads, and other impervious surfaces.

In addition to the increase in stormwater runoff volume, the presence of pollutants that are often carried with stormwater runoff over impervious surfaces can alter surface water chemistry and pose a threat to aquatic plant and animal species. Therefore, the effects on water quality from permanent changes in stormwater runoff can potentially be major if not addressed. However, the effects on water quality from impervious surface stormwater runoff would also be minimized through the creation of stormwater management systems for the Proposed Project. These systems would be designed to hold and naturally filter stormwater prior to being released to nearby surface waters, which will minimize the likelihood that water quality will be affected.

SMPs such as wet extended detention ponds, infiltration basins, and filtration bioretention controls would be incorporated into the design of the Proposed Project to minimize potential stormwater effects from the Proposed Project, as well as from projected increases in precipitation due to climate change. Stormwater modeling was used to size stormwater pipes, bridges, and SMPs to accommodate flows from the 10-year and 100-year storm events and keep post-development peak flow values at or below the pre-development peak flow values in accordance with the *2024 New York State Stormwater Management Design Manual*.[35] Overall, SMPs would maintain existing drainage patterns as much as possible, continue the conveyance of upland watershed runoff, control increases in stormwater runoff, prevent soil erosion and sedimentation, and provide runoff reduction using green infrastructure measures.

Though the Proposed Project is expected to be impacted somewhat by climate change, given projected increases in temperatures and extreme weather events, these impacts are not anticipated to be significant. Micron chose the Proposed Project Site in Part because the area posed very low climate risk to the Proposed Project, including consideration of Special Flood Hazard Areas (SFHAs), base flood elevations, flood insurance risk premium zones, and 500-year floodplains. Through the planning and implementation of resilience strategies such as stormwater management practices and green infrastructure measures,

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[34] These properties are all considered to be Zone X "Areas determined to be outside the 0.2 percent annual chance floodplain" by FEMA.

[35] New York State Department of Environmental Conservation (NYSDEC). (2024g). New York State Stormwater Management Design Manual. https://dec.ny.gov/environmental-protection/water/water-quality/stormwater/construction-stormwater-toolbox.

Micron possesses the ability to minimize the vulnerability of the Proposed Project to climate-related effects.

The Proposed Project is not anticipated to significantly affect the climate resiliency of the surrounding area. The Proposed Project would not directly contribute to the demand for groundwater, increase the likelihood or severity of local flooding, or affect the ability of the surrounding area to respond to future increases in temperate, storm activity, or precipitation. The Proposed Project would rely primarily on water withdrawn, and ultimately returned to Lake Ontario, which is one of the largest freshwater bodies in North America. While there are projections for increased variability in lake levels under future climate scenarios, including potential for extreme highs and lows, the expectation is that water levels in the lake are anticipated to increase slightly in a future affected by climate change, which further indicates that the Proposed Project is unlikely to have any significant adverse impact on freshwater supply.

8.3 Alternatives and Mitigation Measures Considered

Due to the increase in GHG emissions associated with the Proposed Project, a thorough review of potential alternatives and mitigation measures that could reduce GHG emissions is included throughout the analysis above and serves as evidence to support the justification of the Proposed Project.

8.3.1.1 Micron Campus Long Term Operations Stationary Sources

The Proposed Project will include GHG emission sources such as semiconductor process tools utilizing F-GHGs, tool-level thermal oxidation systems, combustion equipment, and process chillers using HTFs that are GHGs. Micron has carefully considered potential alternatives and mitigation measures to reduce GHG emissions from these sources wherever possible.

As noted in Section 2.5.4 of this analysis, many processes in semiconductor manufacturing produce significant GHG emissions that have no alternative with current technology. Micron will continue to evaluate viable alternatives and mitigation measures for various operations including the thin films process and supercritical CO_2 gas.

Technologies such as NF_3 remote chamber cleaning in thin films tools will be implemented from the start of the operation of the Proposed Project to minimize GHG emissions; this system maximizes utilization efficiency of cleaning gas to reduce the CO_2e released from the chamber following the cleaning process. Micron will also maintain RCS technology to oxidize F-GHGs from the plasma etch process. F-GHGs from process operations are major contributors to the emissions of the Proposed Project. Oxidizing the resulting F-GHGs into acid gases, carbon dioxide, and non-GHGs gases will substantially mitigate GHG emissions.

In addition to process operations, the Proposed Project will have GHG emissions from utilities within the fabs, including from the HTFs and combustion installations. Micron has successfully evaluated two HTF replacement alternatives to reduce GHG emissions that will be implemented at the facility. Micron will continue to reduce emissions from HTFs by evaluating alternative, low GWP, HTFs for use throughout the

Proposed Project. Further, Micron has established BMP to mitigate HTF losses and emissions during start-up and normal operation.

Through the rigorous review of GHG emission sources, potential alternatives, and potential mitigation measures for the Proposed Project included above, Micron has identified measures to minimize emissions from the Proposed Project. Micron believes that these measures support the justification of the Proposed Project.

8.3.2 Other Proposed Alternatives and Mitigation Measures

As part of the Green Chips program, outlined in Section 1, and in addition to the alternatives and mitigation measures specific to stationary sources on the Micron Campus, Micron is proposing broad measures to reduce its GHG impacts.

By proposing the Rail Spur Site as an alternative to truck traffic to deliver fill material to the Micron Campus, Micron is avoiding the need for approximately 7,300 trips by trucks running on diesel fuel. On the Micron Campus itself, Micron is committing to install approximately 4 MW of solar panels on the roofs of various buildings.

Further, Micron plans to provide electric vehicle (EV) charging stations and infrastructure that promotes bicycle usage (such as bicycle storage and shower rooms) and will provide shuttle bus options inside the Micron Campus to facilitate travel between Micron buildings and will fund an express Public Transit Service route in collaboration with Centro.

Micron will aim to achieve Gold LEED rating status for the proposed fabs and office buildings, embedding sustainable technology into the construction of the Proposed Project.

These additional mitigation measures demonstrate Micron’s commitment to considering its GHG impacts in all aspects of design.

8.4 Economic and Social Benefits

The Proposed Project is further justified due to Micron’s commitments to promote sustainability, economic development and security, and create a platform to advance climate conscious local economic development. The initiatives described in this section demonstrate “environmental, economic, and/or social harm associated with the absence of the [Proposed Project],” as described in DAR-21.

Central New York and other regions of New York State have experienced a reduction in manufacturing jobs over several decades. The Proposed Project is a tangible high-tech advanced manufacturing initiative that will deliver the promise of transforming the greater Central New York economy through new high-paying jobs, significant financial investment, and increased economic activity, including, but not limited to: (1) the creation of tens of thousands of jobs, including construction jobs, direct jobs, and community jobs; (2) a robust supply chain of companies that will service a high-tech advanced manufacturing organization; (3) a reduction in poverty; (4) an increased commitment to education supports in K-12, trade and vocational services, and higher education, and (5) secondary benefits that could include increased restaurant patronage, more and increased attendance at concerts and events, fully supported civic and cultural organizations, and a renewed community vibrancy typically associated with high-tech hubs.

Micron has also had preliminary conversations with government stakeholders regarding collaboration opportunities with New York State-based universities related to research and development activities that reduce emissions from facility operations.

Micron will need a skilled workforce to support its manufacturing processes and is working with the local trades, and the State, and Onondaga County economic development groups to provide education and training opportunities for this anticipated workforce. Micron anticipates that the Proposed Project will create nearly approximately 9,000 Micron employees by FY2044. Beyond Micron's direct hires, Micron estimates over 50,000 community jobs including suppliers, contractors, and other supporting roles. Thus, the Proposed Project will result in significant additional socioeconomic benefits, through direct and secondary economic development and job demand.

Micron is also making other commitments that will promote the growth of a sustainable local economic ecosystem. Micron will invest $250 million through the Green CHIPS Community Investment Fund, targeting investments in workforce development, education programs, and other community investments. New York State and other local, state, and national partners will invest another $250 million to make this a $500 million fund. Among other goals, the Green CHIPS Community Fund will help develop the local workforce and invest in education throughout Central New York. A highly skilled workforce will create a platform for local service providers and supply vendors, avoiding GHG emissions associated with distant service support and supply.

In addition to the $250 million provided by Micron through the Green CHIPS CIF, Micron has also been selected to participate in the CHIPS Workforce Initiative, provided by the federal government. Under this initiative, Micron will partner with local groups, including not-for-profits and educational systems to allocate federal funds on workforce initiatives in New York State. Micron will partner with a local intermediary to assess and approve grant applications and provide funding for programs that support workforce development for the Proposed Project.

As noted in Section 7 above, due to its location, the Proposed Project is not expected to adversely burden any disadvantaged communities.

Micron's commitments to the community in conjunction with the Proposed Project demonstrate its clear economic and social benefits to local community members and New Yorkers alike.

Finally, in pursuing the Proposed Project, Micron is committed to:

- Utilizing 100% carbon free electricity for purchased electricity needed for its fab complex operations;
- Achieving a minimum of LEED gold status for all fabs and office buildings;

- Obtaining a 75% water recycling and reuse ratio with a target of, if feasible, 100% water conservation through reuse, reclamation, and restoration; and
- Aiming to achieve zero waste to landfills.

These concrete commitments, individually and collectively, ultimately serve the goals of the CLCPA, while also representing the largest private investment in New York State history. Micron's sustainability and local investment commitments further justify the Proposed Project's development under the CLCPA.

APPENDIX A SEMICONDUCTOR PROCESS OVERVIEW

This appendix presents an excerpt from Section 1.4 of the Micron Clay Air Permit Application dated March 2025 that describes the semiconductor processes that will be conducted at the Proposed Air Permit Project.

1.4 Semiconductor Process Overview

The Proposed Air Permit Project will house state-of-the-art manufacturing operations to produce memory chips to be used in electronic devices. The core manufacturing operations will take place in cleanrooms within the fab. Cleanrooms are engineered spaces designed to maintain high air quality with low levels of particulates to avoid contamination of products in the manufacturing process. To successfully operate a modern fab, air in a clean room must be exchanged frequently to meet the strict temperature, humidity, and purity requirements of the cleanroom. Process tools and other support equipment are housed within the cleanroom. Below the fab, support operations, such as exhaust management and raw material supply, will occur in the "subfab".

The manufacturing of semiconductor devices involves many specialized processes that can each generate air emissions in a distinct manner. For the purposes of this air permit application, these processes have been grouped into seven distinct categories, each of which is described in a subsection below. Each of these process categories will have many individual pieces of equipment that carry out the intended operation, each referred to as a "process tool" or simply a "tool."

1.4.1 Fab Process Categories

The semiconductor manufacturing process begins with thin disks of high-purity silicon called wafers, which undergo a large number of individual process steps. The seven process categories described below each play a unique and critical role in generating a memory chip. Each wafer will undergo some or all of these processes in a specific order to achieve a desired end result. A wafer may be processed by one tool multiple times throughout the production process if its design requires the same operation to be performed more than once.

1.4.1.1 Thin Films / Diffusion Deposition

The "thin films" processes each deposit a thin film of a specific material onto a wafer. This category includes processes that occur within the functional area within a fab known as "diffusion" but involve the deposition of a layer of material onto a wafer. The deposition can be performed either via a chemical reaction (chemical vapor deposition [CVD]) or a physical deposition (physical vapor deposition [PVD]). As the industry advances and semiconductor components become smaller over time, atomic layer deposition (ALD) processes have become more common. Gaseous raw materials are used in the deposition process to create a film of a specific portion of the raw material molecule on a wafer.

In thin films operations, the chamber is filled with gases intended to deposit onto a wafer(s). Due to the physics of having gaseous materials in a volume, not all compounds that are in the vapor can be deposited onto the wafer. Therefore, some raw material may be exhausted from a tool without being deposited on a wafer. Individual ions may be left on the walls of a tool chamber. To remove leftover ions and prepare for the next process, a thin films tool may be cleaned with a fluorinated gas. Chamber cleaning is distinct from other semiconductor processes in that it does not occur in the presence of a wafer. The most common gas used to clean thin films tool chambers is nitrogen trifluoride (NF_3) using the "remote clean" process, in which NF_3 is cracked into ionic radicals prior to entering the tool chamber. In the chamber, leftover positively charged ions react with fluorine to form compounds that can be exhausted from the tool chamber.

Air emissions from thin films tools include gaseous raw materials or cleaning gases that are not consumed, byproducts that are formed from partial decomposition and/or combustion of gaseous raw materials in thermal oxidation devices, some of which are criteria pollutants or HAP, and products of combustion of natural gas in thermal oxidation devices.

A PVD process known as "sputtering" is used to deposit metal ions onto a wafer by physically dislodging ions from a solid metal "target" using argon plasma, then directing them onto a wafer. This operation occurs within a tool that is closed during the sputtering process with no vent. Due to the nature of the metal ions in the vapor space of the tool, metal ions not deposited on a wafer will coat the inside of the tool prior to the tool being opened to remove the wafer(s). Therefore, this process does not generate emissions to the atmosphere and is not considered further in this air permit application.

1.4.1.2 Diffusion Non-Deposition

"Diffusion non-deposition" involves the diffusion of ions through a set of wafers to create specific electrochemical properties. These processes may also take place in the "diffusion" functional area of a fab, but do not add material to a wafer. Their goal is to modify the electrochemical properties of the existing material. Gases such as nitrous oxide (N_2O) may be used in this process.

Air emissions from diffusion non-deposition tools include gaseous raw materials not consumed, byproducts that are formed from partial decomposition and/or combustion of gaseous raw materials in thermal oxidation devices, some of which are criteria pollutants or HAP, and products of combustion of natural gas in thermal oxidation devices.

1.4.1.3 Plasma Etch

Plasma etch or dry etch processes remove material from a wafer surface in a pre-determined pattern. Prior to etching, a photoresist layer is placed onto a wafer to protect the area that should not be etched. Plasma etching is performed by removing air from a process tool, introducing an etchant and carrier gas, and creating plasma in the tool chamber. Etchant gases are often fluorinated hydrocarbon compounds (fluorocarbons), as the fluoride ion (F^-) is a very effective etchant. Under plasma conditions, the fluoride ion and carbon-fluorine fluoride radicals are freed, which will strike a wafer surface and remove material from areas not covered by the photoresist layer.

Processing requirements for high-aspect ratio plasma etching continue to become more stringent, requiring both fluoride ion to etch and the right carbon-to-fluorine ratio to ensure successful etching results. The molecular shape of each fluorocarbon is critical to the manufacturing process because it defines the ability for the fluorocarbon etching gas to achieve the desired geometry and etch rate.

Plasma etch processes are a source of GHG emissions, as many of the etchant gases used in the industry are GHGs that can form other GHGs while in the plasma state. Point-of-use (POU) control devices, discussed in Section 1.4.3 below, are often installed to combust these high-GWP gases and reduce GHG emissions on a GWP basis. Where possible, Micron is opting to install centralized regenerative catalytic systems (RCS) to control GHG emissions while using less fuel.

In addition to these process GHG emissions, air emissions from plasma etch processes include other unreacted etchant gas byproducts that are formed from partial decomposition and/or combustion of etchant gases, some of which are criteria pollutants or HAP, byproducts that are formed from reaction of etchant gases with a metal substrate on a wafer being etched, and products of combustion of natural gas in POU control devices and RCS.

1.4.1.4 Photolithography

Photolithography is the process of imaging a pattern onto a wafer. Photoresist material, which contains solids in a solvent solution, is first applied to a wafer in an even layer, then heat treated to remove a portion of the solvent material. A "mask" is then placed over the wafer, and light of a specific wavelength is projected through transparent areas of the mask, forming a specific pattern.

After the photoresist layer has been exposed in certain areas through the mask, it is "developed" in a solution designed to remove only the exposed or unexposed portion of the material. The wafer is then rinsed to remove any excess developer solution. At this point, the wafer is still partially covered in photoresist material in a designated pattern, with the remainder of the wafer exposed. The wafer will move to another process to have a specific operation, such as etching or deposition, performed on only the remaining portion. Once it is no longer needed, the remaining photoresist material can be removed from the wafer in a process called "ashing", in which the organic solids of the photoresist material are oxidized.

Air emissions from photoresist process tools include VOC emissions from evaporation of photoresist and developer solvents. Organic compounds may be oxidized by the control devices discussed in section 1.4.3. below, generating NO_X, SO_X, and CO_2. The ashing process generates additional emissions of CO and CO_2.

1.4.1.5 Wet Etch/Wet Clean

Aqueous solutions are used in wet etch and wet clean tools to achieve multiple objectives in wafer processing. Inorganic solutions are used to remove material from a wafer in a predetermined area. Separately, aqueous inorganic and organic solutions are used to remove impurities from wafer surfaces in between processing steps. In some cases, multiple solutions are dispensed onto a group of wafers in a single tool chamber, called a single wafer tool, in lieu of separate chambers for each solution. Process tool parts may also be cleaned.

Wet processes, regardless of whether they are designed to etch a wafer, clean a wafer, or clean process tool parts, generate air emissions through the evaporation of the organic or inorganic solvent being used. Emissions from each solution, which can include VOC and HAP, will be exhausted to an appropriate emissions control device.

1.4.1.6 Ion Implant

Ion implant processes, also known as "doping", insert specific chemical elements into a silicon layer on a wafer to create a semiconductor. Like etching, ion implant occurs after a photoresist step, which protects certain portions of the wafer and leaves other portions exposed. A wafer is placed in an implanter tool, the air is removed, and then a dopant gas, such as arsine or phosphine, is introduced. A plasma environment is created to generate free metal ions from the dopant gas, which are electromagnetically accelerated to allow them to embed into exposed areas of the wafer. Air emissions from ion implant processes are generated from dopant gas that is not utilized as part of the process.

1.4.1.7 Chemical-Mechanical Planarization

Chemical-mechanical planarization (CMP) is the process of polishing a wafer surface into an even layer, which is accomplished using slurries containing abrasive particles suspended in other chemicals. Many different chemicals are used for the slurries to remove different materials from a wafer. After completing a CMP process, a wafer might then be cleaned to remove any excess particles or other materials.

Depending on the volatility of the chemicals used in the slurry, which could include VOC or ammonia, the CMP process can result in air emissions due to evaporation of a portion of the slurry.

1.4.1.8 Fab Support Chemicals

Isopropyl alcohol (IPA) is used extensively throughout the fab to clean process tool chambers, work benches, parts, floors, or other items, and is a VOC. Several heat transfer fluids (HTFs) that are GHGs are used in process temperature control loops that have the potential for fugitive emissions from flanges, connections, etc. These sources of emissions are the only sources from the main fab not covered under one of the previous seven process categories discussed above.

1.4.2 Fab Exhaust Management

Due to the complexity and variety of semiconductor process operations described above, resultant exhaust must be managed effectively to not only control air emissions but to protect equipment and employees.

1.4.2.1 Managing Safety Hazards

Like other semiconductor manufacturers, the Proposed Air Permit Project will operate a number of process tools that in some cases exhaust a variety of different materials that must be managed to minimize safety hazards and protect facility systems. To manage these materials, certain tools will exhaust to Process Equipment Exhaust Conditioners (PEECs), which are required safety equipment and an inherent part of the semiconductor manufacturing process.[16] Exhausts from thin films tools containing pyrophoric, flammable, and/or toxic materials are generally required to be managed to ensure personnel safety and facility protection. Wet process and single wafer tools using chemicals incompatible in exhaust require management to avoid the formation of hazardous reaction

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[16] Letter from D. Solomon, EPA Office of Air Quality Planning and Standards, to T. Mohin, Intel Government Affairs (Nov. 27, 1995)

byproducts that clog ductwork and to prevent damage to or failure of exhaust ductwork and control equipment. If left unmanaged, pyrophoric, flammable or reactive materials could pose a safety hazard by exceeding 25% of the Lower Flammability Limit within the duct work. In addition, exhausts containing acids and ammonia in the same vent system must generally be managed because untreated streams would generate reactions that form solids, plug the vent headers, and/or damage the control devices.

A fab cannot operate safely without PEECs in place and operational. Redundant PEECs will be installed as part of the Proposed Air Permit Project to ensure uninterrupted hazard management and to maximize the time during which process tools can operate. PEECs are considered exhaust conditioners, not air pollution control devices, because they are installed to address the safety and facility integrity issues that occur when pyrophoric, flammable, and/or incompatible materials are present in a vent stream. Indeed, no modern semiconductor manufacturing facility would be designed without PEECs, regardless of whether environmental regulations existed to limit emissions.

1.4.2.2 Exhaust Segregation

In addition to operation of PEECs, semiconductor fabs can further minimize the occurrence of undesirable chemical reactions in exhaust systems by segregating different classes of chemicals to separate exhausts. Mixing incompatible process tool exhaust streams can result in undesirable reactions, collection of solids and/or flammable material within the ductwork, and other undesirable results. In addition, different vent streams require different construction materials to prevent corrosion and/or failure of ductwork, and process tools are programmed and designed to operate only when these vent streams are separated. For example, acid gases and ammonia will rapidly form ammonium compounds when combined in the exhaust duct of process tools not equipped with PEECs, which may result in visible emissions from stacks. To avoid this and similar issues, modern semiconductor fabs utilize separate exhausts ductwork, systems and air pollution control for streams containing acidic compounds, caustic compounds, and organic compounds.

Exhaust from the Proposed Air Permit Project will be routed to the compound-specific common vent header to one of five exhaust types: acid exhaust, CVD exhaust, ammonia exhaust, solvent exhaust, and general exhaust. Each exhaust type is described in detail in Section 1.4.2 and serves a unique purpose, collecting and routing a specific category of process exhaust to control devices or the atmosphere directly as necessary. The exhaust from several process tools in each subsection of the fab will be routed to a common exhaust header appropriate for the type of the exhaust, and then will be distributed from the header to multiple similar control devices along the length of the header, each of which is equipped with stacks to the atmosphere. Each exhaust type will have dozens of individual stacks at Fab 1 and Fab 2. This redundant arrangement will ensure that adequate control is provided at all times, even during maintenance of control devices. Fab 1 and Fab 2 will be divided into two (2) "halves" each, and each half will be equipped with one common vent header for each exhaust type.

1.4.3 Fab Control Devices

For each exhaust type introduced in Section 1.4.2.2 above, with the exception of general exhaust, a unique type of control device will be used. In addition, plasma etch processes will be equipped with POU control devices and centralized RCS to reduce emissions of GHGs. Each type of control device is discussed in the sections below.

1.4.3.1 Centralized RCS

The Proposed Air Permit Project will employ centralized RCS where feasible to control GHG emissions from plasma etch processes. Each RCS will include a pre-wet scrubbing stage, a natural gas-fired catalytic oxidation stage, and a post-wet scrubbing stage. Exhaust from each RCS will be routed to a fab acid scrubber, discussed below, for further treatment. The RCS will use significantly less natural gas than POU control devices. RCS cannot be used to control exhaust from plasma etch tools in which metal substrates are etched ("metal etch" tools), as metal compounds could form in the catalytic section and damage the catalyst.

1.4.3.2 Point-of-Use Control Devices

POU control devices will be used at or near metal etch process tools to control emissions from metal etch processes, since RCS are not feasible. Thermal oxidation is used as a part of POU control devices to control emissions of fluorinated GHG by thermally treating exhaust streams from process tools that utilize GHG. These POU control devices also use wet scrubbing systems to control the resultant acid gases.

1.4.3.3 Fab Exhaust and Centralized Control Devices

As introduced above, process emissions from each of the seven process categories described in Section 1.4.1 above will be emitted through segregated ductwork designed to manage one of five exhaust types. Each exhaust type, along with the planned control equipment, is described in detail in this section.

1.4.3.3.1 Acid Exhaust

Exhaust streams containing acid gases, including hydrogen fluoride (HF) and hydrogen chloride (HCl), will be routed to this exhaust type. Process categories that generate acid-containing exhaust include plasma etch and diffusion non-deposition, in which acid gases are generated as byproducts of the processes, POU control devices, and/or RCS, and wet etch/wet clean, in which acids may evaporate. Micron is proposing to control emissions from the acid exhaust using centralized wet scrubbers.

1.4.3.3.2 CVD Exhaust

CVD and ALD processes, both subsets of the thin films category, can generate emissions of both acid gases and PM that each need to be controlled. Acid gases may be formed due to decomposition of fluorinated or chlorinated deposition gases, and PM and NO_X may be formed due to oxidation in POUs. To control both categories of pollutants, Micron is proposing to install ionizing wet scrubbers that include both acid scrubbing and electrostatic precipitating technologies. Micron anticipates installing ionizing wet scrubbers with DeNOx technology to remove NO_2 through wet scrubbing.

1.4.3.3.3 Ammonia Exhaust

Ammonia is used in aqueous solution in both the CMP and wet etch/wet clean processes. In addition, other ammonia-based compounds are used in the photolithography process. Exhaust containing these chemicals must be segregated from exhaust containing acids and VOCs. Therefore, exhaust from certain areas of these three processes will be treated separately. Micron is proposing to install centralized ammonia scrubbers on this stack type.

1.4.3.3.4 Solvent Exhaust

Both the photolithography and wet etch/wet clean processes use solvents that can evaporate during the process, resulting in VOC emissions. Exhaust streams from these processes that contain organic compounds will be routed to this exhaust type, hence the term Solvent Exhaust or VOC Exhaust. Micron proposes to use rotor-concentrator thermal oxidizers (RCTOs) to reduce emissions of VOC from this exhaust type. These devices will adsorb organic compounds from high-flowrate streams onto a pair of zeolite rotors, then desorb them into lower-flowrate streams that will be pre-heated and thermally oxidized.

1.4.3.3.5 General Exhaust

The fab operations discussed above are conducted in a carefully controlled cleanroom environment. To successfully operate a modern fab, air must be exchanged frequently to meet the strict temperature, humidity, and purity requirements of the cleanroom. Therefore, many stacks will be dedicated to exhausting air that does not meet strict cleanroom requirements. These stacks will emit air contaminants that are evaporated into the main fab clean room such IPA used for wipe cleaning.

1.4.4 Support Operations

In addition to the core fab processes described in the above sections, the proposed air permit project will also include a number of essential support operations. These operations will not take place in the main fab, but in one of several support buildings or outdoors. Air emissions from these support operations will not exhaust through the main fab stacks described above, but may exhaust through separate stacks of the same exhaust type (acid exhaust, ammonia exhaust, etc.). This section includes operations specific to semiconductor facilities, or to the Proposed Air Permit Project. Typical air emission sources (i.e., emergency generators) are also planned for the Proposed Air Permit Project.

1.4.4.1 Wastewater Treatment

Semiconductor manufacturing generates wastewater that can include inorganic solvents, metals, ammonia, organic compounds, and other pollutants. Micron intends to construct on-site wastewater treatment operations to reduce concentrations of these pollutants before discharging to the local publicly owned treatment works (POTW).

Wastewater treatment operations will be conducted in an industrial wastewater treatment (WWT) building and a biological treatment (BIO) building. High-fluoride wastewater and general industrial wastewater will be pretreated in the WWT building. The WWT building effluent, along with other organic-containing wastewater streams, will be routed to the BIO building to undergo anaerobic digestion.

Emissions from the WWT building will be segregated into acid, ammonia, and solvent exhausts. Emissions from the BIO building will include hydrogen sulfide (H_2S), and therefore will be routed through an odor scrubber prior to release.

1.4.4.2 Water Bath Vaporizers

The proposed air permit project will include a cryogenic air separation plant to generate pure utility gases to be used in the fab. These chemicals will be generated in liquid form and will need to be vaporized in order to be useful. Heat from the fab can often be used to accomplish this vaporization but may not be sufficient in some cases. Therefore, water bath vaporizers (WBVs) will be installed as a backup heat source, which will heat baths of water using natural gas combustion so that heat transfer lines containing liquid chemicals are vaporized before entering the fabs.

1.4.4.3 Spin-on Dielectric Waste Treatment

The spin-on dielectric (SOD) process is a subset of the thin films processes that results in the formation of an unstable liquid waste byproduct. The SOD waste, a mixture of polysilazane and dibutyl ether, will be transferred to an HPM building for treatment before shipment offsite. A rinse solvent will be transferred along with the SOD waste to ensure that it is removed from the tool. In the HPM building, the SOD waste will be reacted with ethanol and potassium hydroxide into a stable silicon-based product for safe shipment. Byproducts of the reaction will include silane, ammonia, and hydrogen. The RCTOs in the HPM building will oxidize the silane- and ammonia-containing exhaust before it is emitted to atmosphere.

APPENDIX B EMISSION QUANTIFICATION METHODOLOGIES

This appendix presents an excerpt from Section 2 of the Micron Clay Air Permit Application dated March 2025 that describes the methodologies used to calculate potential air emissions from the Proposed Air Permit Project, as well as an excerpt of the emission calculations submitted in Appendix F. Note the air permit application describes quantification methods for Fabs 1 and 2. The emissions calculated herein should be multiplied by 2 to compare to the 4-Fab scenario described in this CLCPA analysis. These calculations do not include methodologies for construction and mobile source emissions, which can be found in Micron’s DEIS.

2. EMISSIONS QUANTIFICATION

This section provides the detailed potential to emit (PTE) calculation methodologies for air emissions sources planned for the Proposed Air Permit Project. Appendix F of the Air Permit Application includes the emission calculations described in this section.

2.1 Semiconductor Manufacturing Process Emissions

The semiconductor manufacturing processes described in Section 1.4 include several fab processes that each will exhaust through one or more of five exhaust types. The process flow diagrams in Appendix E illustrate the relationship between the fab processes and exhaust types. The methods used to quantify emissions from fab processes are described in this section.

2.1.1 Projected Material Use Inventory

The PTE from the semiconductor manufacturing process operations is based on the chemical material use inventory that Micron currently projects will be required for operation of Fab 1 presented in Table 6-1 of Appendix F. The chemical material use inventory has been updated for this application based on more recent design information. This inventory includes both raw materials that are incorporated into the product as well as materials used to support the manufacturing process, such as gases used to clean process equipment. In Permit Application 1, Fab 2 was projected to require approximately 75% of the raw materials used in Fab 1. In this application, Fab 2 is projected to have equal material usage to Fab 1. Therefore, the annual projected quantities for Fab 1 were multiplied by 2 to estimate total usage in both Fab 1 and Fab 2.

As discussed above, the nature of Micron's business requires rapidly-changing product mix, architecture, and functionality to meet customer needs. The nature and rapid pace of constant technological change affects the type, number, and configuration of semiconductor process tools required to fabricate devices. The need for this flexibility extends to use of raw materials, process gases, etc. The process categories and exhaust types planned for the fabs described in this application represent typical industry operations and are not expected to change substantially. However, the specific operations, equipment, and materials to be used in each process category have the potential to change throughout the remainder of detailed design and operation of the fabs to keep pace with evolving technology. Many materials that are commonly used in the industry will remain the same. However, evolution of technology may result in the requirement to use different materials and/or change the total quantity of materials projected to be used. Therefore, Micron cannot predict the exact identity and quantity of materials that will be used in the semiconductor manufacturing process operations in Fab 2 and recognizes that the projected material use inventory for Fab 1 may change prior to commencement of operation. To account for this further possible refinement in emission calculations, the PTE for process equipment was developed using conservative assumptions discussed in detail in Appendix G.

2.1.2 Manufacturing Process Categories

Materials used in the manufacturing process (Table 6-1 of Appendix F) have been aligned with one or more of the process categories described in Section 1.4.1. This alignment is documented in the "Process Category" column of Table 6-1 of Appendix F. The process category in which a material will be used determines what the resulting air emissions and exhaust type will be.

Some materials are projected to be used in multiple process categories. For these materials, Micron has projected the percent of the total quantity of each primary chemical that will be used in each process category. This percentage is shown in the "% of Total Usage" column in Table 6-1 of Appendix F. The total quantity of each material projected to be used in each process category is listed in the "Projected Usage in Process Category" column of the same table. The quantity of each primary chemical may be listed multiple times if there is more than one emission chemical associated with the primary chemical for a process category. This is to facilitate calculation of emissions of each emission chemical and the repeated values in the "Projected Usage in Process Category" column for primary chemicals in each process are not additive.

2.1.3 Determination of Emission Chemicals

Table 6-1 of Appendix F refers to "Emission Chemicals" as those that have the potential to be emitted to the atmosphere as a result of using raw materials, process gases and other materials in the manufacturing process, which are collectively listed as "Primary Chemicals" in the same table. The emission chemicals may be the primary chemicals themselves or may be formed due to chemical reactions occurring as part of semiconductor process operations, or through oxidation in tool-level thermal oxidation systems or RCTOs. Materials used in multiple process categories may have different emission chemicals for each process in which they are used. The emission chemicals resulting from the use of each primary chemical were identified using published emission factors and semiconductor process knowledge. An explanation of emission chemical selection is provided in Appendix G. Emission chemicals proposed by the NYSDEC in TR Comment #12 are incorporated into Table 6-1 of Appendix F and Appendix G.

For fluorinated greenhouse gases (F-GHGs), emission chemicals were determined in part by using emission factors presented by the Intergovernmental Panel on Climate Change (IPCC) in the 2019 refinement to the 2006 Guidelines for National Greenhouse Gas Inventories for semiconductor industry manufacturing operations[17] (the "2019 Refinement"). F-GHGs have the potential to react and form other F-GHGs as part of the process. The 2019 Refinement prescribes the F-GHG emission chemicals for each F-GHG based on the semiconductor manufacturing process category in which it is used. In addition, chemical engineering judgement was used to identify emission chemicals from treating F-GHGs in a thermal oxidation system, notably hydrogen fluoride (HF), carbon dioxide (CO_2), carbon monoxide (CO), and other oxidation products.

To determine emission chemicals for primary chemicals for which there are no published emission factors, Micron evaluated the use of each primary chemical in each semiconductor manufacturing process and how each may be treated by thermal oxidation systems. For example, silane (SiH_4) gas will be used in thin films/diffusion processes to deposit silicon atoms onto wafers. Any gaseous silane not utilized for this purpose will react in exhaust ductwork or in a thermal oxidation system to form silicon dioxide, the emission chemical. In addition, some materials will be used as liquid solvents in photolithography processes. A portion of these materials may evaporate and then oxidize in a RCTO to form CO_2, SO_2 and/or NO_X, which are the emission chemicals.

2.1.3.1 Carbon Monoxide Emission Calculation

Carbon monoxide potentially could be generated as a byproduct of thermal oxidation for any of the primary chemicals listed in Table 6-1 to Appendix F that contain a carbon atom. Carbon monoxide emissions also may be generated from incomplete combustion of fuels in thermal oxidation systems. Because of the nature

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[17] IPCC 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 6: Electronics Industry Emissions, Table 6.11.

of the semiconductor process operations, the ratio of CO to CO_2 generation from carbon-based process gases and raw materials in semiconductor manufacturing operations is not easily quantifiable. To account for this, the air emission calculations for CO are based on assumptions presented in a semiconductor exhaust management and control book on this topic, the relevant excerpt of which is included in Appendix U.[18] This approach assumes that CO emissions for all operations can be conservatively estimated using an emission factor equal to five times the emission factor for CO in AP-42 Vol. I, Chapter 1.4: Natural Gas Combustion, Table 1.4-1. This approach is used to estimate emissions of both process-based CO (i.e., that is generated from chemical reactions of process gases) and from incomplete combustion.

2.1.4 Emission Factors

For each emission chemical listed in Table 6-1 of Appendix F a "Process Emission Factor" is given in pounds of emission chemical emitted per pound of primary chemical used (lb emitted / lb used). These emission factors were developed as described previously in this section and as documented in Appendix G.

A large number of primary chemicals listed on Table 6-1 of Appendix F are available to be emitted from semiconductor manufacturing process operations in a quantity equal to the "Projected Usage in Process Category", either directly or through formation of an emission chemical. However, for other chemicals, such as liquids that are emitted by evaporation, a portion of the material used is collected as waste or otherwise is not available to be emitted from the process tool. The "Process Emission Factor" for direct emissions of such primary chemicals accounts for this fact. However, when there is an emission chemical created from a primary chemical, an additional step in the emission calculations in Table 6-1 is necessary. This step includes multiplying the "Process Emission Factor" for each emission chemical by the "Process Emission Factor" for the primary chemical. This additional calculation step accounts for the fact that only the material released into the exhaust stream has the potential to convert from the primary chemical into the emission chemical.

For example, 1-methoxy-2-propanol (PGME) is used in the liquid phase as a solvent in photolithography processes and is assigned a "Process Emission Factor" of 0.2 lb emitted / lb used, indicating that up to 20% of PGME used is assumed to evaporate and enter the exhaust. When PGME is oxidized in an RCTO, CO_2 is generated. Only the 20% of PGME which evaporates is available to be oxidized; therefore, the emission factor for CO_2, 1.95 lb CO_2 / lb PGME (per Table 3-1 of Appendix F), must be multiplied by the "Process Emission Factor" for PGME, 0.2, to calculate mass of CO_2 emitted per quantity of PGME used in production (lb CO_2 / lb PGME used). Emission chemicals for which this adjustment is made are indicated with an "X" in the column "Emission Chem Formation Depends on Primary Chem EF?" in Table 6-1 of Appendix F.

2.1.5 Exhaust Treatment Efficiencies

In Table 6-1 of Appendix F, each emission chemical is assigned an exhaust type based on the identity of the primary chemical and the process category in which it is used. The exhaust types are described in more detail in Section 1.4.3. Table 6-1 of Appendix F includes factors for how semiconductor manufacturing process equipment emissions will be changed prior to exhaust to the atmosphere. Those factors are described below. It is assumed that POU control devices and centralized control devices will be operating 100% of the time during which tools are operating.

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[18] J. Michael Sherer, *Semiconductor Industry Wafer Fab Exhaust Management*, pg. 166, published 2005 by CRC Press, Taylor & Francis Group, Boca Raton, FL.

2.1.5.1 Equipment for Employee, Process, and Facility Safety

Thin films and wet etch/clean process tools require PEECs to minimize hazards in the ductwork and protect personnel and equipment, as introduced in Section 1.4.2 above. PEECs are essential to the safe operation of semiconductor fabrication facilities, and, in the process, they may also incidentally reduce certain chemical compounds in the exhaust beyond those they are intended to manage. The estimated effect of PEECs is summarized in Table 5-1 of Appendix F, based on preliminary information available from potential vendors and conservative engineering estimates. For GHGs, the fraction treated is based on the default values published by the IPCC in the 2019 Refinement.

2.1.5.2 POU Destruction and Removal Efficiency

POU control devices will be installed on a subset of plasma etch tools that etch metal substrates ("metal etch" tools) to mitigate emissions of F-GHGs. These POUs will consist of a thermal oxidizer in series with a wet scrubber (known as burn/wet units). Micron is evaluating alternative POU technologies that will achieve the equivalent performance without combusting natural gas. The GHG destruction and removal efficiency (DRE) of the POU control devices, summarized in Table 5-2 of Appendix F, is based on default values provided in the IPCC 2019 Refinement. For other contaminants used alongside F-GHGs, the DRE is based on preliminary information available from potential vendors and conservative engineering estimates.

2.1.5.3 Centralized Control DRE

As described in Section 1.4.3 above, each exhaust type will be controlled by a unique control device, other than general fab exhaust. The DRE values used in PTE calculations for each of these control devices are summarized in Tables 5-3 and 5-4 of Appendix F. For this application, Micron has updated the DRE values to reflect the most recent available information from potential vendors, as well as updated engineering estimates. As described in Section 1.4.3, Micron plans to equip the ionizing wet scrubbers on the CVD exhausts with $DeNO_X$ technology. Micron also plans to install RCS units on non-metal plasma etch tools rather than POUs to provide reductions in natural gas usage. The DRE values for F-GHGs abated in the RCS units are based on default values provided in the IPCC 2019 Refinement.

Micron has begun the procurement process with potential vendors for centralized control devices but has not selected vendors at this time. In lieu of vendor specification sheets, Micron has provided outlines of its expectations for potential vendors in Appendix V. These documents are for use in the procurement process to help select vendors that are able to meet these specifications.

2.1.6 Process Tool and Operations Emissions

PTE for each emission chemical was calculated using the usage quantities, emission factors, PEEC exhaust management, and DRE values discussed above. Emissions are displayed at the outlet of semiconductor process operations, at the outlet of POUs, and at the exhaust to atmosphere in the "Process Emissions Quantification" section in Table 6-1 of Appendix F as described below.

2.1.6.1 Process Emissions

Emissions at the outlet of the semiconductor manufacturing process equipment are shown for each emission chemical in the "Process Emissions" column in Table 6-1 of Appendix F. These values were determined by multiplying the "Projected Usage in Process Category" of each primary chemical by the "Process Emission Factor" for the emission chemical. If indicated with an "X" in the "Emission Chem Formation Depends on

Primary Chem EF?" column of the same table, the result was then multiplied by the "Process Emission Factor" for direct emissions of the primary chemical. Finally, exhaust management from PEECs listed in the "PEEC Fraction Managed" column was accounted for.

For example, for the example discussed in Section 2.1.4 of CO_2 emitted as an emission chemical for PGME, the value in the "Process Emissions" column was determined by multiplying the "Projected Usage in Process Category" for PGME, 35,817 lb/yr, by the "Process Emission Factor" for CO_2 as an emission chemical of PGME, 1.95. Since an "X" is listed in the "Emission Chem Formation Depends on Primary Chem EF?" column, the product is then multiplied by the "Process Emission Factor" for direct emissions of PGME, 0.2. This value is then multiplied by (1 – "PEEC Fraction Managed"), which in this case is 1 since CO_2 is not managed in a PEEC. This calculation results in the "Pre-Control Process Emissions" quantity of 13,993 lb CO_2/yr for CO_2 as an emission chemical of use of PGME in photolithography.

2.1.6.2 Post POU or RCS Control Device Emissions

Emissions at the outlet of POU control devices, if applicable, are shown for each emission chemical in the "Post POU or RCS Emissions" column in Table 6-1 of Appendix F. This calculation was performed by multiplying the process emissions described above by (1 – "POU or RCS DRE"), where POU DRE is the fraction of emission chemical expected to be controlled by the POU. Emissions at the outlet of the RCS control devices were calculated using the same methodology, where applicable.

2.1.6.3 Post Control Emissions

Emissions from the exhaust stack to atmosphere are shown for each emission chemical in the "Post Control Emissions" column in Table 6-1 of Appendix F. This calculation was performed by multiplying the "Post POU or RCS Emissions", or the "Pre-Control Process Emissions" if a POU is not used, by (1 – "Centralized Control DRE"), where Centralized Control DRE is the fraction of emission chemical expected to be controlled by the applicable centralized control device. Emissions in this column represent the post control emissions of each emission chemical for the specific primary chemical used, process category it is used in, and exhaust type.

2.1.7 Additional Fab Process Emissions

Emissions from certain cleanroom operations were calculated independently from the emissions described in Sections 2.1.1 through 2.1.6. These operations include use of HTFs in process chillers, cleaning with IPA, the photoresist ashing processes, and generation of ozone. The separate methodologies used to calculate these emissions are described below.

2.1.7.1 Heat Transfer Fluid Losses

Various manufacturing processes will require the use of HTFs to maintain appropriate operating temperatures for equipment or components. The HTFs currently projected to be used in Fab 1 are listed in Table 9-1. Micron is currently developing and soliciting U.S. EPA approval for alternative HTFs with lower GWPs than the fluorocarbons compounds currently projected to be used. Potential greenhouse gas emissions are conservatively estimated based on the current usage projections. Emissions from HTF use are a result of losses from process chiller systems components (e.g., valves, connectors, etc).

The 100-year GWPs in units of kg CO_2e/kg HTF were determined based on information available in the IPCC 2019 Refinement. The projected usage in lb/year of each HTF was based on usage information available from similar processes at other Micron facilities. The annual emissions of HTFs were assumed to be equal to the projected usage (i.e., the amount of fluid added to chillers is expected to equal the amount of fluid lost).

Each HTF was analyzed to determine whether it would contribute to total potential VOC or HAP emissions. The chemical structure of each HTF and documentation provided by manufacturers[19] were used to determine VOC status with respect to the definition in 6 NYCRR 200.1(cg). No HTF planned to be used in the Proposed Air Permit Project are defined as HAP. To calculate total CO_2e emissions (on either a 100-year or 20-year basis) from each HTF, the appropriate GWP of each HTF was multiplied by the corresponding HTF usage quantity.

2.1.7.2 Fab Cleaning Emissions

IPA will be used for miscellaneous cleaning operations conducted by hand, including cleaning process equipment, workspaces and other surfaces within the semiconductor fab. This use is separate from IPA used in wet etch/wet clean process tools for cleaning wafers and is purely for routine maintenance as opposed to semiconductor process operations. The quantity of IPA used for wiping is estimated based on the current detailed engineering design information. Since IPA is a volatile solvent, 100% of IPA used for cleaning is assumed to be emitted from the fab. Total annual emissions are presented in Table 10-1 of Appendix F.

IPA used for cleaning will evaporate into the cleanroom air and be dispersed. Therefore, IPA used for cleaning is assumed to exhaust through each stack type at a rate proportional to the total flowrate through all stacks of each type. Each solvent exhaust is divided into two stacks, one at the outlet of the pair of zeolite rotors, and one at the outlet of the thermal oxidizer. For the purpose of this calculation, they are treated as one stack. The annual emissions of IPA through each stack type is calculated in Table 10-2 of Appendix F by dividing the total flowrate for all stacks of each type by the total flowrate for all fab stacks, then multiplying by the total annual emissions of IPA. Emissions are also calculated on an hourly basis per quadrant and per stack by applying a variance factor of 25% to account for potential variability in operations from hour to hour, then dividing by the appropriate number of halves (four for Fab 1 and Fab 2 combined) or stacks.

2.1.7.3 Ozone Emissions

Ozone (O_3) is used as a raw material in thin films processes and will be generated onsite as opposed to being purchased from a supplier. Therefore, it is not included on the Projected Material Use Inventory. Micron has conservatively estimated the amount of O_3 that will be generated per year based on demands for similar manufacturing facilities. Ozone that is not utilized in the process will be managed by PEECs that serve to prevent safety and odor issues in the fab if reentrainment of O_3 were to occur. These assumptions are documented in Table 11-1 of Appendix F.

Emissions of ozone will exhaust through centralized acid scrubbers and CVD scrubbers along with other emissions from thin films processes. Using a similar methodology to calculate emissions as is used for IPA , O_3 is assumed to be emitted through acid and CVD exhausts at rates proportional to the total flowrate of all stacks of each type. The methodology described in Section 2.1.7.2 above that is used for IPA is also used to calculate annual emissions per stack type, hourly emissions per half, and hourly emissions per stack of O_3 in Table 11-2 of Appendix F.

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[19] Details of the analysis of exclusions from being a VOC per 6 NYCRR 200.1(cg) are presented with Table 9-1 in Appendix F.

2.1.7.4 Photoresist Ashing

As described in Section 1.4.1.4, photoresist material, which is composed of solids in a solvent solution, is selectively applied to wafers to protect certain areas of the wafer during processes like etching. When the photoresist remaining on the wafer is no longer needed, it is combusted in a process called "ashing" and is oxidized to form CO_2 and CO. Emissions associated with this process are presented on Tables 8-1 and 8-2 of Appendix F.

Multiple materials on the material use inventory are used to formulate photoresist mixtures, and some of those may be used for other purposes as well. To calculate emissions of CO_2 and CO, the total annual photoresist usage quantity for the Proposed Air Permit Project was projected based on available design information. The percentage of remaining photoresist material assumed to be solid material that could remain on a wafer was 30%, based on semiconductor process knowledge. Of the total amount of photoresist solids, 5% were assumed to remain on the surface of wafers after the "development" of the photoresist material, in which photoresist material is removed from areas exposed to light. These remaining photoresist solids were conservatively assumed to be composed of 100% carbon atoms for the purposes of calculating potential CO and CO_2 emissions. It was assumed that, on a molar basis, 50% of the carbon solids would oxidize to CO while 50% would oxidize to CO_2. In reality, some photoresist material may react with process gases used in the plasma etch process before it has the potential to be combusted in the ashing process, forming F-GHG byproducts. These emissions are captured as part of the IPCC 2019 Refinement emission factors discussed in Appendix E.

The total amount of material to be oxidized into either pollutant during combustion was calculated by multiplying each percentage by the total estimated usage of photoresist material. The amount of material to be oxidized into each pollutant in lb/year was then multiplied by the ratio of the molar weight of each pollutant in pounds per pound-mole (lb/lb-mole) to the molar weight of carbon in lb/lb-mole. This calculated pollutant-specific emission rates of CO_2 and CO in lb/year. These emission rates were converted to final pollutant-specific ton per year (tpy) potential emission rates.

2.2 Emissions from Combustion Sources

The following sections detail the different pieces of equipment that will combust fossil fuels as part of the Proposed Air Permit Project and the calculation methodology associated with each that was used to calculate potential emissions from combustion.

2.2.1 Diesel Fuel-Fired Emergency Generators and Emergency Fire Pump Engine

As part of the Proposed Air Permit Project, diesel fuel-fired generator sets will be installed to provide power during emergency events for health and safety purposes. One diesel fuel-fired emergency fire pump engine will be used to provide fire water supply in the event of an emergency during which the primary electric fire pump cannot be used. Emission calculations using information from potential vendors are shown on Tables 17-1, 17-2, and 17-3 of Appendix F for the generators, and Tables 32-1, 32-2, 32-3 of Appendix F for the fire pump.

Diesel fuel-fired generator sets will be compliant with Tier 4 exhaust emissions standards.[20] Therefore, these standards were used to determine potential emissions of criteria pollutants. Criteria pollutant emission

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factors for combustion of ultra-low sulfur diesel (ULSD) were obtained from AP-42[21] for pollutants for which Tier 4 emissions standards have not been set. The AP-42 emission factors were multiplied by the brake horsepower (bhp) provided in specifications from potential vendors at full load to calculate the emission rate of each pollutant in lb/hr. To calculate emissions using the Tier 4 emission standards, the bhp rating was converted to kilowatts (kW) and then multiplied by the provided emission factors in grams per kW hour. These emission rates were then converted to units of pounds per hour (lbs/hr).
Hazardous air pollutant (HAP) emission factors in pounds per million British thermal unit (lb/MMBtu) were obtained from AP-42.[22,23] These emission factors were multiplied by the conversion of MMBtu to brake horsepower-hour (bhp-hr) and subsequently multiplied by the brake horsepower of the engines at full load to calculate the emission rate of each HAP in lb/hr.

The diesel fuel-fired emergency fire pump will be compliant with Tier 3 exhaust emissions standards.[24] Therefore, these standards were used to determine potential emissions of criteria pollutants, supplemented with AP-42[25] factors for other criteria pollutants and for HAP.

The emission factor for CO_2 was obtained from 40 CFR Part 98 Table C-1,[26] while the emission factors for methane (CH_4) and nitrous oxide (N_2O) were obtained from 40 CFR Part 98 Table C-2.[27] The greenhouse gas (GHG) emission factors were provided in units of kilograms per million British thermal units (kg/MMBtu). These emission factors were converted to units of lb/hr using both the conversion from kilograms to pounds and by multiplying the conversion from MMBtu to bhp-hr by the brake horsepower of each generator set engine model at full load.

Potential carbon dioxide equivalent (CO_2e) emissions were calculated across a 20-year and 100-year period using established global warming potentials (GWPs) for CH_4 and N_2O.[28] The GWPs of both CH_4 and N_2O were multiplied by the respective calculated lb/hr emission rate of each gas and summed with the CO_2 lb/hr emission rate. To calculate potential annual emissions from these generator sets, the emission rates from each generator set were multiplied by the proposed 100 hr/yr limit for each generator, then multiplied by the total estimated amount of generator sets to be installed as part of the Proposed Air Permit Project. To calculate potential annual emissions from the fire pump, the emission rates were multiplied by the required 500 hr/yr limit to maintain emergency status. Upstream emissions as a result of the extraction and

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[21] AP-42 Vol. I, Chapter 3.4: Large Stationary Diesel and All Stationary Dual-fuel Engines, Table 3.4-1: Gaseous Emission Factors for Large Stationary Diesel and All Stationary Dual-fuel Engines and Table 3.4-2: Particulate and Particle-sizing Emission Factors for Large Uncontrolled Stationary Diesel Engines

[22] AP-42 Vol. I, Chapter 3.4: Large Stationary Diesel and All Stationary Dual-fuel Engines, Table 3.4-3: Speciated Organic Compound Emission Factors for Large Uncontrolled Stationary Diesel Engines

[23] AP-42 Vol. I, Chapter 3.4: Large Stationary Diesel and All Stationary Dual-fuel Engines, Table 3.4-4: PAH Emission Factors for Large Uncontrolled Stationary Diesel Engines

[24] 40 CFR 1039 Subpart B

[25] AP-42 Vol. I, Chapter 3.3: Gasoline and Diesel Industrial Engines

[26] 40 CFR Part 98, Table C-1: Default CO_2 Emission factors and High Heat Values for Various Types of Fuel

transmission of ULSD were quantified using emission factors published by the NYSDEC in the 2024 NYS Statewide GHG Emissions Report, Table A1.[29]

2.2.2 Tool-Level Thermal Oxidation Systems and RCS

Tool-level thermal oxidation systems, which include metal etch POUs and thin films PEECs, will be utilized as described in Section 1.4.2. RCS will be used on non-metal plasma etch tools that would otherwise require POUs. The operation of these devices will require the combustion of natural gas. Emission calculations are shown on Tables 13-1, 13-2, and 13-3 of Appendix F for tool-level thermal oxidation systems, and on Tables 31-1, 31-2, and 31-3 of Appendix F for RCS.

To calculate potential emissions from natural gas use, the total estimated natural gas usage for metal etch POUs and thin films PEECs was estimated based on available design information in Table 13-1 of Appendix F. RCS natural gas usage is based on the required burner size.

Emission factors for criteria pollutants, greenhouse gases, and HAPs were obtained from AP-42[30] in units of pounds per million standard cubic feet (lb/MMscf). The emission factors for PM_{10} and $PM_{2.5}$ were conservatively assumed equal to the emission factor for total PM, which is the sum of the emission factors for filterable and condensable PM. These emission factors were multiplied by the estimated total annual natural gas usage in MMscf/year to determine emission rates in lb/year. The emission factor for CO was multiplied by a safety factor of five to account for the incomplete oxidation of process chemicals and the incomplete combustion of natural gas, as described in Section 2.1.3.1 above. To calculate the 20-year and 100-year CO_2e emission rates, the GWPs[31] of both CH_4 and N_2O were multiplied by the respective lb/year emission rate of each gas and summed with the CO_2 lb/year emission rate. Upstream emissions as a result of the extraction and transmission of natural gas were quantified using emission factors published by the NYSDEC in the 2024 NYS Statewide GHG Emissions Report, Table A1.

The annual emission rates were divided by the total operational stack count by oxidation system exhaust type to determine per-stack emission rates in units of tpy. To determine pollutant-specific lb/hr emission rates per stack, a conversion factor of 8,760 hours of operation per year was applied. Multiplying the per-stack pollutant-specific tpy emission rates by each respective total operational stack count yielded the total pollutant-specific tpy emission rate by device-specific stack type.

2.2.3 Rotor-Concentrator Thermal Oxidizers

Rotor-concentrator/thermal oxidizer (RCTO) units will be employed as part of the Proposed Air Permit Project to control emissions from certain semiconductor manufacturing processes. Emission calculations are presented in Tables 14-1, 14-2, and 14-3 of Appendix F.

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[29] Emission Factors for Use by State Agencies and Applicants, Appendix A to the 2024 NYS Statewide GHG Emissions Report, Table A1

[30] AP-42 Vol. I, Chapter 1.4: Natural Gas Combustion, Tables 1.4-1 through 1.4-4

Natural gas will be combusted in the burners as part of the operation of the RCTOs. Emission factors for criteria pollutants, greenhouse gases, and HAPs were obtained from AP-42[32] in units of pounds per million standard cubic feet (lb/MMscf). The emission factor for CO was multiplied by a safety factor of five as described in Section 2.1.3.1 above.

Each pollutant-specific emission factor in lb/MMscf was multiplied by the natural gas flow rate in MMscf/hr to each RCTO model type, the latter of which was calculated using the model-specific burner rating in MMBtu/hr and the Btu/scf heat value of natural gas established in AP-42,[33] to calculate emission rates in units of lb/hr. To calculate the 20-year and 100-year CO_2e emission rates, the GWPs[34] of both CH_4 and N_2O were multiplied by the respective calculated lb/hr emission rate of each gas and summed with the CO_2 lb/hr emission rate. Upstream emissions as a result of the extraction and transmission of natural gas were quantified using emission factors published by the NYSDEC in the 2024 NYS Statewide GHG Emissions Report, Table A1.

The pollutant-specific per-RCTO lb/hr emission rates were converted to per-RCTO tpy emission rates using a potential 8,760 hours of operation per year. Total potential tpy emission rates were calculated by multiplying the per-RCTO tpy emission rates by the projected number of operational RCTOs.

2.2.4 Water Bath Vaporizers

WBVs will be installed to heat large baths of water to vaporize nitrogen when needed to supplement the supply from the onsite air separation unit. Potential combustion emissions were calculated as shown in Tables 15-1, 15-2, and 15-3 of Appendix F.

The natural gas flow rate to the burners in scf/hr was calculated using the proposed burner rating and the Btu/scf heat value of natural gas established in AP-42.[35] Potential emissions for NO_X, CO, and VOC were based on applicable BACT or LAER emission limits for WBVs. Emission factors for other criteria pollutants, greenhouse gases, and HAPs were obtained from AP-42[36] in units of pounds per million standard cubic feet (lb/MMscf). Pollutant-specific per-WBV lb/hr emission rates were calculated by multiplying the natural gas flow rate to the burners in MMscf/hr by the lb/MMscf emission factors. To calculate the 20-year and 100-year CO_2e emission rates, the GWPs[37] of both CH_4 and N_2O were multiplied by the respective calculated lb/hr emission rate of each gas and summed with the CO_2 lb/hr emission rates. Upstream emissions as a result of the extraction and transmission of natural gas were quantified using emission factors published by the NYSDEC in the 2024 NYS Statewide GHG Emissions Report, Table A1. All hourly emission rates were converted to per-WBV tpy emission rates using a proposed limit of 8,000 total hours of operation per year.

The potential per-WBV pollutant-specific emission rates in lb/hr and tpy were multiplied by the projected total count of operational WBVs to calculate total potential lb/hr and tpy emission rates for the operation of

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[32] AP-42 Vol. I, Chapter 1.4: Natural Gas Combustion, Tables 1.4-1 through 1.4-4

[33] AP-42 Vol. I, Chapter 1.4: Natural Gas Combustion

[34] 20-year GWPs per 6 NYCRR Part 496. 100-year GWPs per 40 CFR Part 98, Table A-1: Global Warming Potentials

[35] AP-42 Vol. I, Chapter 1.4: Natural Gas Combustion

[36] AP-42 Vol. I, Chapter 1.4: Natural Gas Combustion, Tables 1.4-1 through 1.4-4

WBVs as part of the Proposed Air Permit Project. Emissions from redundant WBVs were assumed to be zero, as Micron will operate the four redundant and four operational WBVs for a total of no more than 8,000 hours per year.

2.2.5 Natural Gas-Fired Boilers

Micron plans to install natural gas-fired boilers as part of the Proposed Air Permit Project to supplement heat recycled within the fab when necessary. Emission calculations are shown in Tables 16-1, 16-2, and 16-3 of Appendix F.

Potential emissions for NO_X, CO, and VOC were based on applicable BACT or LAER emission limits for natural gas-fired boilers. Other criteria pollutant, greenhouse gas, and HAP emission factors from AP-42 Chapter 1.4 in units of lb/MMscf for natural gas combustion were divided by the standard heat value of natural gas in Btu/scf before being multiplied by the burner rating of the boilers to calculate pollutant-specific lb/hr emission rates. To calculate the 20-year and 100-year CO_2e emission rates, the GWPs[38] of both CH_4 and N_2O were multiplied by the respective calculated lb/hr emission rate of each gas and summed with the CO_2 lb/hr emission rate. Upstream emissions as a result of the extraction and transmission of natural gas were quantified using emission factors published by the NYSDEC in the 2024 NYS Statewide GHG Emissions Report, Table A1.

These potential emission rates were converted to units of tpy using the proposed limit of 6,000 hours of operation per year.

2.3 Facility Support Emissions

Outside of emissions generated from combustion and from semiconductor fab manufacturing processes, several pieces of equipment to be installed as part of the Proposed Air Permit Project will result in air emissions during daily operation. The following sections describe the different methodologies that were used to calculate potential emissions for each type of facility support equipment.

2.3.1 Cooling Towers

As part of the Proposed Air Permit Project, cooling towers will be installed in the CUB and gas yard for heat dissipation purposes. Specifications sheets provided by potential vendors were used to determine the drift loss and flow rate in gallons per minute (gal/min) of each cooling tower model for use in the emissions calculations.

To begin the calculation, lb/hr emission rates of total dissolved solids (TDS) were calculated by multiplying together the density of water in pounds per gallon (lb/gal), the flow rate to each cooling tower model in gallons per minute (gpm), the drift loss percentage of each cooling tower model, and the concentration of TDS in the circulating water in parts per million by weight (ppmw) (converted to a percentage). Then, percentages of TDS emissions that were PM_{10} or $PM_{2.5}$ based on the drift loss percentages of each cooling tower model were interpolated based on droplet diameter and total PM concentration data compiled by

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Environmental Canada.[39] These pollutant-specific emission percentages were multiplied by the lb/hr emission rate of TDS to obtain per-unit lb/hr emission rates of PM_{10} and $PM_{2.5}$. The per-unit lb/hr emission rates were converted to per-unit tpy emission rates using 8,760 hours/year of operation, which were subsequently multiplied by the estimated total cooling tower count to calculate the total tpy emission rates.

To calculate speciated particulate matter emissions from the cooling towers, the inventory of additives to the cooling water was evaluated to determine constituents that could potentially emit as particulate matter. The speciated particulate matter PTE from the cooling towers is based on the potential annual usage of the additives and weight percent of each constituent in each additive, as shown in Table 20-3 of Appendix F. The average concentration of each additive constituent in the cooling water was estimated by dividing the total annual projected constituent usage by the total annual projected cooling water flow. Then, the ratio of the constituent concentration to the estimated total TDS concentration was multiplied by the total estimated TDS emissions to calculate the total estimated constituent emissions.

2.3.2 Storage Tanks

Storage tanks will be used as part of the Proposed Air Permit Project to store both raw chemical components and waste from manufacturing processes. A list of projected storage tanks is provided on Table 21-1 of Appendix F. The proposed storage tanks will all be equipped with fixed roofs, and the majority will be installed indoors. For indoor tanks, breathing losses were not considered since the tanks will not be exposed to direct sunlight or outdoor temperature fluctuations. Potential working loss emissions of volatile chemicals from all storage tanks were calculated. The working loss equations referenced below were obtained from AP-42 Chapter 7.1.[40]

For outdoor tanks, the tank emissions calculation software tool BREEZE TankESP^{TM} was utilized to calculate potential breathing losses based on historical meteorological data for near Clay, NY and projected attributes of the tanks (i.e., design, color, and capacity). BREEZE TankESP^{TM} uses the emission estimation procedures from Chapter 7 of U.S. EPA's Compilation of Air Pollutant Emission Factors (AP-42) to estimate emissions from tanks. Breathing loss estimates are presented in Table 23-3 of Appendix F.

The throughput for each tank in terms of gal/day of raw material was based on projected raw material needs and waste generation capacities. A default filling rate of 2,500 gal/hr was assumed for all bulk chemical tanks, while waste tanks were assumed to be filled constantly based on continual fab operation. The filling rate of waste tanks was calculated by dividing the annual throughput in gal/year by 8,760 hours of operation per year.

The molecular weight and vapor pressure of each chemical projected to be stored is documented on Table 22-1 of Appendix F. Using this information, working losses were calculated as shown on Table 23-2. A normalized mole percentage of each component by tank was calculated based on the projected weight percent of chemicals in solution in each tank. The weight percent of the particular chemical in the raw material delivered was divided by the molecular weight of the chemical. These ratios, representative of the pound-moles (lb-mole) of each individual chemical constituent per pound of stored material, were then

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[39] https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/sector-specific-tools-calculate-emissions/wet-cooling-tower-particulate-guide.html, Accessed February 1, 2024

[40] AP-42 Vol. I, Chapter 7.1.3.1: Routine Losses From Fixed Roof Tanks

divided against the sum of all ratios belonging to the same particular raw material to calculate a normalized mole percentage.

The methodology summarized in Table 23-1 of Appendix F was used to calculate working losses. The stock vapor density in lb/gal was calculated by multiplying the vapor pressure of the component in pounds per square inch absolute (psia) by the molecular weight of the vapors of the raw material in lb/lb-mole and dividing by the product of the temperature of the bulk raw material loaded into the tank (assumed to be 540 degrees Rankine (˚R)) and the ideal gas constant in units of psia*scf/lb-mole*˚R. The stock vapor density of each component was multiplied by the throughput in gal/year, the dimensionless working loss turnover factor (calculated using the amount of annual turnovers), the dimensionless working loss product factor, the dimensionless vent setting correction factor, and the vapor weight percent of the component to calculate the working loss emissions in units of lb/year. The working loss product factor and vent setting correction factor were both assumed equal to one for the purposes of these calculations.

The pre-control lb/year working loss emission rates for each group of tanks were converted to total tpy. The "Control Efficiency" for each group of tanks is shown in Table 23-2. The control efficiencies for each group and pollutant are determined based on specifications that Micron has required of vendors and conservative engineering estimates. Controlled lb/yr working and breathing loss emission rates were calculated by multiplying the pre-control emission rates by (1 – "Control Efficiency"). Emissions that were classified as HAP or VOC emissions based on the constituent in question were added to the total potential facilities emissions.

2.3.3 Storage Silos

Bulk material storage silos will be installed as part of the Proposed Air Permit Project to store lime. The calculation methodology described below was used to estimate emissions of particulate matter from daily use of the storage silo, as shown on Tables 24-1 and 24-2 of Appendix F.

It was assumed that filters will be installed on the silos to control particulate emissions. A particulate capture rate of 100% was assumed along with a 99.5% control efficiency. To estimate emissions of total PM, PM_{10}, and $PM_{2.5}$, emission factors were obtained from AP-42[41] in units of lb/ton of material processed. The factor for "product loading to an enclosed truck" was used as truck loading operations were deemed representative of the operations taking place at the storage silos. Emission factors for PM_{10} and $PM_{2.5}$ were conservatively assumed equivalent to total PM.

The pollutant-specific emission rate in lb/hr for each silo was calculated by multiplying the emission factor by the throughput of lime in ton per day and applying the 99.5% control efficiency. The emission rate in lb/hr was then converted to units of tpy by multiplying by 8,760 hours/yr of operations. To determine the final potential emission rates of particulate matter from all silos, the per-silo emission rates were multiplied by the total silo count.

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[41] AP-42 Vol. I, Chapter 11.17: Lime Manufacturing, Table 11.17-4: Emission Factors for Lime Manufacturing Raw Material and Product Processing and Handling

2.3.4 Process Wastewater Emissions

The treatment of wastewater generated in the semiconductor fab manufacturing process will result in the emission of certain organic and inorganic compounds to the atmosphere. Estimates of these emissions are provided in Table 12-1 of Appendix F.

These emission estimates were developed using the Toxchem modeling software developed by Hydromantis. Toxchem is a steady-state mass balance simulator capable of predicting the fate of organic and inorganic compounds in water streams. Toxchem uses the Henry's Law constant for each organic and inorganic compound to simulate emission rates attributable to liquid-to-gas mass transfer as influenced by specific design criteria (e.g., liquid surface area, agitator horsepower) for each wastewater treatment operation.

The wastewater flow rates used in the Toxchem model originate from Micron's water balance for Fab 1 and Fab 2. The concentrations of organic and inorganic compounds in these wastewater streams are conservative engineering estimates derived from chemical usage rates, design data, and process simulations. Certain compounds that may be present in the wastewater streams from Fab 1 and Fab 2 are not represented in Toxchem's chemical database. In order to simulate emissions of these compounds, representative surrogate compounds were selected based on similarities in chemical structure.

Although Toxchem is capable of simulating the biodegradation rate for various compounds in biological treatment units, Toxchem does not quantify the generation of secondary compounds such as hydrogen sulfide and nitrates. Emissions of these secondary compounds were calculated manually assuming stoichiometric conversion of the incoming biodegraded compounds (e.g., sulfur-bearing compounds and ammonia) along with the biodegradation rate predicted by Toxchem.

2.3.5 Roadway Emissions

Traffic on roadways surrounding Fab 1 and Fab 2 has the potential to generate PM emissions by disturbing silt present on the surface. These roads will be paved to minimize such emissions, which was determined to be PM BACT as discussed in Appendix K. An estimate of PM emissions from roadways is provided in Table 26-1 of Appendix F.

To estimate PTE from this source, industrial truck traffic expected to travel on roads surrounding Fab 1 and Fab 2 for trucks delivering raw materials and removing waste was considered. For raw materials expected to be delivered or accumulated for shipment and stored in bulk, identified as the "Materials Hauled" in Table 26-1, the location of the storage vessel/container was determined based on the current site master plan, and an "Estimated Round Trip Distance Traveled" was calculated based on the difference between the destination and nearest entrance from a public roadway. Process materials were assumed to be delivered to the buildings in or near which they will be stored (e.g., HPM, WWT, BIO, or Fab).

Emissions were calculated using the equation and table in AP-42 Chapter 13[42] for particulate emissions from ubiquitous paved roads (i.e., not roads used for heavy industry). The equation is presented in footnote 4 to Table 26-1. A silt loading factor of 1.5 was chosen to conservatively estimate emissions assuming winter conditions occur for half of the year. It was assumed that traditional rock salt would be used in winter. The

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[42] AP-42 Vol. I, Chapter 13.2.1: Paved Roads, Equation 2, and Table 13.2.1-2: Ubiquitous Silt Loading Default Values with Hot Spot Contributions from Anti-Skid Abrasives (g/m^2)

average weight of each shipment was calculated using an "Estimated Weight When Empty" for each truck, the specific gravity or density of each material being transported in bulk, and an estimated capacity of each shipment. The number of shipments of each material in a year was determined by dividing the total annual "Material Throughput" by the "Estimated Load Weight" (for throughputs in tons) or an estimated load volume of 5,000 gallons (for throughputs in gallons). The total number of vehicle miles traveled (VMT) to transport each material was calculated by multiplying the number of "Pickup / Delivery Trips" by the "Estimated Round Trip Distance Traveled" for each trip. Then, Equation 2 from AP-42 Chapter 13.2.1 was used to calculate the emissions of PM as total suspended particulate (TSP), PM_{10} , and $PM_{2.5}$.

2.3.6 Electrical Insulation Emissions

High-voltage equipment, such as circuit breakers and ion implant tools, require the use of insulating gases such as sulfur hexafluoride (SF_6). These gases have the potential to leak over time and are therefore a source of air emissions.

The projected total usage of SF_6 in all circuit breakers and similar equipment was multiplied by a manufacturer guaranteed leak rate of 0.5% per year to calculate PTE. To calculate the 20-yr and 100-yr CO_2e emission rates, the GWPs[43] of SF6 were multiplied by the calculated lb/yr emission rate.

2.3.7 Lab Process Emissions

The Proposed Air Permit Project includes two laboratories to support each fab with testing and quality assurance, one in each Probe building and WWT building. Lab operations are exempt from permitting per 6 NYCRR 201-3.2(c)(40), therefore only criteria pollutant and HAP emissions were considered for the purpose of determining PTE with respect to relevant Title V and PSD/NNSR thresholds, consistent with 6 NYCRR 201-3.1(b).

An inventory of projected chemicals to be used in each lab was reviewed to identify VOC and HAP compounds, as well as compounds that may react to form criteria pollutants through use in the labs. Constituents present in amounts below the thresholds in 6 NYCRR 201-3.3(c)(94) were not considered. For each chemical, the potential amount of VOC, HAP, or criteria pollutant present after use was estimated by multiplying the projected annual usage by the appropriate concentration and/or conversion rate. It was conservatively assumed that the entire amount of each constituent used/generated is emitted. These calculations are shown on Tables 29-1 and 29-2 of Appendix F.

2.3.8 Solvent Waste Neutralization Emissions

The spin-on dielectric (SOD) process is a subset of the thin films processes that results in the formation of an unstable liquid waste byproduct. The SOD waste, a mixture of polysilazane and dibutyl ether, will be transferred to an HPM building for neutralization required to ensure safe shipment offsite. A rinse solvent will be transferred along with the SOD waste to ensure that it is removed from the tool. In the HPM building, the SOD waste will be reacted with ethanol and potassium hydroxide into a stable silicon-based product for safe shipment. Byproducts of the reaction will include silane, ammonia, and hydrogen. The RCTOs in the HPM building will oxidize the silane- and ammonia-containing exhaust before it is emitted to atmosphere.

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[43] 20-year GWPs per 6 NYCRR Part 496. 100-year GWPs per 40 CFR Part 98, Table A-1: Global Warming Potentials

The PTE from the SOD waste neutralization process is based on the potential generation rate of SOD waste, including rinse solvent, and estimated usage of reactant, as shown in Table 30-1 of Appendix F. The methodology used in Table 30-2 is very similar to that used on Table 6-1 to calculate emissions from fab process operations. Refer to Section 2.1 for details on that methodology.

2.4 Emissions Summaries

All of the emission calculations described in the sections above are summarized on an annual PTE basis, and also on an hourly basis as needed. These emissions summaries are described in this section.

2.4.1 Annual Emissions Summaries

Table 1-1 of Appendix F summarizes the PTE for the Proposed Air Permit Project for criteria pollutants on an annual basis. The "Semiconductor Process Tools" column represents the sum of all relevant rows in the "Post Control Emissions (lb/yr)" column in Table 6-1 of Appendix for each pollutant, plus photoresist ashing emissions. The classification of each emission chemicals in Table 6-1 is shown in the "Emission Chemical Classifications" set of columns.

Table 1-2 of Appendix F summarizes criteria pollutants by proposed emission unit. These quantities should be used as a basis for setting specific emission limits in permit conditions. Refer to the emission unit matrix in Appendix Q, which identifies the emission sources and processes that are part of each proposed emission unit.

Table 1-3 of Appendix F summarizes the total annual emissions subject to 6 NYCRR Part 212 for each toxic air contaminant, including individual PM, HAP, VOC, and GHG. Each row in the "Total Emissions (lb/yr)" columns represents the sum of the "Post control Emissions (lb/yr)" column in Table 6-1 for all rows where the emission chemical is the chemical listed in Table 1-3. Additional information relevant to analysis under 6 NYCRR Part 212, discussed in Section 3.3.4 below, is provided.

For certain emission chemicals, structural and/or toxicological similarity was used to create groups that should be evaluated as a whole under 6 NYCRR Part 212. Combined emission rates for these groups are provided in Table 1-4. This concept is discussed in more detail in Section 3.3.4.5 below.

Compliance with Part 212 PM grain standards is assessed on a facility-wide basis in Table 1-5.

2.4.2 Fab Process Hourly Emissions Calculations

For the emissions sources discussed in Sections 2.1.7, 2.2 and 2.3, hourly emissions are presented alongside annual emissions in each table. For the emissions from semiconductor manufacturing processes discussed in Section 2.1, hourly emissions from each exhaust type are summarized in Tables 7-1 through 7-3 of Appendix F. In Table 7-1, each potential exhaust type through which each emission chemical may emit is identified.

In Tables 7-1 and 7-2, a row exists for each unique pair of emission chemical and exhaust type. Table 7-1 summarizes emissions for toxic air contaminants, while Table 7-2 summarizes emissions for criteria pollutants that require air dispersion modeling. The total annual pre-control emissions in each row, shown in the "Annual Pre-Control Emissions" column, is determined by summing relevant rows in the "Process Emissions (lb/yr)" column in Table 6-1. The "Average Hourly Pre-Control Emissions" column is calculated simply by dividing the annual pre-control emissions by 8,760 hours per year. To account for the fact that in any one given hour, emissions may fluctuate due to variability in manufacturing operations, a 25% variance factor is added to the "Average Hourly Pre-Control Emissions" to conservatively estimate maximum hourly emissions. Using this factor and dividing emissions by the 4 total halves that will comprise Fab 1 and Fab 2 combined, the "Emission Rate Potential per Half" column was generated. The values in this column are used in the analysis with respect to 6 NYCRR Part 212 described in Section 3.3.4 below. The "POU or RCS DRE" and "Centralized Control DRE" used in Table 6-1 calculations are presented on this table for reference. Finally, emissions per stack were determined by dividing the "Annual Potential Emissions" by the number of stacks of each exhaust type by 8,760 to calculate the "Average Hourly Emissions Per Stack" and adding the Variance Factor to calculate the "Maximum Hourly Emissions Per Stack". These values are used for air dispersion modeling where required. Note that the number of stacks of each exhaust type used to calculate "Maximum Hourly Emissions Per Stack" was set to the projected number of operational stacks, and excluded the redundant stacks to calculate an accurate per-stack emission rate.

All emissions from organic compounds from solvent exhaust are listed in Table 7-3. As described in Section 2.1.7.2, each RCTO is equipped with two separate stacks, one at the outlet of the pair of zeolite rotors, and one at the outlet of the thermal oxidizer. The column layout and calculations align with that described above for Tables 7-1 and 7-2. However, for each Emission Chemical, the "Exhaust Type" column is labelled as either "Solvent Exhaust" or "RCTO Burner Exhaust" to clarify the exhaust stack. It is assumed based on semiconductor process experience that 95% of total emissions of each emission chemical from each RCTO will be from the stacks at the outlet of the zeolite rotors, indicated as "Solvent Exhaust". The remaining 5% of emissions are assumed to be emitted from the stacks at the outlet of the thermal oxidizers, indicated as "RCTO Burner Exhaust".

Micron - Clay, NY Fabs 1 & 2
Total Emissions Summary

Table 1-1: Criteria Pollutant Annual Potential Emissions - By Source Type

CAS#	Chemical Name	Semiconductor Process Tools	Heat Transfer Fluids	Wastewater Treatment	Tool-Level Thermal Oxidation Systems	RCTO Combustion	Water Bath Vaporizers	Boilers	Emergency Generators	SF_6 Leaks	SOD Waste Processing	RCS Combustion	Fire Pump Engine	Total PTE
		(tpy)	(tpy)	(tpy)	(tpy)	(tpy)	(tpy)	(tpy)	(tpy)	(tpy)	(tpy)	(tpy)	(tpy)	(tpy)
N/A	Direct GHG (CO_2e 20-yr)	378,913	111,272	61,545	178,142	157,660	40,442	69,456	8,251	8,759	79.3	6,223	26.1	1,020,768
N/A	Upstream GHG (CO_2e 20-yr)	--	--	--	135,583	119,994	30,885	53,044	2,612	--	--	4,737	8.26	346,863

Micron - Clay, NY Fabs 1 & 2
1-FABOP and 2-FABOP
Oxidation Emission Factor Derivation

Air contaminant Emission Factors (EF) are presented in pounds of air contaminant emitted per pound of process chemical used.

NOTE: Confidential business information (CBI) has been omitted from this excerpt. As a result, the table below is not comprehensive of all process compounds generating CO2 as a byproduct.

Table 3-1: Oxidation Emission Factors for Process Chemicals

				Molar Mass (g/mol) ->	44.01
CAS No.	**Process Chemical Name**	**Molecular Formula**	**Molar Mass (g/mol)**	**# of C**	**CO_2 EF**
95-63-6	1,2,4-Trimethylbenzene	C_9H_{12}	120.19	9	3.30
1436-34-6	1,2-Epoxyhexane	$C_6H_{12}O$	100.16	6	2.64
123-91-1	1,4-Dioxane	$C_4H_8O_2$	88.11	4	2.00
1569-02-4	1-Ethoxypropan-2-ol	$C_5H_{12}O_2$	104.15	5	2.11
107-98-2	1-Methoxy-2-propanol	$C_4H_{10}O_2$	90.12	4	1.95
872-50-4	1-Methyl-2-pyrrolidone	C_5H_9NO	99.13	5	2.22
929-06-6	2-(2-aminoethoxy)ethanol	$C_4H_{11}NO_2$	105.14	4	1.67
108-65-6	2-Methoxy-1-methylethyl acetate	$C_6H_{12}O_3$	132.16	6	2.00
75-65-0	2-Methylpropan-2-ol	$C_4H_{10}O$	74.12	4	2.38
123-42-2	4-Hydroxy-4-methylpentan-2-one	$C_6H_{12}O_2$	116.16	6	2.27
108-11-2	4-Methylpentan-2-ol	$C_6H_{14}O$	102.18	6	2.58
74-86-2	Acetylene	C_2H_2	26.04	2	3.38
100-66-3	Anisole	C_7H_8O	108.14	7	2.85
463-58-1	Carbonyl sulphide	COS	60.07	1	0.73
108-94-1	Cyclohexanone	$C_6H_{10}O$	98.14	6	2.69
120-92-3	Cyclopentanone	C_5H_8O	84.12	5	2.62
142-96-1	Dibutyl ether	$C_8H_{18}O$	130.23	8	2.70
75-10-5	Difluoromethane	CH_2F_2	52.02	1	0.85
107-21-1	Ethanediol	$C_2H_6O_2$	62.07	2	1.42
687-47-8	ethyl (S)-2-hydroxypropionate	$C_5H_{10}O_3$	118.13	5	1.86
97-64-3	Ethyl lactate	$C_5H_{10}O_3$	118.13	5	1.86
74-85-1	Ethylene	C_2H_4	28.05	2	3.14
593-53-3	Fluoromethane	CH_3F	34.03	1	1.29
96-48-0	Gamma-butyrolactone	$C_4H_6O_2$	86.09	4	2.04
110-43-0	Heptan-2-one	$C_7H_{14}O$	114.19	7	2.70
685-63-2	Hexafluorobutadiene	C_4F_6	162.03	4	1.09
999-97-3	Hexamethyldisilazane	$C_6H_{19}NSi_2$	161.39	6	1.64
67-63-0	Isopropanol	C_3H_8O	60.10	3	2.20
79-41-4	Methacrylic acid	$C_4H_6O_2$	86.09	4	2.04
74-82-8	Methane	CH_4	16.04	1	2.74
67-56-1	Methanol	CH4O	32.04	1	1.37
2110-78-3	Methyl 2-hydroxy-2-methylpropionate	$C_5H_{10}O_3$	118.13	5	1.86
1319-77-3	Mixed cresols	C_7H_8O	108.14	7	2.85
68-12-2	N,N-Dimethylformamide	C_3H_7NO	73.09	3	1.81
91-20-3	Naphthalene	$C_{10}H_8$	128.17	10	3.43
123-86-4	n-Butyl acetate	$C_6H_{12}O_2$	116.16	6	2.27
115-25-3	Octafluorocyclobutane	C_4F_8	200.03	4	0.88

NOTE: Confidential business information (CBI) has been omitted from this excerpt. As a result, the table below is not comprehensive of all process compounds generating CO2 as a byproduct.

Table 3-1: Oxidation Emission Factors for Process Chemicals

				Molar Mass (g/mol) ->	44.01
CAS No.	**Process Chemical Name**	**Molecular Formula**	**Molar Mass (g/mol)**	**# of C**	**CO_2 EF**
556-67-2	Octamethylcyclotetrasiloxane	$C_8H_{24}O_4Si_4$	296.61	8	1.19
52125-53-8	Propanol, 1(or 2)-ethoxy-	$C_5H_{12}O_2$	104.15	5	2.11
110-86-1	Pyridine	C_5H_5N	79.10	5	2.78
64742-94-5	Solvent naphtha (petroleum), heavy arom.	Varies	192.00	16	3.67
78-10-4	Tetraethyl orthosilicate	$SiC_8H_{20}O_4$	208.33	8	1.69
75-73-0	Tetrafluoromethane	CF_4	88.00	1	0.50
97-99-4	Tetrahydrofurfuryl alcohol	$C_5H_{10}O_2$	102.13	5	2.15
150-46-9	Triethyl borate	$C_6H_{15}BO_3$	145.99	6	1.81
78-40-0	Triethyl phosphate	$C_6H_{15}O_4P$	182.15	6	1.45
75-46-7	Trifluoromethane	CHF_3	70.01	1	0.63
75-24-1	Trimethylaluminium	C_3H_9Al	72.09	3	1.83
993-07-7	Trimethylsilane	$C_3H_{10}Si$	74.20	3	1.78

1. Emission factors derived in this table are utilized for calculating emissions in table 6-1.

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1-FABOP and 2-FABOP
Greenhouse Gas Process Emission Factors

Table 4-1: GHG Emission Factors

Primary Chemical			Process Used	Emission Chemical			Process Emission Factor (lb emitted / lb used)[1,2]
CAS #	Chemical Name	Molecular Formula		CAS #	Chemical Name	Molecular Formula	
75-10-5	Difluoromethane	CH2F2	Plasma Etch	75-10-5	Difluoromethane	CH2F2	0.2
75-10-5	Difluoromethane	CH2F2	Plasma Etch	124-38-9	Carbon Dioxide	CO2	0.846
75-10-5	Difluoromethane	CH2F2	Plasma Etch	593-53-3	Fluoromethane	CH3F	0.0044
75-10-5	Difluoromethane	CH2F2	Plasma Etch	76-16-4	Hexafluoroethane	C2F6	0.044
75-10-5	Difluoromethane	CH2F2	Plasma Etch	75-73-0	Tetrafluoromethane	CF4	0.06
75-10-5	Difluoromethane	CH2F2	Plasma Etch	75-46-7	Trifluoromethane	CHF3	0.057
75-10-5	Difluoromethane	CH2F2	Plasma Etch	115-25-3	Octoflourocyclobutane	C4F8	0.072
7782-41-4	Fluorine	F2	Thin Films / Diffusion Deposition	75-73-0	Tetrafluoromethane	CF4	0.116
593-53-3	Fluoromethane	CH3F	Plasma Etch	593-53-3	Fluoromethane	CH3F	0.32
593-53-3	Fluoromethane	CH3F	Plasma Etch	124-38-9	Carbon Dioxide	CO2	1.29
593-53-3	Fluoromethane	CH3F	Plasma Etch	75-10-5	Difluoromethane	CH2F2	0.0023
593-53-3	Fluoromethane	CH3F	Plasma Etch	685-63-2	Hexafluorobutadiene	C4F6	0.0012
593-53-3	Fluoromethane	CH3F	Plasma Etch	76-16-4	Hexafluoroethane	C2F6	0.011
593-53-3	Fluoromethane	CH3F	Plasma Etch	75-73-0	Tetrafluoromethane	CF4	0.031
593-53-3	Fluoromethane	CH3F	Plasma Etch	75-46-7	Trifluoromethane	CHF3	0.0016
593-53-3	Fluoromethane	CH3F	Plasma Etch	115-25-3	Octoflourocyclobutane	C4F8	0.007
685-63-2	Hexafluorobutadiene	C4F6	Plasma Etch	685-63-2	Hexafluorobutadiene	C4F6	0.15
685-63-2	Hexafluorobutadiene	C4F6	Plasma Etch	124-38-9	Carbon Dioxide	CO2	1.09
685-63-2	Hexafluorobutadiene	C4F6	Plasma Etch	75-10-5	Difluoromethane	CH2F2	0.00003
685-63-2	Hexafluorobutadiene	C4F6	Plasma Etch	593-53-3	Fluoromethane	CH3F	0.00065
685-63-2	Hexafluorobutadiene	C4F6	Plasma Etch	76-16-4	Hexafluoroethane	C2F6	0.062
685-63-2	Hexafluorobutadiene	C4F6	Plasma Etch	75-73-0	Tetrafluoromethane	CF4	0.059
685-63-2	Hexafluorobutadiene	C4F6	Plasma Etch	75-46-7	Trifluoromethane	CHF3	0.017
685-63-2	Hexafluorobutadiene	C4F6	Plasma Etch	115-25-3	Octoflourocyclobutane	C4F8	0.0051
7783-54-2	Nitrogen Trifluoride	NF3	Plasma Etch	7783-54-2	Nitrogen Trifluoride	NF3	0.16
7783-54-2	Nitrogen Trifluoride	NF3	Plasma Etch	75-10-5	Difluoromethane	CH2F2	0.00086
7783-54-2	Nitrogen Trifluoride	NF3	Plasma Etch	593-53-3	Fluoromethane	CH3F	0.008
7783-54-2	Nitrogen Trifluoride	NF3	Plasma Etch	76-16-4	Hexafluoroethane	C2F6	0.045
7783-54-2	Nitrogen Trifluoride	NF3	Plasma Etch	75-73-0	Tetrafluoromethane	CF4	0.045
7783-54-2	Nitrogen Trifluoride	NF3	Plasma Etch	75-46-7	Trifluoromethane	CHF3	0.025
7783-54-2	Nitrogen Trifluoride	NF3	Thin Films - In-Situ Clean	7783-54-2	Nitrogen Trifluoride	NF3	0.2
7783-54-2	Nitrogen Trifluoride	NF3	Thin Films - In-Situ Clean	75-73-0	Tetrafluoromethane	CF4	0.037
7783-54-2	Nitrogen Trifluoride	NF3	Thin Films - Remote Clean	7783-54-2	Nitrogen Trifluoride	NF3	0.018
7783-54-2	Nitrogen Trifluoride	NF3	Thin Films - Remote Clean	75-73-0	Tetrafluoromethane	CF4	0.038
7783-54-2	Nitrogen Trifluoride	NF3	Thin Films - Remote Clean	75-73-0	Tetrafluoromethane	CF4	0.093
7783-54-2	Nitrogen Trifluoride	NF3	Thin Films - Thermal Clean	7783-54-2	Nitrogen trifluoride	NF3	0.28
7783-54-2	Nitrogen Trifluoride	NF3	Thin Films - Thermal Clean	75-73-0	Tetrafluoromethane	CF4	0.01
10024-97-2	Nitrous Oxide	N2O	Thin Films / Diffusion Deposition	10024-97-2	Nitrous Oxide	N2O	0.5
10024-97-2	Nitrous Oxide	N2O	Other	10024-97-2	Nitrous Oxide	N2O	1
115-25-3	Octafluorocyclobutane	C4F8	Plasma Etch	115-25-3	Octafluorocyclobutane	C4F8	0.18
115-25-3	Octafluorocyclobutane	C4F8	Plasma Etch	124-38-9	Carbon Dioxide	CO2	0.88
115-25-3	Octafluorocyclobutane	C4F8	Plasma Etch	75-10-5	Difluoromethane	CH2F2	0.0014
115-25-3	Octafluorocyclobutane	C4F8	Plasma Etch	593-53-3	Fluoromethane	CH3F	0.0022
115-25-3	Octafluorocyclobutane	C4F8	Plasma Etch	685-63-2	Hexafluorobutadiene	C4F6	0.0094
115-25-3	Octafluorocyclobutane	C4F8	Plasma Etch	76-16-4	Hexafluoroethane	C2F6	0.027
115-25-3	Octafluorocyclobutane	C4F8	Plasma Etch	75-73-0	Tetrafluoromethane	CF4	0.045
115-25-3	Octafluorocyclobutane	C4F8	Plasma Etch	75-46-7	Trifluoromethane	CHF3	0.029
559-40-0	Octafluorocyclopentene	C5F8	Plasma Etch	559-40-0	Octafluorocyclopentene	C5F8	0.1
559-40-0	Octafluorocyclopentene	C5F8	Plasma Etch	124-38-9	Carbon Dioxide	CO2	1.04
559-40-0	Octafluorocyclopentene	C5F8	Plasma Etch	76-16-4	Hexafluoroethane	C2F6	0.083
559-40-0	Octafluorocyclopentene	C5F8	Plasma Etch	75-73-0	Tetrafluoromethane	CF4	0.11
559-40-0	Octafluorocyclopentene	C5F8	Plasma Etch	75-46-7	Trifluoromethane	CHF3	0.0069
559-40-0	Octafluorocyclopentene	C5F8	Plasma Etch	76-19-7	Octafluoropropane	C3F8	0.00012

Table 4-1: GHG Emission Factors

Primary Chemical			Process Used	Emission Chemical			Process Emission Factor (lb emitted / lb used)[1,2]
CAS #	**Chemical Name**	**Molecular Formula**		**CAS #**	**Chemical Name**	**Molecular Formula**	
76-19-7	Octafluoropropane	C3F8	Plasma Etch	76-19-7	Octafluoropropane	C3F8	0.3
76-19-7	Octafluoropropane	C3F8	Plasma Etch	124-38-9	Carbon Dioxide	CO2	0.702
76-19-7	Octafluoropropane	C3F8	Plasma Etch	593-53-3	Fluoromethane	CH3F	0.00073
76-19-7	Octafluoropropane	C3F8	Plasma Etch	76-16-4	Hexafluoroethane	C2F6	0.18
76-19-7	Octafluoropropane	C3F8	Plasma Etch	75-73-0	Tetrafluoromethane	CF4	0.21
76-19-7	Octafluoropropane	C3F8	Plasma Etch	75-46-7	Trifluoromethane	CHF3	0.012
2551-62-4	Sulfur Hexafluoride	SF6	Plasma Etch	2551-62-4	Sulfur Hexafluoride	SF6	0.29
2551-62-4	Sulfur Hexafluoride	SF6	Plasma Etch	75-10-5	Difluoromethane	CH2F2	0.00002
2551-62-4	Sulfur Hexafluoride	SF6	Plasma Etch	593-53-3	Fluoromethane	CH3F	0.0082
2551-62-4	Sulfur Hexafluoride	SF6	Plasma Etch	76-16-4	Hexafluoroethane	C2F6	0.041
2551-62-4	Sulfur Hexafluoride	SF6	Plasma Etch	75-73-0	Tetrafluoromethane	CF4	0.034
2551-62-4	Sulfur Hexafluoride	SF6	Plasma Etch	75-46-7	Trifluoromethane	CHF3	0.0039
2551-62-4	Sulfur Hexafluoride	SF6	Plasma Etch	7446-09-5	Sulfur Dioxide	SO2	1.000
75-73-0	Tetrafluoromethane	CF4	Plasma Etch	75-73-0	Tetrafluoromethane	CF4	0.65
75-73-0	Tetrafluoromethane	CF4	Plasma Etch	124-38-9	Carbon Dioxide	CO2	0.5
75-73-0	Tetrafluoromethane	CF4	Plasma Etch	75-10-5	Difluoromethane	CH2F2	0.014
75-73-0	Tetrafluoromethane	CF4	Plasma Etch	593-53-3	Fluoromethane	CH3F	0.0053
75-73-0	Tetrafluoromethane	CF4	Plasma Etch	685-63-2	Hexafluorobutadiene	C4F6	0.0015
75-73-0	Tetrafluoromethane	CF4	Plasma Etch	76-16-4	Hexafluoroethane	C2F6	0.061
75-73-0	Tetrafluoromethane	CF4	Plasma Etch	75-46-7	Trifluoromethane	CHF3	0.013
75-73-0	Tetrafluoromethane	CF4	Plasma Etch	115-25-3	Octafluorocyclobutane	C4F8	0.0033
75-46-7	Trifluoromethane	CHF3	Plasma Etch	75-46-7	Trifluoromethane	CHF3	0.38
75-46-7	Trifluoromethane	CHF3	Plasma Etch	124-38-9	Carbon Dioxide	CO2	0.629
75-46-7	Trifluoromethane	CHF3	Plasma Etch	75-10-5	Difluoromethane	CH2F2	0.0026
75-46-7	Trifluoromethane	CHF3	Plasma Etch	593-53-3	Fluoromethane	CH3F	0.037
75-46-7	Trifluoromethane	CHF3	Plasma Etch	685-63-2	Hexafluorobutadiene	C4F6	0.0001
75-46-7	Trifluoromethane	CHF3	Plasma Etch	76-16-4	Hexafluoroethane	C2F6	0.062
75-46-7	Trifluoromethane	CHF3	Plasma Etch	75-73-0	Tetrafluoromethane	CF4	0.076
75-46-7	Trifluoromethane	CHF3	Plasma Etch	115-25-3	Octafluorocyclobutane	C4F8	0.00067

1. Emission factors for CF_4 generated from combustion of F_2 are from the IPCC 2019 Refinement Equation 6.15 on pages 6.31 and 6.32. F2 may be used directly or generated as a byproduct of use of NF3 in remote clean processes
2. Emission factors chemicals not covered by footnote 1 are from the IPCC 2019 Refinement Table 6.11

Micron - Clay, NY Fabs 1 & 2
1-FABOP and 2-FABOP
Destruction and Removal Efficiency (DRE) and PEEC Management Values

Table 5-1: Process Equipment Exhaust Conditioner (PEEC) Management

Category/Chemical Controlled[1]	Chemical Names(s)	CAS #	Fleet Average Fraction Managed	Source
CF4	Tetrafluoromethane	75-73-0	0.89	IPCC Table 6.17
N2O	Nitrous Oxide-Other	10024-97-2	0.60	IPCC Table 6.17
N2O	Nitrous Oxide-CVD	10024-97-2	0.60	IPCC Table 6.17
NF3	Nitrogen Trifluoride-In Situ	7783-54-2	0.95	IPCC Table 6.17
NF3	Nitrogen Trifluoride-Remote	7783-54-2	0.95	IPCC Table 6.17

1. CF_4 generated in a PEEC as a result of management of F_2 is not itself managed in the PEEC

Table 5-2: Point-of-Use Control Device DRE Values

Category/Chemical Controlled	Chemical Names(s)	CAS #	Fleet Average DRE Value	Source
CH2F2	Difluoromethane	75-10-5	0.99	IPCC Table 6.17
CH3F	Fluoromethane	593-53-3	0.99	IPCC Table 6.17
CF4	Tetrafluoromethane	75-73-0	0.89	IPCC Table 6.17
C2F6	Hexafluoroethane	76-16-4	0.98	IPCC Table 6.17
CHF3	Trifluoromethane	75-46-7	0.98	IPCC Table 6.17
C4F8	Octafluorocyclobutane	115-25-3	0.98	IPCC Table 6.17
C4F6	Hexafluorobutadiene	685-63-2	0.98	IPCC Table 6.17
NF3	Nitrogen Trifluoride-Etch	7783-54-2	0.95	IPCC Table 6.17
SF6	Sulfur Hexafluoride	2551-62-4	0.96	IPCC Table 6.17

Table 5-4: Regenerative Catalytic System DRE Values

Category/Chemical Controlled	Chemical Names(s)	Primary CAS #	Fleet Average DRE Value	Source
C4F8	Octafluorocyclobutane	115-25-3	0.98	Info. from Potential Supplier
C4F6	Hexafluorobutadiene	685-63-2	0.98	Info. from Potential Supplier
CH2F2	Difluoromethane	75-10-5	0.99	Info. from Potential Supplier
CH3F	Fluoromethane	593-53-3	0.99	Info. from Potential Supplier
CHF3	Trifluoromethane	75-46-7	0.98	Info. from Potential Supplier
CF4	Tetrafluoromethane	75-73-0	0.89	Info. from Potential Supplier
NF3	Nitrogen Trifluoride-All	7783-54-2	0.95	Info. from Potential Supplier
SF6	Sulfur Hexafluoride	2551-62-4	0.96	Info. from Potential Supplier
C2F6	Hexafluoroethane	76-16-4	0.98	Info. from Potential Supplier
C3F8	Octafluoropropane	76-19-7	0.89	Assumed to be the same as CF4
C5F8	Octafluorocyclopentene	559-40-0	0.98	IPCC Table 6.17
N2O	Nitrous Oxide-All	10024-97-2	0.60	IPCC Table 6.17
CO2	Carbon Dioxide	124-38-9	0.00	
CH4	Methane	74-82-8	0.89	Assumed to be the same as CF4

Micron - Clay, NY Fabs 1 & 2
1-FABOP and 2-FABOP
Process Chemical Emissions Calculations

NOTE: Confidential business information (CBI) has been omitted from this excerpt. As a result, the table below is not comprehensive of all process compounds generating CO2 as a byproduct.

Table 6-1: Process Chemical Emissions Calculations

	Primary Chemical							Emission Chemical							Process Emission Quantification					
Chemical Use Case ID #	CAS #	Chemical Name	Common Acronym/Alternate Name	Molecular Formula	Process Category	% of Total Usage	Projected Usage in Process Category (lb/yr)	CAS #	Emission Chemical	Molecular Formula	Emission Chem Formation Depends on Primary Chem EF?	Process Emission Factor (lb emitted / lb used)	GHG	Exhaust Type	PEEC Fraction Managed	Pre-Control Process Emissions (lb/yr)	POU or RCS DRE	Post POU Emissions (lb/yr)	Centralized Control DRE	Post-Control Emissions (lb/yr)
1	95-63-6	1,2,4-Trimethylbenzene	TMB	C_9H_{12}	Photolithography	100%	27,331	124-38-9	Carbon dioxide	CO2	X	3.30	X	Fab Solvent	0.00	18,014	N/A	N/A	0.00	18,014
1	1436-34-6	1,2-Epoxyhexane		$C_6H_{12}O$	Photolithography	100%	19.7	124-38-9	Carbon dioxide	CO2	X	2.64	X	Fab Solvent	0.00	10.4	N/A	N/A	0.00	10.4
1	123-91-1	1,4-Dioxane		$C_4H_8O_2$	Photolithography	100%	31.1	124-38-9	Carbon dioxide	CO2	X	2.00	X	Fab Solvent	0.00	12.4	N/A	N/A	0.00	12.4
1	1569-02-4	1-Ethoxypropan-2-ol		$C_5H_{12}O_2$	Photolithography	100%	0.00	124-38-9	Carbon dioxide	CO2	X	2.11	X	Fab Solvent	0.00	0.00	N/A	N/A	0.00	0.00
1	107-98-2	1-Methoxy-2-propanol	PGME	$C_4H_{10}O_2$	Photolithography	100%	35,817	124-38-9	Carbon dioxide	CO2	X	1.95	X	Fab Solvent	0.00	13,993	N/A	N/A	0.00	13,993
1	872-50-4	1-Methyl-2-pyrrolidone	NMP	C_5H_9NO	Wet Etch / Wet Clean	100%	2,213,132	124-38-9	Carbon dioxide	CO2	X	2.22	X	Fab Solvent	0.00	245,630	N/A	N/A	0.00	245,630
1	929-06-6	2-(2-aminoethoxy)ethanol		$C_4H_{11}NO_2$	Photolithography	100%	10,845	124-38-9	Carbon dioxide	CO2	X	1.67	X	Fab Solvent	0.00	3,632	N/A	N/A	0.00	3,632
1	108-65-6	2-Methoxy-1-methylethyl acetate	PGMEA	$C_6H_{12}O_3$	Photolithography	37%	5,352,987	124-38-9	Carbon dioxide	CO2	X	2.00	X	Fab Solvent	0.00	2,139,105	N/A	N/A	0.00	2,139,105
2	108-65-6	2-Methoxy-1-methylethyl acetate	PGMEA	$C_6H_{12}O_3$	Wet Etch / Wet Clean	63%	9,210,208	124-38-9	Carbon dioxide	CO2	X	2.00	X	Fab Solvent	0.00	3,680,487	N/A	N/A	0.00	3,680,487
1	75-65-0	2-Methylpropan-2-ol		$C_4H_{10}O$	Photolithography	100%	138.9	124-38-9	Carbon dioxide	CO2	X	2.38	X	Fab Solvent	0.00	66.0	N/A	N/A	0.00	66.0
1	123-42-2	4-Hydroxy-4-methylpentan-2-one		$C_6H_{12}O_2$	Photolithography	100%	393.4	124-38-9	Carbon dioxide	CO2	X	2.27	X	Fab Solvent	0.00	178.9	N/A	N/A	0.00	178.9
1	108-11-2	4-Methylpentan-2-ol		$C_6H_{14}O$	Photolithography	100%	131,329	124-38-9	Carbon dioxide	CO2	X	2.58	X	Fab Solvent	0.00	67,878	N/A	N/A	0.00	67,878
1	74-86-2	Acetylene		C_2H_2	Thin Films / Diffusion Deposition	100%	37,524	124-38-9	Carbon dioxide	CO2	X	3.38	X	Fab CVD	0.00	126,839	N/A	N/A	0.00	126,839
1	100-66-3	Anisole		C_7H_8O	Photolithography	100%	0.00	124-38-9	Carbon dioxide	CO2	X	2.85	X	Fab Solvent	0.00	0.00	N/A	N/A	0.00	0.00
1	124-38-9	Carbon dioxide		CO_2	Wet Etch / Wet Clean	100%	4,047,301	124-38-9	Carbon dioxide	CO2		1.00	X	Fab Acid	0.00	4,047,301	N/A	N/A	0.00	4,047,301
1	463-58-1	Carbonyl sulphide		COS	Plasma Etch	100%	1,442	124-38-9	Carbon dioxide	CO2	X	0.73	X	Fab Acid	0.00	1,057	0	1,057	0.00	1,057
1	108-94-1	Cyclohexanone		$C_6H_{10}O$	Photolithography	100%	260,863	124-38-9	Carbon dioxide	CO2	X	2.69	X	Fab Solvent	0.00	140,378	N/A	N/A	0.00	140,378
1	120-92-3	Cyclopentanone		C_5H_8O	Photolithography	100%	164.1	124-38-9	Carbon dioxide	CO2	X	2.62	X	Fab Solvent	0.00	85.9	N/A	N/A	0.00	85.9
1	142-96-1	Dibutyl ether		$C_8H_{18}O$	Photolithography	100%	24,263	124-38-9	Carbon dioxide	CO2	X	2.70	X	Fab Solvent	0.00	13,119	N/A	N/A	0.00	13,119
1	75-10-5	Difluoromethane		CH_2F_2	Plasma Etch	100%	14,066	75-10-5	Difluoromethane	CH2F2		0.20	X	Fab Acid	0.00	2,813	0.99	28.1	0.00	28.1
1	75-10-5	Difluoromethane		CH_2F_2	Plasma Etch	100%	14,066	124-38-9	Carbon dioxide	CO2		0.85	X	Fab Acid	0.00	11,900	0	11,900	0.00	11,900
1	75-10-5	Difluoromethane		CH_2F_2	Plasma Etch	100%	14,066	593-53-3	Fluoromethane	CH3F		4.40E-03	X	Fab Acid	0.00	61.9	0.99	0.62	0.00	0.62
1	75-10-5	Difluoromethane		CH_2F_2	Plasma Etch	100%	14,066	76-16-4	Hexafluoroethane	C2F6		0.04	X	Fab Acid	0.00	618.9	0.98	12.4	0.00	12.4
1	75-10-5	Difluoromethane		CH_2F_2	Plasma Etch	100%	14,066	75-73-0	Tetrafluoromethane	CF4		0.06	X	Fab Acid	0.00	843.9	0.89	92.8	0.00	92.8
1	75-10-5	Difluoromethane		CH_2F_2	Plasma Etch	100%	14,066	75-46-7	Trifluoromethane	CHF3		0.06	X	Fab Acid	0.00	801.8	0.98	16.0	0.00	16.0
1	75-10-5	Difluoromethane		CH_2F_2	Plasma Etch	100%	14,066	115-25-3	Octafluorocyclobutane	C4F8		0.07	X	Fab Acid	0.00	1,013	0.98	20.3	0.00	20.3
1	687-47-8	ethyl (S)-2-hydroxypropionate		$C_5H_{10}O_3$	Photolithography	100%	35,947	124-38-9	Carbon dioxide	CO2	X	1.86	X	Fab Solvent	0.00	13,392	N/A	N/A	0.00	13,392
1	97-64-3	Ethyl lactate		$C_5H_{10}O_3$	Photolithography	100%	31,809	124-38-9	Carbon dioxide	CO2	X	1.86	X	Fab Solvent	0.00	11,851	N/A	N/A	0.00	11,851
1	74-85-1	Ethylene		C_2H_4	Thin Films / Diffusion Deposition	100%	0.00	124-38-9	Carbon dioxide	CO2	X	3.14	X	Fab CVD	0.00	0.00	N/A	N/A	0.00	0.00
1	7782-41-4	Fluorine		F_2	Thin Films / Diffusion Deposition	100%	1,795	75-73-0	Tetrafluoromethane	CF4		0.12	X	Fab CVD	0.00	208.2	N/A	N/A	0.00	208.2
1	593-53-3	Fluoromethane		CH_3F	Plasma Etch	100%	3,201	593-53-3	Fluoromethane	CH3F		0.32	X	Fab Acid	0.00	1,024	0.99	10.2	0.00	10.2
1	593-53-3	Fluoromethane		CH_3F	Plasma Etch	100%	3,201	124-38-9	Carbon dioxide	CO2		1.29	X	Fab Acid	0.00	4,140	0	4,140	0.00	4,140
1	593-53-3	Fluoromethane		CH_3F	Plasma Etch	100%	3,201	75-10-5	Difluoromethane	CH2F2		2.30E-03	X	Fab Acid	0.00	7.36	0.99	0.07	0.00	0.07
1	593-53-3	Fluoromethane		CH3F	Plasma Etch	100%	3,201	685-63-2	Hexafluorobutadiene	C4F6		1.20E-03	X	Fab Acid	0.00	3.84	0.98	0.08	0.00	0.08
1	593-53-3	Fluoromethane		CH_3F	Plasma Etch	100%	3,201	76-16-4	Hexafluoroethane	C2F6		0.01	X	Fab Acid	0.00	35.2	0.98	0.70	0.00	0.70
1	593-53-3	Fluoromethane		CH_3F	Plasma Etch	100%	3,201	75-73-0	Tetrafluoromethane	CF4		0.03	X	Fab Acid	0.00	99.2	0.89	10.9	0.00	10.9
1	593-53-3	Fluoromethane		CH_3F	Plasma Etch	100%	3,201	75-46-7	Trifluoromethane	CHF3		1.60E-03	X	Fab Acid	0.00	5.12	0.98	0.10	0.00	0.10
1	593-53-3	Fluoromethane		CH3F	Plasma Etch	100%	3,201	115-25-3	Octafluorocyclobutane	C4F8		0.01	X	Fab Acid	0.00	22.4	0.98	0.45	0.00	0.45
1	96-48-0	Gamma-butyrolactone		$C_4H_6O_2$	Photolithography	100%	13,766	124-38-9	Carbon dioxide	CO2	X	2.04	X	Fab Solvent	0.00	5,630	N/A	N/A	0.00	5,630
1	110-43-0	Heptan-2-one		$C_7H_{14}O$	Photolithography	100%	2,366	124-38-9	Carbon dioxide	CO2	X	2.70	X	Fab Solvent	0.00	1,276	N/A	N/A	0.00	1,276
1	685-63-2	Hexafluorobutadiene		C_4F_6	Plasma Etch	100%	11,751	685-63-2	Hexafluorobutadiene	C4F6		0.15	X	Fab Acid	0.00	1,763	0.98	35.3	0.00	35.3
1	685-63-2	Hexafluorobutadiene		C_4F_6	Plasma Etch	100%	11,751	124-38-9	Carbon dioxide	CO2		1.09	X	Fab Acid	0.00	12,767	0	12,767	0.00	12,767
1	685-63-2	Hexafluorobutadiene		C_4F_6	Plasma Etch	100%	11,751	75-10-5	Difluoromethane	CH2F2		3.00E-05	X	Fab Acid	0.00	0.35	0.99	3.53E-03	0.00	3.53E-03
1	685-63-2	Hexafluorobutadiene		C_4F_6	Plasma Etch	100%	11,751	593-53-3	Fluoromethane	CH3F		6.50E-04	X	Fab Acid	0.00	7.64	0.99	0.08	0.00	0.08
1	685-63-2	Hexafluorobutadiene		C_4F_6	Plasma Etch	100%	11,751	76-16-4	Hexafluoroethane	C2F6		0.06	X	Fab Acid	0.00	728.6	0.98	14.6	0.00	14.6
1	685-63-2	Hexafluorobutadiene		C_4F_6	Plasma Etch	100%	11,751	75-73-0	Tetrafluoromethane	CF4		0.06	X	Fab Acid	0.00	693.3	0.89	76.3	0.00	76.3
1	685-63-2	Hexafluorobutadiene		C_4F_6	Plasma Etch	100%	11,751	75-46-7	Trifluoromethane	CHF3		0.02	X	Fab Acid	0.00	199.8	0.98	4.00	0.00	4.00
1	685-63-2	Hexafluorobutadiene		C_4F_6	Plasma Etch	100%	11,751	115-25-3	Octafluorocyclobutane	C4F8		0.01	X	Fab Acid	0.00	59.9	0.98	1.20	0.00	1.20
1	999-97-3	Hexamethyldisilazane	HMDS	$C_6H_{19}NSi_2$	Photolithography	100%	43,928	124-38-9	Carbon dioxide	CO2	X	1.64	X	Fab Solvent	0.00	71,874	N/A	N/A	0.00	71,874
1	67-63-0	Isopropanol	IPA	C_3H_8O	Wet Etch / Wet Clean	99%	23,237,104	124-38-9	Carbon dioxide	CO2		2.20	X	Fab Solvent	0.00	51,048,166	N/A	N/A	0.00	51,048,166
1	79-41-4	Methacrylic Acid		$C_4H_6O_2$	Photolithography	100%	22,361	124-38-9	Carbon dioxide	CO2	X	2.04	X	Fab Solvent	0.00	9,145	N/A	N/A	0.00	9,145
1	74-82-8	Methane		CH_4	Plasma Etch	100%	3,411	74-82-8	Methane	CH4		1.00	X	Fab Acid	0.00	3,411	0.99	34.1	0.00	34.1
1	74-82-8	Methane		CH_4	Plasma Etch	100%	3,411	124-38-9	Carbon dioxide	CO2		2.74	X	Fab Acid	0.00	9,358	0	9,358	0.00	9,358
1	2110-78-3	Methyl 2-hydroxy-2-methylpropionate		$C_5H_{10}O_3$	Photolithography	100%	6,168	124-38-9	Carbon dioxide	CO2	X	1.86	X	Fab Solvent	0.00	2,298	N/A	N/A	0.00	2,298
1	1319-77-3	Mixed cresols		C_7H_8O	Photolithography	100%	31.1	124-38-9	Carbon dioxide	CO2	X	2.85	X	Fab Solvent	0.00	17.7	N/A	N/A	0.00	17.7
1	68-12-2	N,N-Dimethylformamide		C_3H_7NO	Photolithography	100%	0.00	124-38-9	Carbon dioxide	CO2	X	1.81	X	Fab Solvent	0.00	0.00	N/A	N/A	0.00	0.00
1	91-20-3	Naphthalene		$C_{10}H_9$	Photolithography	100%	13,665	124-38-9	Carbon dioxide	CO2	X	3.43	X	Fab Solvent	0.00	9,385	N/A	N/A	0.00	9,385
1	123-86-4	n-Butyl acetate		$C_6H_{12}O_2$	Photolithography	100%	1,780,301	124-38-9	Carbon dioxide	CO2	X	2.27	X	Fab Solvent	0.00	809,412	N/A	N/A	0.00	809,412
1	7783-54-2	Nitrogen trifluoride		NF_3	Plasma Etch	24%	266,465	7783-54-2	Nitrogen trifluoride	NF3		0.16	X	Fab Acid	0.00	42,634	0.95	2,132	0.00	2,132
1	7783-54-2	Nitrogen trifluoride		NF_3	Plasma Etch	24%	266,465	75-10-5	Difluoromethane	CH2F2		8.60E-04	X	Fab Acid	0.00	229.2	0.99	2.29	0.00	2.29
1	7783-54-2	Nitrogen trifluoride		NF_3	Plasma Etch	24%	266,465	593-53-3	Fluoromethane	CH3F		0.01	X	Fab Acid	0.00	2,132	0.99	21.3	0.00	21.3
1	7783-54-2	Nitrogen trifluoride		NF_3	Plasma Etch	24%	266,465	76-16-4	Hexafluoroethane	C2F6		0.05	X	Fab Acid	0.00	11,991	0.98	239.8	0.00	239.8
1	7783-54-2	Nitrogen trifluoride		NF_3	Plasma Etch	24%	266,465	75-73-0	Tetrafluoromethane	CF4		0.05	X	Fab Acid	0.00	11,991	0.89	1,319	0.00	1,319
1	7783-54-2	Nitrogen trifluoride		NF_3	Plasma Etch	24%	266,465	75-46-7	Trifluoromethane	CHF3		0.03	X	Fab Acid	0.00	6,662	0.98	133.2	0.00	133.2
2	7783-54-2	Nitrogen trifluoride		NF_3	Thin Films - In-Situ Clean	1%	5,665	7783-54-2	Nitrogen trifluoride	NF3		0.20	X	Fab CVD	0.95	56.6	N/A	N/A	0.00	56.6
2	7783-54-2	Nitrogen trifluoride		NF_3	Thin Films - In-Situ Clean	1%	5,665	75-73-0	Tetrafluoromethane	CF4		0.04	X	Fab CVD	0.89	23.1	N/A	N/A	0.00	23.1
3	7783-54-2	Nitrogen trifluoride		NF_3	Thin Films - Remote Clean	76%	866,532	7783-54-2	Nitrogen trifluoride	NF3		0.02	X	Fab CVD	0.95	779.9	N/A	N/A	0.00	779.9
3	7783-54-2	Nitrogen trifluoride		NF_3	Thin Films - Remote Clean	76%	866,532	75-73-0	Tetrafluoromethane	CF4		0.04	X	Fab CVD	0.89	3,622	N/A	N/A	0.00	3,622
3	7783-54-2	Nitrogen trifluoride		NF_3	Thin Films - Remote Clean	76%	866,532	75-73-0	Tetrafluoromethane	CF4		0.09	X	Fab CVD	0.00	80,588	N/A	N/A	0.00	80,588
4	7783-54-2	Nitrogen trifluoride		NF_3	Thin Films - Thermal Clean	1%	5,665	7783-54-2	Nitrogen trifluoride	NF3		0.28	X	Fab CVD	0.95	79.3	N/A	N/A	0.00	79.3
4	7783-54-2	Nitrogen trifluoride		NF_3	Thin Films - Thermal Clean	1%	5,665	75-73-0	Tetrafluoromethane	CF4		0.01	X	Fab CVD	0.00	56.6	N/A	N/A	0.00	56.6
2	10024-97-2	Nitrous oxide		N_2O	Thin Films / Diffusion Deposition	100%	1,576,605	10024-97-2	Nitrous oxide	N2O		0.50	X	Fab CVD	0.60	315,321	N/A	N/A	0.00	315,321
1	115-25-3	Octafluorocyclobutane		C_4F_8	Plasma Etch	100%	11,619	115-25-3	Octafluorocyclobutane	C4F8		0.18	X	Fab Acid	0.00	2,091	0.98	41.8	0.00	41.8
1	115-25-3	Octafluorocyclobutane		C_4F_8	Plasma Etch	100%	11,619	124-38-9	Carbon dioxide	CO2		0.88	X	Fab Acid	0.00	10,226	0	10,226	0.00	10,226
1	115-25-3	Octafluorocyclobutane		C_4F_8	Plasma Etch	100%	11,619	75-10-5	Difluoromethane	CH2F2		1.40E-03	X	Fab Acid	0.00	16.3	0.99	0.16	0.00	0.16
1	115-25-3	Octafluorocyclobutane		C_4F_8	Plasma Etch	100%	11,619	593-53-3	Fluoromethane	CH3F		2.20E-03	X	Fab Acid	0.00	25.6	0.99	0.26	0.00	0.26
1	115-25-3	Octafluorocyclobutane		C_4F_8	Plasma Etch	100%	11,619	685-63-2	Hexafluorobutadiene	C4F6		0.01	X	Fab Acid	0.00	109.2	0.98	2.18	0.00	2.18
1	115-25-3	Octafluorocyclobutane		C_4F_8	Plasma Etch	100%	11,619	76-16-4	Hexafluoroethane	C2F6		0.03	X	Fab Acid	0.00	313.7	0.98	6.27	0.00	6.27
1	115-25-3	Octafluorocyclobutane		C_4F_8	Plasma Etch	100%	11,619	75-73-0	Tetrafluoromethane	CF4		0.05	X	Fab Acid	0.00	522.9	0.89	57.5	0.00	57.5
1	115-25-3	Octafluorocyclobutane		C_4F_8	Plasma Etch	100%	11,619	75-46-7	Trifluoromethane	CHF3		0.03	X	Fab Acid	0.00	337.0	0.98	6.74	0.00	6.74
1	556-67-2	Octamethylcyclotetrasiloxane	OMCTS / D4	$C_8H_{24}O_4Si_4$	Thin Films / Diffusion Deposition	100%	26,181	124-38-9	Carbon dioxide	CO2		1.19	X	Fab CVD	0.00	31,077	N/A	N/A	0.00	31,077
1	52125-53-8	Propanol, 1(or 2)-ethoxy-		$C_5H_{12}O_2$	Photolithography	100%	18,616	124-38-9	Carbon dioxide	CO2	X	2.11	X	Fab Solvent	0.00	7,866	N/A	N/A	0.00	7,866
1	110-86-1	Pyridine		C_5H_5N	Photolithography	100%	379.1	124-38-9	Carbon dioxide	CO2	X	2.78	X	Fab Solvent	0.00	210.9	N/A	N/A	0.00	210.9

Table 6-1: Process Chemical Emissions Calculations

Chemical Use Case ID #	Primary Chemical				Process Category	% of Total Usage	Projected Usage in Process Category (lb/yr)	Emission Chemical			Emission Chem Formation Depends on Primary Chem EF?	Process Emission Factor (lb emitted / lb used)	GHG	Exhaust Type	Process Emission Quantification					
	CAS #	Chemical Name	Common Acronym/Alternate Name	Molecular Formula				CAS #	Emission Chemical	Molecular Formula					PEEC Fraction Managed	Pre-Control Process Emissions (lb/yr)	POU or RCS DRE	Post POU Emissions (lb/yr)	Centralized Control DRE	Post-Control Emissions (lb/yr)
1	64742-94-5	Solvent naphtha (petroleum), heavy arom.		Varies	Photolithography	100%	273,307	124-38-9	Carbon dioxide	CO2	X	3.67	X	Fab Solvent	0.00	200,471	N/A	N/A	0.00	200,471
1	2551-62-4	Sulfur hexafluoride		SF_6	Plasma Etch	100%	5,149	2551-62-4	Sulfur hexafluoride	SF6		0.29	X	Fab Acid	0.00	1,493	0.96	59.7	0.00	59.7
1	2551-62-4	Sulfur hexafluoride		SF_6	Plasma Etch	100%	5,149	75-10-5	Difluoromethane	CH2F2		2.00E-05	X	Fab Acid	0.00	0.10	0.99	1.03E-03	0.00	1.03E-03
1	2551-62-4	Sulfur hexafluoride		SF_6	Plasma Etch	100%	5,149	593-53-3	Fluoromethane	CH3F		0.01	X	Fab Acid	0.00	42.2	0.99	0.42	0.00	0.42
1	2551-62-4	Sulfur hexafluoride		SF_6	Plasma Etch	100%	5,149	76-16-4	Hexafluoroethane	C2F6		0.04	X	Fab Acid	0.00	211.1	0.98	4.22	0.00	4.22
1	2551-62-4	Sulfur hexafluoride		SF_6	Plasma Etch	100%	5,149	75-73-0	Tetrafluoromethane	CF4		0.03	X	Fab Acid	0.00	175.1	0.89	19.3	0.00	19.3
1	2551-62-4	Sulfur hexafluoride		SF_6	Plasma Etch	100%	5,149	75-46-7	Trifluoromethane	CHF3		3.90E-03	X	Fab Acid	0.00	20.1	0.98	0.40	0.00	0.40
1	75-73-0	Tetrafluoromethane	Tetrafluoromethane	CF_4	Plasma Etch	100%	392,549	75-73-0	Tetrafluoromethane	CF4		0.65	X	Fab Acid	0.00	255,157	0.89	28,067	0.00	28,067
1	75-73-0	Tetrafluoromethane	Tetrafluoromethane	CF_4	Plasma Etch	100%	392,549	124-38-9	Carbon dioxide	CO2		0.50	X	Fab Acid	0.00	196,309	0	196,309	0.00	196,309
1	75-73-0	Tetrafluoromethane	Tetrafluoromethane	CF_4	Plasma Etch	100%	392,549	75-10-5	Difluoromethane	CH2F2		0.01	X	Fab Acid	0.00	5,496	0.99	55.0	0.00	55.0
1	75-73-0	Tetrafluoromethane	Tetrafluoromethane	CF_4	Plasma Etch	100%	392,549	593-53-3	Fluoromethane	CH3F		0.01	X	Fab Acid	0.00	2,081	0.99	20.8	0.00	20.8
1	75-73-0	Tetrafluoromethane	Tetrafluoromethane	CF_4	Plasma Etch	100%	392,549	685-63-2	Hexafluorobutadiene	C4F6		1.50E-03	X	Fab Acid	0.00	588.8	0.98	11.8	0.00	11.8
1	75-73-0	Tetrafluoromethane	Tetrafluoromethane	CF_4	Plasma Etch	100%	392,549	76-16-4	Hexafluoroethane	C2F6		0.06	X	Fab Acid	0.00	23,945	0.98	478.9	0.00	478.9
1	75-73-0	Tetrafluoromethane	Tetrafluoromethane	CF_4	Plasma Etch	100%	392,549	75-46-7	Trifluoromethane	CHF3		0.01	X	Fab Acid	0.00	5,103	0.98	102.1	0.00	102.1
1	75-73-0	Tetrafluoromethane	Tetrafluoromethane	CF_4	Plasma Etch	100%	392,549	115-25-3	Octafluorocyclobutane	C4F8		3.30E-03	X	Fab Acid	0.00	1,295	0.98	25.9	0.00	25.9
1	97-99-4	Tetrahydrofurfuryl Alcohol		$C_5H_{10}O_2$	Photolithography	100%	3,571	124-38-9	Carbon dioxide	CO2	X	2.15	X	Fab Solvent	0.00	1,539	N/A	N/A	0.00	1,539
1	150-46-9	Triethyl borate	TEB	$C_6H_{15}BO_3$	Thin Films / Diffusion Deposition	100%	0.00	124-38-9	Carbon dioxide	CO2		1.81	X	Fab CVD	0.00	0.00	N/A	N/A	0.00	0.00
1	78-40-0	Triethyl phosphate	TEPO	$C_6H_{15}O_4P$	Thin Films / Diffusion Deposition	100%	0.00	124-38-9	Carbon dioxide	CO2		1.45	X	Fab CVD	0.00	0.00	N/A	N/A	0.00	0.00
1	75-46-7	Trifluoromethane		CHF_3	Plasma Etch	100%	31,689	75-46-7	Trifluoromethane	CHF3		0.38	X	Fab Acid	0.00	12,042	0.98	240.8	0.00	240.8
1	75-46-7	Trifluoromethane		CHF_3	Plasma Etch	100%	31,689	124-38-9	Carbon dioxide	CO2		0.63	X	Fab Acid	0.00	19,920	0	19,920	0.00	19,920
1	75-46-7	Trifluoromethane		CHF_3	Plasma Etch	100%	31,689	75-10-5	Difluoromethane	CH2F2		2.60E-03	X	Fab Acid	0.00	82.4	0.99	0.82	0.00	0.82
1	75-46-7	Trifluoromethane		CHF_3	Plasma Etch	100%	31,689	593-53-3	Fluoromethane	CH3F		0.04	X	Fab Acid	0.00	1,173	0.99	11.7	0.00	11.7
1	75-46-7	Trifluoromethane		CHF_3	Plasma Etch	100%	31,689	685-63-2	Hexafluorobutadiene	C4F6		1.00E-04	X	Fab Acid	0.00	3.17	0.98	0.06	0.00	0.06
1	75-46-7	Trifluoromethane		CHF_3	Plasma Etch	100%	31,689	76-16-4	Hexafluoroethane	C2F6		0.06	X	Fab Acid	0.00	1,965	0.98	39.3	0.00	39.3
1	75-46-7	Trifluoromethane		CHF_3	Plasma Etch	100%	31,689	75-73-0	Tetrafluoromethane	CF4		0.08	X	Fab Acid	0.00	2,408	0.89	264.9	0.00	264.9
1	75-46-7	Trifluoromethane		CHF_3	Plasma Etch	100%	31,689	115-25-3	Octafluorocyclobutane	C4F8		6.70E-04	X	Fab Acid	0.00	21.2	0.98	0.42	0.00	0.42
1	75-24-1	Trimethylaluminium	TMAl	C_3H_9Al	Thin Films / Diffusion Deposition	100%	1,182	124-38-9	Carbon dioxide	CO2		1.83	X	Fab CVD	0.00	2,165	N/A	N/A	0.00	2,165
1	993-07-7	Trimethylsilane		$C_3H_{10}Si$	Thin Films / Diffusion Deposition	100%	5,853	74-82-8	Methane	CH4		0.65	X	Fab CVD	0.99	38.0	N/A	N/A	0.00	38.0
1	993-07-7	Trimethylsilane		$C_3H_{10}Si$	Thin Films / Diffusion Deposition	100%	5,853	124-38-9	Carbon dioxide	CO2		1.78	X	Fab CVD	0.00	10,414	N/A	N/A	0.00	10,414

Micron - Clay, NY Fabs 1 & 2
1-FABOP and 2-FABOP
Photoresist Ashing Emissions

Table 8-1: Photoresist Ashing Process Usage and Specifications

Annual Photoresist Usage[1] (lb/yr)	444,000
Percentage of Photoresist Remaining on Wafer Post-Application	5%
Percentage of Solids in Photoresist Material[2]	30%
Percentage of Solids Oxidized to CO	50%
Percentage of Solids Oxidized to CO_2	50%

1. To calculate emissions of CO_2 and CO from the ashing process, the total photoresist usage in pounds per year (lb/year) for the Proposed Air Permit Project was estimated based on usage at an existing Micron facility.

2. Some photoresist material contains solids that will remain on a wafer post-application and later be combusted in other processes. The weight of photoresist solids remaining on the wafer is assumed to be oxidized into 50% CO and 50% CO_2 on a molar basis.

3. Weight of organic compounds in photoresist solids assumed to be 100% carbon for the purpose of potential emission calculations.

4. Carbon from photoresist material may react with etch gases to form additional byproducts covered in process chemical emissions calculations. This calculation covers all CO and CO_2 expected to be generated from photoresist carbon.

Table 8-2: Photoresist Ashing Potential to Emit

Pollutant	**Molar Weight**	**Emissions from Photoresist Ashing**	
	lb/lb-mol	**lb/yr**	**tpy**
CO	28.01	7,766	3.88
CO_2	44.01	12,203	6.10

Conversions

1 ton =	2,000	lbs
Carbon MW =	12	lb/lb-mol

Micron - Clay, NY Fabs 1 & 2
1-FABOP and 2-FABOP
Heat Transfer Fluid Emissions

NOTE: Detailed calculations of HTF emissions have been omitted to protect confidential business information (CBI).

Note:

Various semiconductor manufacturing processes require the use of heat transfer fluids (HTFs) to maintain equipment or component temperatures. These HTFs can leak and evaporate from the manufacturing process, resulting in VOC and GHG emissions to the atmosphere. HTF emissions are estimated below.

Table 9-2. Heat Transfer Fluid GHG Emissions

Pollutant	Emissions (tpy)
CO_2e - 20-yr	111,272

Micron - Clay, NY Fabs 1 & 2
1-WWBIO and 2-WWBIO
Toxic Air Contaminant Emissions - Wastewater Emissions

NOTE: Confidential business information (CBI) has been omitted from this excerpt. As a result, the table below is not comprehensive of all CO2 and CH4 generation.
This calculation methodology reflects mixed aerobic and anaerobic digestion. However, Micron currently plans to pursue purely aerobic digestion.

Table 12-1: Toxchem Estimated Wastewater Treatment Potential Emissions

Emission Chemical		Total Emissions from Wastewater[1]		VOC	PM	HAP	Percent Emitted in WWT Bldg	Percent Emitted in BIO Bldg
CAS No.	Name	(lb/yr)	(tpy)					
124-38-9	Carbon dioxide	5,745,799	2,873				0%	100%
74-82-8	Methane	1,396,964	698				0%	100%
	Total CO$_2$e - 20-yr[2]	123,090,770	61,545					

1. Emissions estimated using Toxchem modeling software, supplemented by degredation byproduct calculations below. PTE totals assume 98% control of ammonia in the WWT ammonia scrubber.
2. 20-yr Global warming potentials per 6 NYCRR Part 496.
3. 100-yr Global warming potentials per 40 CFR Part 98, Table A-1 (Global Warming Potentials).

Conversions

1 ton =	2,000	lbs

Table 12-2: Calculation of Secondary Generation of CO$_2$ in Aerobic Zones

Emission Chemical		MW	Carbon	Mass Degraded in Aerobic Zone	CO$_2$ from Aerobic Zone	Mass Degraded in Aeration Zone	CO$_2$ from Aeration Zone	Mass Degraded in MBR	CO$_2$ from MBR	Total CO$_2$
CAS No.	Name	(lb/lbmol)	Count	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)
75-59-2	Tetramethylammonium hydroxide	91.2	4.00	59.5	114.8	0.05	0.10	1.24E-03	2.40E-03	114.9
67-63-0	Isopropanol	60.1	3.00	2,821	6,198	1,333	2,929	233.8	513.5	9,640
872-50-4	1-Methyl-2-pyrrolidone	99.1	5.00	735.1	1,632	123.0	273.0	20.0	44.3	1,949
288-88-0	1,2,4-Triazole	69.1	2.00	0.52	0.66	0.02	0.03	3.10E-04	3.95E-04	0.69
929-06-6	2-(2-aminoethoxy)ethanol	105.1	4.00	2.99	5.01	1.37	2.29	0.23	0.38	7.68
77-92-9	Citric acid	192.1	6.00	1.82	2.51	0.72	0.99	0.12	0.16	3.66
64-19-7	Acetic acid	60.1	2.00	1.49	2.19	0.03	0.04	2.52E-03	3.69E-03	2.23
107-21-1	Ethanediol	62.1	2.00	0.88	1.24	0.45	0.64	0.08	0.11	2.00
67-56-1	Methanol	32.0	1.00	4.66E-03	0.01	3.87E-06	5.31E-06	8.96E-08	1.23E-07	0.01

Table 12-3: Calculation of Secondary Generation of CH$_4$ and CO$_2$ from Anaerobically Digested COD

Stream	Flow	Flow	COD	COD	Influent COD
	(gpm)	(m^3/week)	(mg/L)	(kg/m^3)	(kg/week)
Stream 1	1,285	49,019	200.0	0.20	9,804
Stream 2	264.7	10,101	90.0	0.09	909.0
Stream 3	328.3	12,528	15.0	0.02	187.9
Stream 4	406.8	15,520	10.00	0.01	155.2
Stream 5	262.8	10,027	4,800	4.80	48,127
Stream 6	426.7	16,281	90.0	0.09	1,465
Stream 7	98.5	3,757	30.0	0.03	112.7

Total Influent COD	60,761.17	kg/week	
B$_0$	0.25	kg-CH$_4$/kg-COD	*Table II-1 to Subpart II of 40 CFR 98*
MCF - Anaerobic Reactor	0.8		*Table II-1 to Subpart II of 40 CFR 98*
CH$_4$ Emission Rate from Anaerobic Zones	3,827.30	lb/day	*Eq. II-1 in Subpart II of 40 CFR 98*
CO$_2$ Emission Rate from Anaerobic Zones	3,827.30	lb/day	*COD is typically converted equally to CH$_4$ and CO$_2$ in anaerobic zones*

Micron - Clay, NY Fabs 1 & 2
1-FABOP and 2-FABOP
Tool-Level Thermal Oxidation System Combustion Emissions

Table 13-1. Tool-Level Thermal Oxidation System Specifications and Inventory

Exhaust Type	Number of Operational Exhaust Stacks	Total Natural Gas Usage (MMscf/year)[1,2]
Metal Etch POUs - Process FA1 and FA2	72	650
Thin Films PEECs - Process FC1 and FC2	24	2,300
	Total NG Flow Rate	2,950

1. Total natural gas usage by thermal oxidation systems provided by Micron and scaled accordingly for Fab 1 and Fab 2.
2. Emissions from GHG thermal oxidation system natural gas combustion will pass through acid exhausts.

Table 13-2. Tool-Level Thermal Oxidation System Criteria Pollutant and GHG Potential to Emit

Pollutant	Emission Factor (lb/MMscf)	Potential to Emit (per Stack)				Potential to Emit (Total per Stack Type)	
		Metal Etch POUs - FA1 and FA2		Thin Films PEECs - FC1 and FC2		FA1 and FA2	FC1 and FC2
		(lb/hr)	(tpy)	(lb/hr)	(tpy)	(tpy)	(tpy)
CO_2	120,000	123.7	541.7	1,313	5,750	39,000	138,000
CH_4	2.3	2.37E-03	0.01	0.03	0.11	0.75	2.65
N_2O	2.2	2.27E-03	0.01	0.02	0.11	0.72	2.53
CO_2e - 20-yr[5]	-	124.5	545.2	1,321	5,787	39,252	138,890
Upstream CO_2e[7]	91,921	94.7	414.9	1,006	4,405	29,874	105,709
Upstream CO_2[7]	28,219	29.1	127.4	308.7	1,352	9,171	32,452
Upstream CH_4[7]	758	0.78	3.42	8.29	36.3	246.3	871.5
Upstream N_2O[7]	0.31	3.24E-04	1.42E-03	3.44E-03	0.02	0.10	0.36

1. 20-yr Global warming potentials per 6 NYCRR Part 496.
2. Upstream GHG emission factors per Appendix of 2024 NYS Statewide GHG Emissions Report:

CO_2e:	40,877	g/MMBtu
CO_2:	12,549	g/MMBtu
CH_4:	337	g/MMBtu
N_2O:	0.14	g/MMBtu

Conversions

1 lb =	453.59	g
1 scf NG =	1,020	BTU - Average heat content of NG from AP-42 1.4.1.
1 year =	8,760	hours

Micron - Clay, NY Fabs 1 & 2
1-FABOP, 2-FABOP, 1-HPMCU, 2-HPMCU
RCTO Combustion Emissions

Table 14-1. RCTO Specifications and Inventory

Description	Operating Status	Equipment Count	Burner Rating (Each) (MMBtu/hr)	Natural Gas Flow (scfh)
Fab RCTOs - Process FS1 and FS2	Active	64	4.00	3,922
Fab RCTOs - Process FS1 and FS2	Redundant	8	4.00	3,922
HPM RCTOs - Process HS1 and HS2	Active	12	1.00	980.4
HPM RCTOs - Process HS1 and HS2	Redundant	4	1.00	980.4
			Total NG Flow Rate (scfh)	**298,039**

Table 14-2. RCTO Criteria Pollutant and GHG Potential to Emit

Pollutant	Emission Factor (lb/MMscf)	Potential to Emit (per RCTO)				Potential to Emit (RCTO Totals)
		Fab RCTOs - FS1 and FS2		HPM RCTOs - HS1 and HS2		
		(lb/hr)	(tpy)	(lb/hr)	(tpy)	(tpy)
CO_2	120,000	470.6	2,061	117.6	515.3	156,649
CH_4	2.3	0.01	0.04	2.25E-03	0.01	3.00
N_2O	2.2	0.01	0.04	2.16E-03	0.01	2.87
CO_2e - 20-yr[4]	-	473.6	2,074	118.4	518.6	157,660
Upstream CO_2e[6]	91,921	360.5	1,579	90.1	394.7	119,994
Upstream CO_2[6]	28,219	110.7	484.7	27.7	121.2	36,838
Upstream CH_4[6]	758	2.97	13.0	0.74	3.25	989.3
Upstream N_2O[6]	0	1.23E-03	0.01	3.09E-04	1.35E-03	0.41

1. 20-yr Global warming potentials per 6 NYCRR Part 496.
2. Upstream GHG emission factors per Appendix of 2024 NYS Statewide GHG Emissions Report:

CO_2e:	40,877	g/MMBtu
CO_2:	12,549	g/MMBtu
CH_4:	337	g/MMBtu
N_2O:	0.14	g/MMBtu

Conversions

1 lb =	453.59	g
1 year =	8,760	hr
1 scf NG =	1,020	BTU - Average heat content of NG from AP-42 1.4.1.

Micron - Clay, NY Fabs 1 & 2
1-CMBOP and 2-CMBOP
Water Bath Vaporizer Combustion Emissions

Table 15-1. Water Bath Vaporizer Inventory

Equipment Description	Operating Status	Equipment Count	Operating Hours Limit (hrs)[1]	Burner Rating (Each)	Natural Gas Flow Rate[2]	Maximum Stack Flow Rate
				(MMBtu/hr)	(scfh)	(scfm)
Water Bath Vaporizers - Process WBV	Active	4	2,000	42.8	42,000	22,500
Water Bath Vaporizers - Process WBV	Redundant	4	0	42.8	0	0
				Total	**168,000**	**90,000**

1. Micron proposes a permit condition limiting total hours of WBV operation to 8,000 per year and specifying that no more than 4 WBV are operated at any given time. Therefore, the PTE is calculated assuming that redundant units do not operate.
2. Natural gas flow rate to the vaporizer based on manufacturer specifications.

Table 15-2. Water Bath Vaporizer Criteria Pollutant and GHG Potential to Emit

Pollutant	Molecular Weight	Emission Factor (lb/MMscf)	BACT/LAER Limits		Potential to Emit (Per Unit)		Potential to Emit (All Units)	
	(lb/lb-mole)		Value	Unit	(lb/hr)	(tpy)	(lb/hr)	(tpy)
CO_2		120,000			5,040	5,040	20,160	20,160
CH_4		2.3			0.10	0.10	0.39	0.39
N_2O		0.64			0.03	0.03	0.11	0.11
CO_2e - 20-yr[3]		-			5,055	5,055	40,442	40,442
Upstream CO_2e[5]		91,921			3,861	3,861	30,885	30,885
Upstream CO_2[5]		28,219			1,185	1,185	9,482	9,482
Upstream CH_4[5]		758			31.8	31.8	254.6	254.6
Upstream N_2O[5]		0			0.01	0.01	0.11	0.11

3. 20-yr Global warming potentials per 6 NYCRR Part 496.
5. Upstream GHG emission factors per Appendix of 2024 NYS Statewide GHG Emissions Report:

CO_2e: 40,877 g/MMBtu
CO_2: 12,549 g/MMBtu
CH_4: 337 g/MMBtu
N_2O: 0.14 g/MMBtu

Conversions

1 lb = 453.59 g
1 year = 8,760 hr
1 scf NG = 1,020 BTU - Average heat content of NG from AP-42 1.4.1.
1 year = 525,600 minutes
1 lb-mole of gas (@ 20C) = 385.3 Cubic feet
1 hr= 60 minutes
Fd Factor= 8,710

Micron - Clay, NY Fabs 1 & 2
1-CMBOP and 2-CMBOP
Natural Gas Boiler Combustion Emissions

Table 16-1. Total Boiler Burner Rating

Equipment Description	Equipment Count	Operating Hours Limit[1]	Burner Rating	Maximum Outlet Flow
		(hrs/yr)	(MMBtu/hr)	(scfm)
Natural Gas Boilers - Process BLR	6	6,000	32.7	22,500
		Total	196.2	135,000

1. Micron proposes a permit condition limiting each boiler to 6,000 hours of operation per year.

Table 16-2. Boiler Criteria Pollutant/GHG Potential to Emit

Pollutant	Molecular Weight	Emission Factor (lb/MMscf)	BACT/LAER Limits		Potential to Emit (Per Unit)		Potential to Emit (All Units)	
	(lb/lb-mole)		Value	Unit	(lb/hr)	(tpy)	(lb/hr)	(tpy)
CO_2		120,000			3,847	11,541	23,082	69,247
CH_4		2.3			0.07	0.22	0.44	1.33
N_2O		0.64			0.02	0.06	0.12	0.37
CO_2e - 20-yr[3]		-			3,859	11,576	23,152	69,456
Upstream CO_2e[5]		91,921			2,947	8,841	17,681	53,044
Upstream CO_2[5]		28,219			904.7	2,714	5,428	16,284
Upstream CH_4[5]		758			24.3	72.9	145.8	437.3
Upstream N_2O[5]		0.31			0.01	0.03	0.06	0.18

1. 20-yr Global warming potentials per 6 NYCRR Part 496.
2. Upstream GHG emission factors per Appendix of 2024 NYS Statewide GHG Emissions Report:

CO_2e:	40,877	g/MMBtu
CO_2:	12,549	g/MMBtu
CH_4:	337	g/MMBtu
N_2O:	0.14	g/MMBtu

Conversions

1 lb =	453.59	g
1 year =	8,760	hr
1 scf NG =	1,020	BTU - Average heat content of NG from AP-42 1.4.1.
1 kW =	3,413	BTU - AP-42 appendix A pg. 15
	0.85	kW out/kW in
1 year =	525,600	minutes
1 lb-mole of gas (@ 20C) =	385.3	Cubic feet
1 hr=	60	minutes
Fd Factor=	8,710	

Micron - Clay, NY Fabs 1 & 2
1-CMBOP and 2-CMBOP
Diesel Emergency Generator Combustion Emissions

Table 17-1. Diesel Generator Inventory

Equipment Description	Equipment Count	Annual Operating Hours Limit (hrs/yr/engine)	Engine Full Load	Engine Power
			HP	kW
CUB 1 Diesel Emergency Generators - Process EMD	60	100	3,350	2,498
CUB 2 Diesel Emergency Generators - Process EMD	58			
Total Load (All Units)	118	--	**395,300**	**8,367,272**

Table 17-2. Diesel Emergency Generators Criteria Pollutant and GHG Potential to Emit

Pollutant	Tier 4 Exhaust Emission Standards	AP-42 Emission Factors	GHG Emission Factors[4]	Potential to Emit (Per Unit)		Potential to Emit (All Diesel Generators)
	(g/kW-hr)	(lb/HP-hr)	(kg/MMBtu)	(lb/hr)	(tpy)	(tpy)
CO_2	-	-	73.96	1,391	69.5	8,206
CH_4	-	-	0.0030	0.06	2.82E-03	0.33
N_2O	-	-	0.00060	0.01	5.64E-04	0.07
CO_2e - 20-yr[5]	-	-	-	1,399	69.9	8,251
Upstream CO_2e[7]	-	-	23.54	442.7	22.1	2,612
Upstream CO_2[7]	-	-	13.63	256.4	12.8	1,513
Upstream CH_4[7]	-	-	0.12	2.20	0.11	13
Upstream N_2O[7]	-	-	0.00	4.70E-03	2.35E-04	2.77E-02

1. CO_2, N_2O and CH_4 emission factors based on 40 CFR Part 98 Table C-1 and C-2 Default diesel emissions factors.
2. 20-yr Global warming potentials per 6 NYCRR Part 496.
3. Upstream GHG emission factors per Appendix of 2024 NYS Statewide GHG Emissions Report:

CO_2e:	23,540	g/MMBtu
CO_2:	13,634	g/MMBtu
CH_4:	117	g/MMBtu
N_2O:	0.25	g/MMBtu

Conversions

1 lb =	453.59	g
1 year (Emergency Operation) =	500	hr
Energy Conversion Factor:	392.75	bhp-hr/MMBtu (mechanical) in AP-42 Appendix A
15 ppm S =	0.0015	wt% S
Hoursepower (mechanical) =	0.74558	Kilowatts
Diesel Usage Conversion Factor:	0.138	MMBtu/gal

Micron - Clay, NY Fabs 1 & 2
Greenhouse Gas Global Warming Potentials

Table 25-1: Greenhouse Gas Global Warming Potentials

CAS	GHG Name	HFC/PFC Number	Molecular Formula	GWP (20-yr)
124-38-9	Carbon dioxide	--	CO2	1
74-82-8	Methane	--	CH4	84
10024-97-2	Nitrous oxide	--	N2O	264
75-10-5	Difluoromethane	HFC-32	CH2F2	2,430
593-53-3	Fluoromethane	HFC-41	CH3F	427
75-73-0	Tetrafluoromethane	PFC-14	CF4	4,880
76-16-4	Hexafluoroethane	PFC-116	C2F6	8,210
75-46-7	Trifluoromethane	HFC-23	CHF3	10,800
115-25-3	Octafluorocyclobutane	PFC-318	C4F8	7,110
685-63-2	Hexafluorobutadiene	--	C4F6	1
7783-54-2	Nitrogen trifluoride	--	NF3	12,800
2551-62-4	Sulfur hexafluoride	--	SF6	17,500

Table 25-2: 2024 Upstream Natural Gas CO2e Emission Factors

GHG	g/MMBtu	lb/MMBtu
CO2e	40,877	90.12
CO2	12,549	27.67
CH4	337	0.74
N2O	0.14	0.00

1. Per Appendix of 2024 NYS Statewide GHG Emissions Report

Table 25-3: 2024 Upstream Diesel CO2e Emission Factors

GHG	g/MMBtu	lb/MMBtu
CO2e	23,540	51.90
CO2	13,634	30.06
CH4	117	0.26
N2O	0.25	0.00

1. Per Appendix of 2024 NYS Statewide GHG Emissions Report

Micron - Clay, NY Fabs 1 & 2
1-FUGEM and 2-FUGEM
Sulfur Hexafluoride (SF_6) Emissions from Circuit Breakers and other Gas Insulated Equipment

Table 28-1: Sulfur Hexafluoride (SF6) Leak Emissions

Pollutant	Total Usage in Ion Implant Tools (lb/yr)	Total Usage in Circuit Breakers, etc. (lb/yr)	Estimated Max Annual SF_6 Circuit Breaker Leak Rate (%/yr)	Potential Leak Emissions	
				(lb/yr)	(tpy)
SF_6	600	80,196	0.5%	1,001	0.50
CO_2e - 20-yr[2]	-	-	-	17,517,132	8,759

1. Leak rates based on manufacturer guarantee.

2. 20-yr global warming potentials per 6 NYCRR Part 496.

Micron - Clay, NY Fabs 1 & 2
1-HPMCU and 2-HPMCU
Spin On Dielectric (SOD) Waste Treatment Emissions

Table 30-1: SOD Waste and Processing Chemical Usage

Mixture	SOD Waste Generated (lb/yr)
SOD Waste	24,714
Rinse Solvent	273,307
Reactant	16,009
Total SOD Waste	314,030

Table 30-2: Individual Chemical Emissions

Mixture	Primary Chemical					Emission Chemical			Process Emission Factor (lb emitted / lb used)	GHG	Pre-Control Emissions (lb/yr)	RCTO DRE	Annual Emissions (lb/yr)
	CAS #	Chemical Name	Molecular Formula	Weight % of Mixture[1]	Usage (lb/yr)	CAS #	Emission Chemical	Molecular Formula					
SOD Waste	142-96-1	Dibutyl Ether	$C_8H_{18}O$	98%	24,263	124-38-9	Carbon dioxide	CO2	0.54	X	13,119	0%	13,119
Rinse Solvent	91-20-3	Naphthalene	$C_{10}H_8$	8%	21,865	124-38-9	Carbon dioxide	CO2	0.17	X	3,754	0%	3,754
Rinse Solvent	95-63-6	TMB (1,2,4-TMB and 1,3,5-TMB)	C_9H_{12}	4%	10,932	124-38-9	Carbon dioxide	CO2	0.66	X	7,206	0%	7,206
Rinse Solvent	64742-94-5	Solvent naphtha (petroleum), heavy arom.	Varies	100%	273,307	124-38-9	Carbon dioxide	CO2	0.41	X	112,765	0%	112,765
Reactant	64-17-5	Ethanol	C_2H_6O	71%	11,398	124-38-9	Carbon dioxide	CO2	1.91	X	21,777	0%	21,777

1. The total of this column for all components in each mixture may exceed 100% due to variable composition.

Conversions

1 gal = 3785 cm^3

1 gram = 2.205E-03 lbs

Micron - Clay, NY Fabs 1 & 2
1-FABOP and 2-FABOP
Regenerative Catalytic System (RCS) Combustion Emissions

Table 31-1. RCS Specifications and Inventory

Equipment Description[1]	Equipment Count	Burner Rating
		(MMBtu/hr)
Regenerative Catalytic System - Process FA1 and FA2	20	0.6

1. Exhaust from the outlet of each RCS, including emissions from natural gas combustion, will pass through fab acid exhausts.

Table 31-2. RCS Criteria Pollutant and GHG Potential to Emit

Pollutant	Emission Factor (lb/MMscf)	Potential to Emit (per Unit)		Potential to Emit (All Units)	
		(lb/hr)	(tpy)	(lb/hr)	(tpy)
CO_2	120,000	70.6	309.2	1,412	6,184
CH_4	2.3	1.35E-03	0.01	0.03	0.12
N_2O	2.2	1.29E-03	0.01	0.03	0.11
CO_2e - 20-yr[1]	-	71.0	311.2	1,421	6,223
Upstream CO_2e[2]	91,921	54.1	236.8	1,081	4,737
Upstream CO_2[2]	28,219	16.6	72.7	332.0	1,454
Upstream CH_4[2]	758	0.45	1.95	8.92	39.0
Upstream N_2O[2]	0.31	1.85E-04	8.11E-04	3.70E-03	0.02

1. 20-yr Global warming potentials per 6 NYCRR Part 496.
2. Upstream GHG emission factors per Appendix of 2024 NYS Statewide GHG Emissions Report:

CO_2e:	40,877	g/MMBtu
CO_2:	12,549	g/MMBtu
CH_4:	337	g/MMBtu
N_2O:	0.14	g/MMBtu

Micron - Clay, NY Fabs 1 & 2
1-CMPOP and 2-CMBOP
Diesel Fire Pump Combustion Emissions

Table 32-1. Diesel Fire Pump Engine Information

Equipment Description	Annual Operating Hours Limit (hrs/yr/engine)	Engine Full Load	Engine Power
		HP	kW
Diesel Fire Pump Engine	500	250	186

1. This diesel fire pump engine is a backup to an electric fire pump. It will only run in the event of a fire during a loss of power. It will be tested weekly.

Table 32-2. Diesel Fire Pump Engine Criteria Pollutant and GHG Potential to Emit

Pollutant	Tier 3 Exhaust Emission Standards	AP-42 Emission Factors	GHG Emission Factors[1]	Potential to Emit	
	(g/kW-hr)	(lb/HP-hr)	(kg/MMBtu)	(lb/hr)	(tpy)
CO_2	-	-	73.96	103.8	25.9
CH_4	-	-	0.0030	4.21E-03	1.05E-03
N_2O	-	-	0.00060	8.42E-04	2.10E-04
CO_2e - 20-yr[2]	-	-	-	104.4	26.1
Upstream CO_2e[3]	-	-	23.54	33.0	8.26
Upstream CO_2[3]	-	-	13.63	19.1	4.78
Upstream CH_4[3]	-	-	0.12	0.16	0.04
Upstream N_2O[3]	-	-	2.50E-04	3.51E-04	8.77E-05

1. CO_2, N_2O and CH_4 emission factors based on 40 CFR Part 98 Table C-1 and C-2 Default diesel emissions factors.
2. 20-yr Global warming potentials per 6 NYCRR Part 496.
3. Upstream GHG emission factors per Appendix of 2024 NYS Statewide GHG Emissions Report:

CO_2e:	23,540	g/MMBtu
CO_2:	13,634	g/MMBtu
CH_4:	117	g/MMBtu
N_2O:	0.25	g/MMBtu

APPENDIX C WETLANDS IMPACTS

MICRON SEMICONDUCTOR FABRICATION
CLAY, NY

CLCPA WETLANDS ANALYSIS

June 20, 2025

Ver. 7.0

CONTENTS

LIST OF FIGURES

APPENDICES

ABBREVIATIONS

C	Carbon
CH4	Methane
CO2	Carbon Dioxide
FEMA	Federal Emergency Management Agency
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
OCDWEP	Onondaga County Department of Water Environment Protection
OCIDA	Onondaga County Industrial Development Agency
SOM	Soil Organic Carbon
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
USEPA	U.S. Environmental Protection Agency

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1 Introduction

Micron New York Semiconductor Manufacturing LLC (“Micron”), a Delaware limited liability company, is proposing to construct a semiconductor manufacturing campus in the Town of Clay, New York, at the White Pine Commerce Park, a ±1400-acre (approximately 566.5 hectares) industrial park, on parcels currently controlled by the Onondaga County Industrial Development Agency (OCIDA) (“the Micron Campus”) (**Figure 1** and **Figure 2A**). To depict certain elements of the Micron Campus at a scale that can easily be reviewed, the site was graphically divided into eight blocks. **Figure 2B** depicts the location of the blocks with respect to the overall Site.

As a result of the proposed construction and operation of the Micron Campus, 176.44 acres (71.40 hectares) of New York State Department of Environmental Conservation (NYSDEC or Department) jurisdictional wetlands will be permanently impacted by construction activities (**Figure 3**). A figure depicting NYSDEC jurisdictional wetlands by Edinger Plant Community Types is included as **Figure 4**. A Joint Permit Application (JPA) requesting approval to fill those wetlands as part of construction and then to mitigate for permanent impacts to these jurisdictional wetlands has been submitted to both the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (CWA) and to the NYSDEC under Article 24 of the NYS Environmental Conservation Law (ECL).

Consistent with the planned joint National Environmental Policy Act (NEPA) and State Environmental Quality Review Act (SEQRA) Environmental Impact Statement (EIS) currently under development, a review under the New York Climate Leadership and Community Protection Act (CLCPA) of 2019 is also required.

CLCPA Section 7(2) requires state agencies to consider whether their administrative decisions, including issuing permits, licenses, contracts, and financial awards such as grants and loans are inconsistent with or will interfere with the greenhouse gas (GHG) emission limits set by NYSDEC. The NYSDEC’s authority to approve and issue a CWA 401 Certification and permit under NYS ECL Article 24 requires the Department to consider whether these approvals are inconsistent with or will interfere with the statewide GHG emissions limits.

As part of the development of the Micron Campus, additional utilities and their associated infrastructure (“Connected Actions”) will need to be built to support the operation of the Micron Campus. This would include water, energy, and utility infrastructure improvements, most of which would be undertaken by public utility providers. Each of the Connected Actions with permanent impacts to wetlands will be responsible for their own permit applications. However, for the purposes of this CLCPA evaluation, Connected Actions with known permanent impacts to wetlands, though minimal (0.11 acres or 0.044 hectares) will be included in the analysis.

On September 4, 2024, Micron submitted a Draft CLCPA Work Plan outlining proposed procedures to be used in the completion of the CLCPA analysis for the Micron Campus and all associated Connected Actions with known permanent impacts to wetlands (**Appendix A**). Recognizing that a CLCPA analysis of wetland impacts is novel, with no precedent currently available, Micron developed a logical approach based on the relationship that wetlands and wetland plants play in the carbon cycle to remove carbon dioxide (CO2) from the atmosphere and cycle carbon to the soil where it is sequestered. The loss of this carbon sequestration, resulting from importing fill and the construction of impervious surfaces within the Micron Campus and Connected Action limits of disturbance (LOD), will remove or reduce the ability of those disturbed areas to cycle carbon at current rates, thereby increasing the amount of carbon dioxide remaining in the atmosphere. However, Micron's mitigation efforts of creating high quality wetlands within the same watershed as the Micron Campus, will increase the carbon cycling and sequestration process through the creation and net gain of wetland acres, including wetland plants and wetland soils.

In a letter dated October 8, 2024, the NYSDEC commented on the Draft CLCPA Work Plan provided by Micron (**Appendix B**). The NYSDEC agreed with Micron's technical approach for estimating CLCPA impacts, but instead, requested certain changes in the various parameters that would be used for impact calculations. This report is submitted to the NYSDEC as an outcome of the information requests provided in the October 8, 2024 letter.

Via an e-mail dated May 6, 2025, NYSDEC provided comments on the March 12, 2025 version of the CLCPA wetlands report. Those comments are included as **Appendix C**.

Based on discussions with NYSDEC regarding the proposed CLCPA analysis, the Department collaborated with Micron in preparing the CLCPA analysis. NYSDEC developed a proposed calculation sheet that used some of Micron's proposed inputs and approaches but utilized values that the NYSDEC wanted to see used with respect to estimating carbon flux in wetland systems. After a review of the calculations with the

NYSDEC on June 13, 2025, Micron agreed with the use of the NYSDEC's calculations and has presented them in this CLCPA assessment.

2 Background

There is an intrinsic connection between plant communities and soil with respect to carbon and carbon cycling (Berryman et al. 2020). Plant communities accumulate carbon through photosynthesis in a process where carbon dioxide is removed from the atmosphere, carbon is converted to plant tissue, and oxygen is returned to the atmosphere (Binkley et al., 2004). Plants then cycle carbon back to the atmosphere and to soil through the processes of decomposition. Carbon is also cycled to the soil through the root system. **Figures 5A** through **5H** depict the soil surveys for the Micron Campus. It is noted that all the soil units identified on the Micron Campus were listed as mineral soils. This is important for the selection of one of the input parameters to be used in calculating potential GHG releases as noted in Section 4.0.

Organic matter is a key component of soil and affects its physical, chemical, and biological properties, contributing to its proper functioning on which human societies depend (Woodbury et al., 2006). One of the benefits of soil organic matter is the improvement of soil quality through increased retention of water and nutrients. This results in greater productivity of plants in both natural and agricultural settings. Globally, the soil carbon pool is about four times larger than the atmospheric pool, and consequently, any change in the flux of CO2 from the soil to the atmosphere has paramount importance in the balance of atmospheric CO_2 (Luo and Zhou, 2006). Carbon dioxide amounts to approximately 72% of the total anthropogenic greenhouse gases. Further, CO2 is a primary agent of climate change (Ahmed, 2018).

Among terrestrial ecosystems, forests and forested wetlands provide a disproportionately large service in carbon sequestration. Collectively, forest soils contain more than two thirds of the global soil organic carbon reserve, while occupying only 30% of the earth’s surface. This creates the highest carbon-rich domain among different land use-based ecosystems.

Histosols, a type of wetland soil with a high moisture content (hydric soil), has some of the highest soil carbon sequestration potential of any plant community (Lol, 2004). The presence of the water table at or near the soil surface is a key factor in soil organic carbon (SOC) histosol sequestration. Histosols occur in NY floodplain forests and other low-lying forested areas, depressions, or basins adjacent to rivers and streams, often forming transitional zones between uplands and open water. Forests with hydric soils, such as palustrine forested wetlands (PFO) including hemlock-hardwood swamp, red maple-hardwood swamp, and floodplain forests, are therefore some of the most valuable ecosystems for carbon sequestration. **Figures 6A** through **6H** depict the presence of hydric soils across the Site.

Ahmed (2018) notes that CO2 is one of the major greenhouse gases (approximately 72% of the total anthropogenic greenhouse gases). It has been estimated that CO2 is responsible for about 9–26% of the global greenhouse effects (Kiehl and Trenberth, 1997). The concentration of CO2 in the atmosphere has increased from 280 parts per million (ppm) during the pre-industrial era (1750) to 408.84 ppm in July 2017, with an increasing rate of 2.11 ppm per year (NOAA, 2017). The dramatic rise of CO2 concentration is attributed to human activities, and since soil is the second largest reservoir of carbon in terrestrial ecosystems, there is a strong link between soil and atmospheric carbon through the carbon cycle.

Biophysical factors affect and determine the stabilization of carbon within soils. These factors include soil physiochemistry (pH, oxygen, nutrient, and element concentrations, temperature), vegetation, quality, quantity, and rates of decay of organic inputs, soil organisms (including microbial community composition), climate, and hydrology (Ji et al., 2020). Total SOC inputs are derived from the combination of autochthonous (litterfall, root turnover, root exudation of organic compounds, animal, plant, and microbial detritus) and allochthonous (external) inputs from atmospheric or hydrologic sources. Different plant species vary in their production of SOC concentrations and chemical structures, which affect cycling dynamics and carbon sequestration. When total carbon inputs exceed total carbon decomposition, a net accumulation of soil carbon results (Jandl et al., 2007; Moomaw et al., 2018). Soil organic carbon is lost from the soil through heterotrophic (microorganism mineralization) and autotrophic (plant root and microbial) respiration, loss via leaching, and physical loss through erosion (Ji et al., 2020).

While soil does serve as a sink for carbon in the carbon cycle process, a significant portion of carbon stored in soil is released back into the atmosphere through soil respiration. Wetlands are well documented as being hot spots for GHG production through the generation and release of methane (CH4). Estimates from scientific literature suggest that the loss of as much as 4 tons of CH_4 per acre per year can occur in wetland ecosystems from soil respiration (Gomez, 2016; Blais et al, 2010).

To balance soil sequestration losses resulting from permanent impacts to wetlands at the Micron Campus, Micron has proposed a comprehensive mitigation package of wetland re-establishment/restoration and rehabilitation/enhancement projects totaling approximately 389 acres (157 hectares).Known permanent impacts to wetlands as a result of Connected Actions 0.11acres (0.044 hectares) will be mitigated by the responsible party in a separate mitigation plan. Studies have shown that it could take up to 60 years for a newly planted forest to reach the carbon sequestration potential of a mature forest ecosystem. To counteract this delay in carbon sequestration ability, Micron has proposed to mitigate 68.82 acres (27.85 hectares) of permanently impacted forested wetlands on the Micron Site by restoring/enhancing 239.9 acres (97.08 hectares) of forested wetlands. This means that for every one acre of forested wetland that is lost, a little over three acres will be created as part of the mitigation project. **Figure 7A** shows the relationship of the proposed wetland mitigation sites with respect to the Micron Campus. To depict certain elements of the site at a scale that can be easily reviewed, the mitigation sites were divided into four blocks. **Figure 7B** depicts the location of the blocks with respect to the overall Site. **Figures 8A** through **8D** depict the soils associated with the mitigation sites.

3 Baseline Characterization

The Micron Campus and Connected Action wetlands are a mix of palustrine forested wetlands (PFO) including red maple-hardwood swamp, hemlock-hardwood swamp, and floodplain forest, palustrine scrub-shrub wetlands (PSS) including shrub swamp, palustrine emergent wetlands (PEM) including shallow emergent marsh and deep emergent marsh, and palustrine open water (POW) including habitat consisting of several old farm ponds as well as active and inactive beaver ponds. Based on *Classification of Wetlands and Deepwater Habitats of the United States* (1979) and *Ecological Communities of New York State, Second Edition* (2014), the wetlands found on the Micron Campus and Connected Actions are classified as palustrine in nature. Palustrine wetlands include all nontidal wetlands dominated by trees, shrubs, persistent emergent plants, and emergent mosses or lichens. More specific classifications include palustrine forested wetlands (typified by red maples, green ash, and American elms); palustrine shrub/scrub wetlands (typified by various dogwood species); and palustrine emergent wetlands (typified by goldenrods, asters, purple loosestrife, and ferns.

Based on a review of historical aerial photographs from the 1930s, 1950s, 1970, 1980s and 2000s, the Micron Campus has historically been in agricultural production until as recent as the early 2020s. Based on the presence of field-observed clay drainage tiles and drainage ditch-like features, the Micron Campus wetlands have likely been historically influenced by agriculture activities. Based on review of the aerial photographs and field observations, a significant portion of the identified wetlands occur on lands that, at one time, were in agricultural production and are now in a successional stage of natural habitat development.

4 Technical Approach

As a means of performing the CLCPA evaluation for GHG emissions related to wetland impacts, Micron will focus on the roles that wetlands and wetland plants play in the carbon cycle. Additionally, the evaluation will consider the generation of methane (CH4), another GHG often seen in wetlands. This will amount to the multiplication of the sequestration rates of CO2 per acre in wetlands times the number of acres of wetlands that will be lost as part of disturbance, as well as the number of acres of wetlands that will be created through mitigation.

Scientific research has shown that wetlands created from non-wetland areas, either for mitigation purposes or for water treatment, will provide an equivalent amount of carbon sequestration and methane generation as a natural wetland. Extended research conducted through The Ohio State University (Mitsch et al., 2014), has shown that constructed wetlands were actually more adept at sequestering carbon than reference wetlands. Similar results were also reported by Rosli et al. (2017).

Similarly, for CH_4, the rate of methane generation will be multiplied by the number of hectares of wetlands that will be lost as part of disturbance, as well as the number of hectares of wetlands that will be created through mitigation. Additionally, it is assumed that the existing wetlands retain a volume of CO2 in the available biomass, and when disturbed, that CO2 is released into the atmosphere. That includes both CO2 that is found sequestered in the soil, as well as CO2 that is a component of tree and leaf litter biomass.

The following assumptions were used in preparing this CLCPA analysis.

- Assumed that soils in onsite wetland areas have a standing amount of 222.577 tons of CO2/acre that, when disturbed, is released into the atmosphere
- Assumed that standing trees and litter biomass represent 167.382 tons of CO2/acre
- Assume the wetlands can sequester (flux) 2.28 tons of CO2/acre/year
- Assume that tree and litter biomass without soil will sequester 1.27 tons of CO2/acre/year
- Assume that wetlands are generating 0.427 tons of CH4/acre/year

- Based on a review of soil surveys for the onsite wetlands, it assumed that all soils in onsite wetlands were mineral in nature,
- Assumed that CO2 will be released from the soil upon disturbance. Assumed that Phase 1 wetlands (104.26 acres) will be disturbed over a 4-month period in 2025/2026, and that the remaining Phase 2 wetlands (64.06 acres) of the remaining wetlands onsite will be disturbed over a 4-month period beginning in 2030, Micron has assumed that Phase 1 impacts will include the Phase 1 work on Campus, as well as the National Grid connected actions at the substation and along gas main. Phase 2 impacts are solely the Micron Phase 2 component.
- Used the following number of wetlands that were projected to be permanently impacted over the course of development for use in the CLCPA analysis.
    - Wetlands to be impacted during Phase 1 – PEM: 39.4 acres
    - Wetlands to be impacted during Phase 1 – PFO: 55.80 acres
    - Wetlands to be impacted during Phase 1 – PSS: 8.96 acres
    - Wetlands to be impacted during Phase 2 – PEM: 43.73 acres
    - Wetlands to be impacted during Phase 2 – PFO: 11.46 acres
    - Wetlands to be impacted during Phase 2 – PSS: 8.87 acres
    - Mitigation amounts to be developed in compensation for site impacts – PEM: 154.86 acres
    - Mitigation amounts to be developed in compensation for site impacts – PFO: 239.96 acres
    - Mitigation amounts to be developed in compensation for site impacts – PSS: 28,07 acres
    - Wetlands to be preserved on the mitigation Sites – PEM: 138.65 acres
    - Wetlands to be preserved on the mitigation Sites – PFO: 82.16 acres
    - Wetlands to be preserved on the mitigation Sites – PSS: 28.79 acres

- For mitigation development, it was assumed that it would take 10 years to build all PEM wetlands and 5 years for complete maturation of the PEM wetlands to be able to functionally sequester CO2 and generate CH4 at rates of an unimpaired wetland. Maturation rates of the PEM, PFO, and PSS wetlands were recommended by the NYSDEC staff based on U.S. Department of Agriculture references.
- For mitigation development, it was assumed that it would take 10 years to build all PFO wetlands and 20 years for complete maturation of the PFO wetlands to be able to functionally sequester CO2 and generate CH4 at rates of an unimpaired wetland
- For mitigation development, it was assumed that it would take 10 years to build all PSS wetlands and 10 years for complete maturation of the PSS wetlands to be able to functionally sequester CO2 and generate CH4 at rates of an unimpaired wetland

The change in CO2 sequestration and CH4 generation from wetland impacts projected for certain connected actions associated with the Micron facility was included in this analysis. The connected actions have various construction start-dates and therefore are in various stages of planning. Those connected actions include the National Grid electrical substation expansion and duct bank installation, and the new gas main impacts, which are known and are included in the analysis. Other connected actions include the Onondaga County Department of Water Protection (OCDWEP) Oak Orchard site and IWW line connecting the Micron Campus to Oak Orchard. While these areas have been field delineated, engineering plans have not yet been developed and therefore, impacts to the wetlands are unknown at this time. Wetlands have not been delineated for the proposed OCWA Clearwater line and associated upgrades, one of the other connected actions.

5 Results and Conclusions

The results of this CLCPA evaluation will provide some insight into the projected changes in the ability of soil in wetland areas that have been impacted by construction on the Micron Campus and Connected Actions to sequester CO2, as well as generate CH4. Additionally, the creation of wetlands for mitigation purposes and the preservation of existing wetlands on mitigation sites will create potential for gains in the amount of CO2 sequestration that will be occurring, as well as the amount of CH4 that is generated from these areas.

The following results were noted as part of this CLCPA evaluation.

- The loss of wetlands onsite will result in the loss/pulse emission of 48,700 tons of CO2 in wetland soil and a total foregone sequestration of CO2 in tree and litter biomass of10,803 tons of CO2.
- Wetland mitigation efforts would result in a total increase in carbon sequestration over a 23-year period beginning in 2027 in the amount of 14,578 tons of CO2.
- During that same period, it is projected that the mitigated wetlands would generate 524 tons of CH4.

Total for GHG up to 2050 were estimated as follows:

	tons	tons CO2e	tons CO2e
		GWP20-AR5	GWP100-AR5
Gross Emissions Summary			
CO2 emitted by carbon stock loss of wetland soil and biomass	48700	48700	48700
CH4 emitted by restored wetland (up to year 2050)	524	44011	14670
Total (gross emissions)		**92711**	**63370**
Net Emissions Summary			
Net CO2 (biomass and soil stock loss + foregone sequestration by removed wetland + sequestration by restored wetland (up to year 2050))	44925	44925	44925
Net CH4 (avoided emission from removed wetland + emission from restored wetland (up to year 2050))	280	234891	7830
Total (net emissions)		**68415**	**52755**

In summary, the loss of wetlands on the Micron Campus and Connected Actions will affect the ability of wetlands to both sequester and generate CO2 and CH4, respectively. The initial issue will be the one-time release of CO2 into the atmosphere from the disturbance of the standing biomass in soil that will be excavated as part of construction. While the loss is not all at once, but is separated into two distinct activities, each of which is spread over several months, it is still a large amount of CO2. The effect is that there will be negative impact on GHG emissions noting that the loss of the CO2 sequestration potential will greatly outweigh the CH4 generation of onsite wetlands. It is noted that a significant portion of onsite wetlands (51%) will be preserved in a fully mature state that sequesters CO2 and generates CH4. Further, by 2030, Micron will have constructed 504.54acres of wetland compared to 104.01 acres of wetlands that will have been impacted by onsite Phase 1 construction activities. This will allow for mitigation wetlands to develop in advance of when they are needed for mitigation. Additionally, even when considering the low level of GHG emission maturity in 2030, when adding that to the amount of CO2 sequestration and CH4 generation that is occurring with the preserved wetlands onsite, as well as the preserved wetlands on the mitigation sites, the loss of the onsite wetlands, as well as the limited amount of wetland lost as part of the National Grid actions will be more than compensated for. By 2050, the amount of CO2 sequestration and CH4 generation from the preserved wetlands onsite, the preserved wetlands at the mitigation sites, and the mitigation wetlands that have been constructed will amount to more than 3 times the losses seen from the full build out of the Micron Campus. By the time the mitigation wetlands reach full maturity, the compensation from onsite preservation, mitigation site preservation, and mitigation site wetland construction will greatly surpass the GHG changes that occur because of the Micron Campus construction.

6 References

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Figures

Image World Street Map: Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, USFWS

wsp

Legend

🟥 Site Boundary

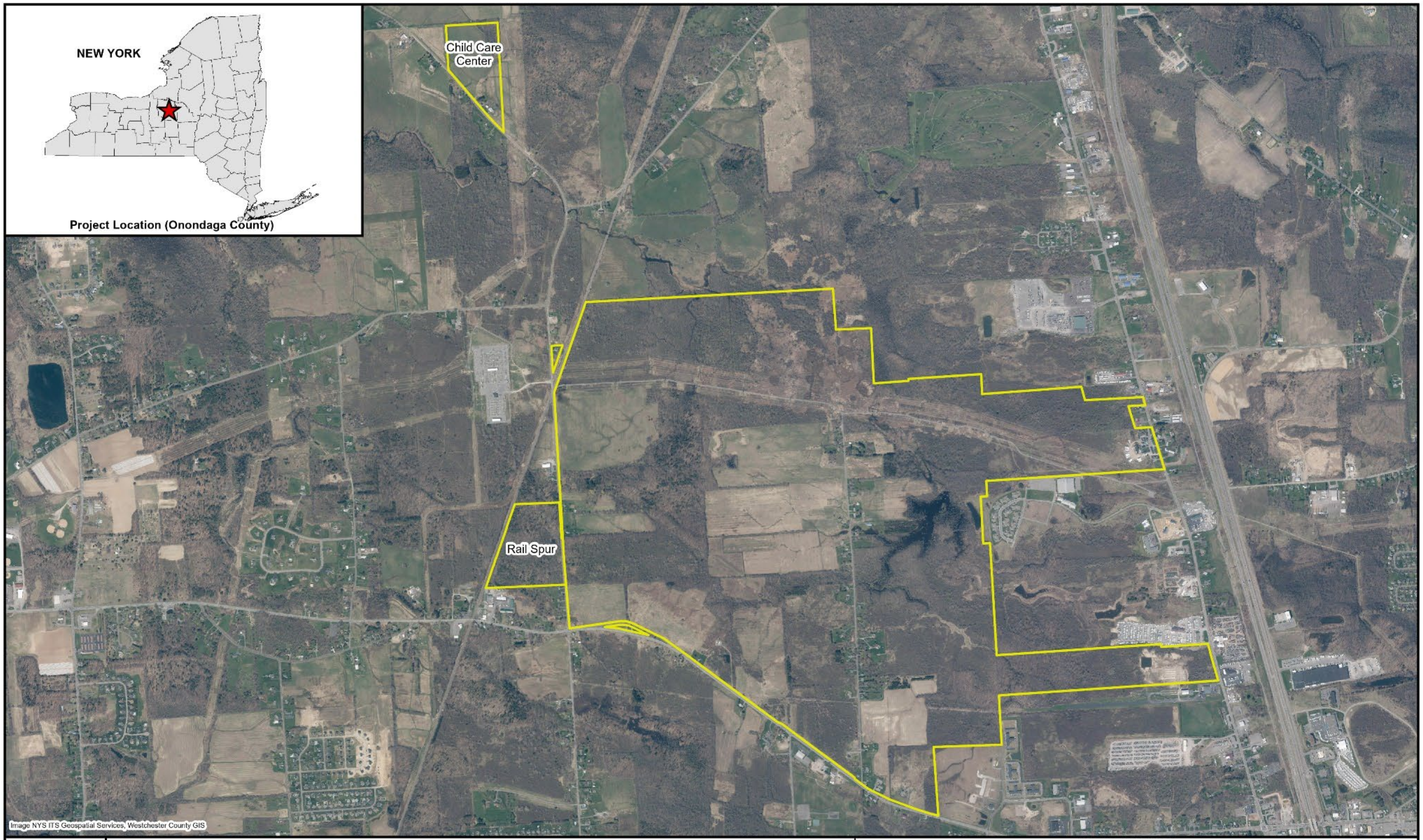
Approximate Center of Site:
43.190494, -76.151430
State Plane NY:
935,387.468 E,
1,162,799.968 N Feet

N

0 3 6
Miles

CLCPA ANALYSIS
FIGURE 1 - SITE LOCATION MAP
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

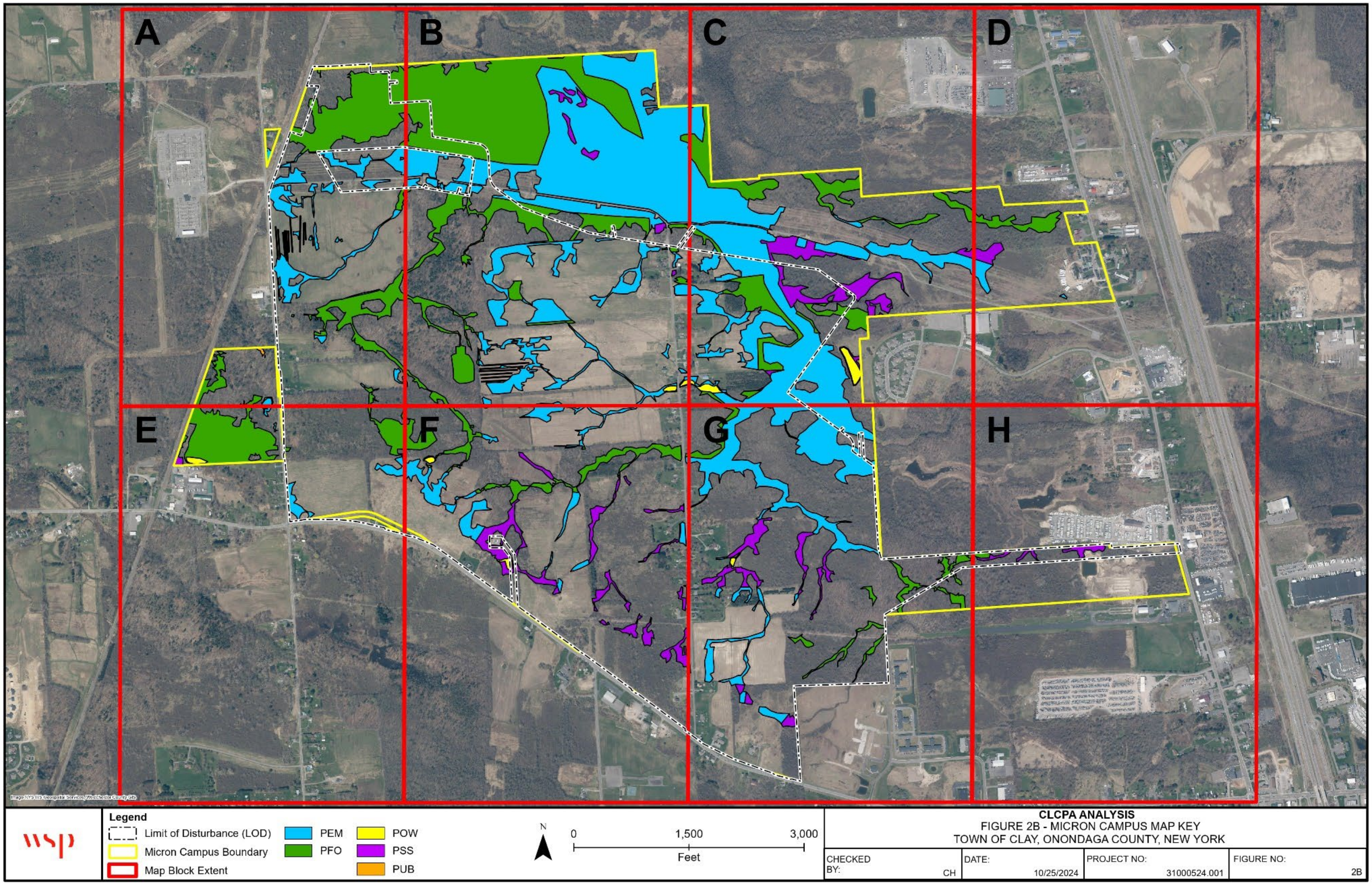
CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
PP	01/28/2025	31000524.001	1



Approximate Center of Site:
43.190494, -76.151430
State Plane NY:
935,387.468 E,
1,162,799.968 N Feet

CLCPA ANALYSIS
FIGURE 2 - AERIAL PHOTO MAP
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
PP	03/15/2024	31000524.001	2



CLCPA ANALYSIS
FIGURE 2B - MICRON CAMPUS MAP KEY
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	2B

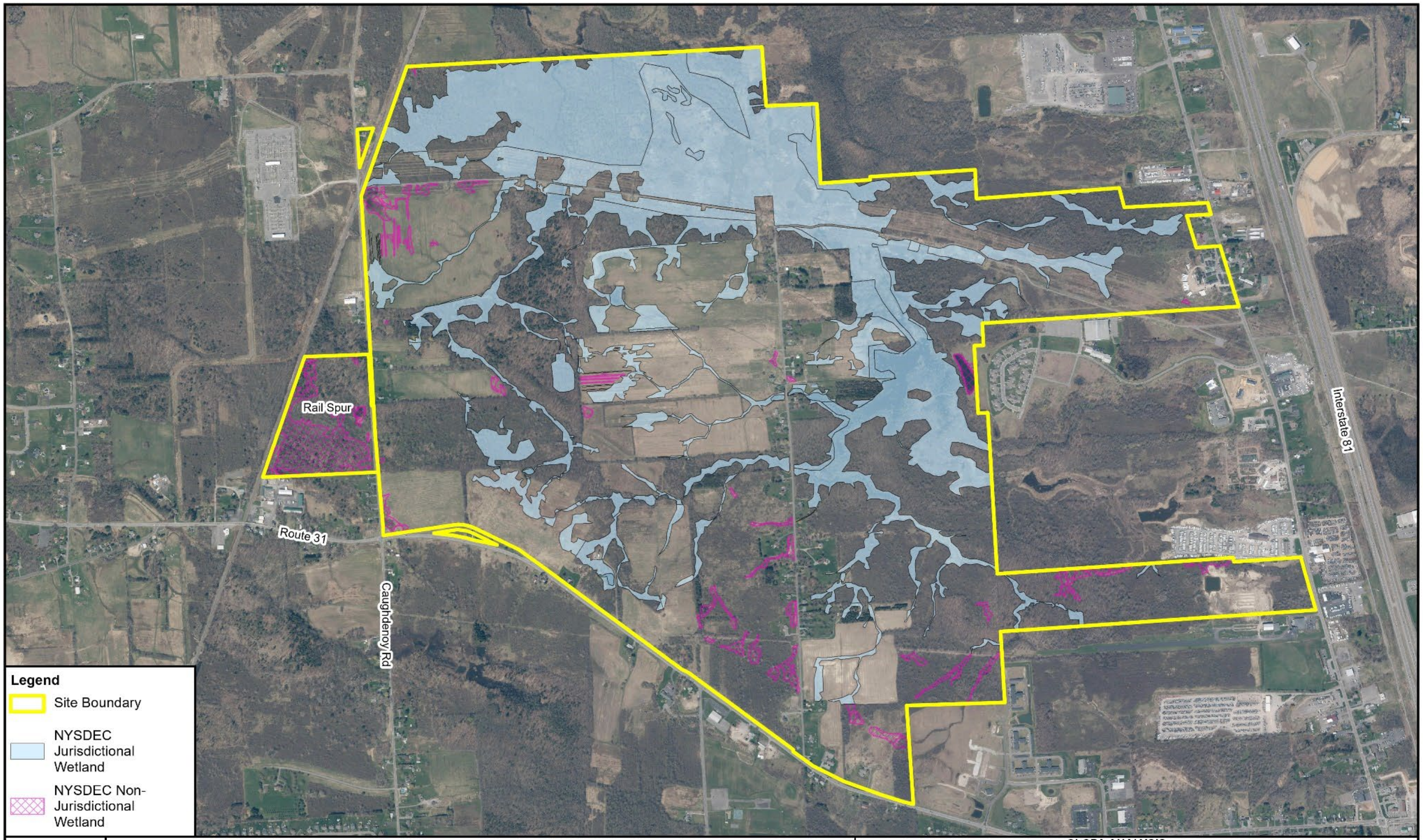
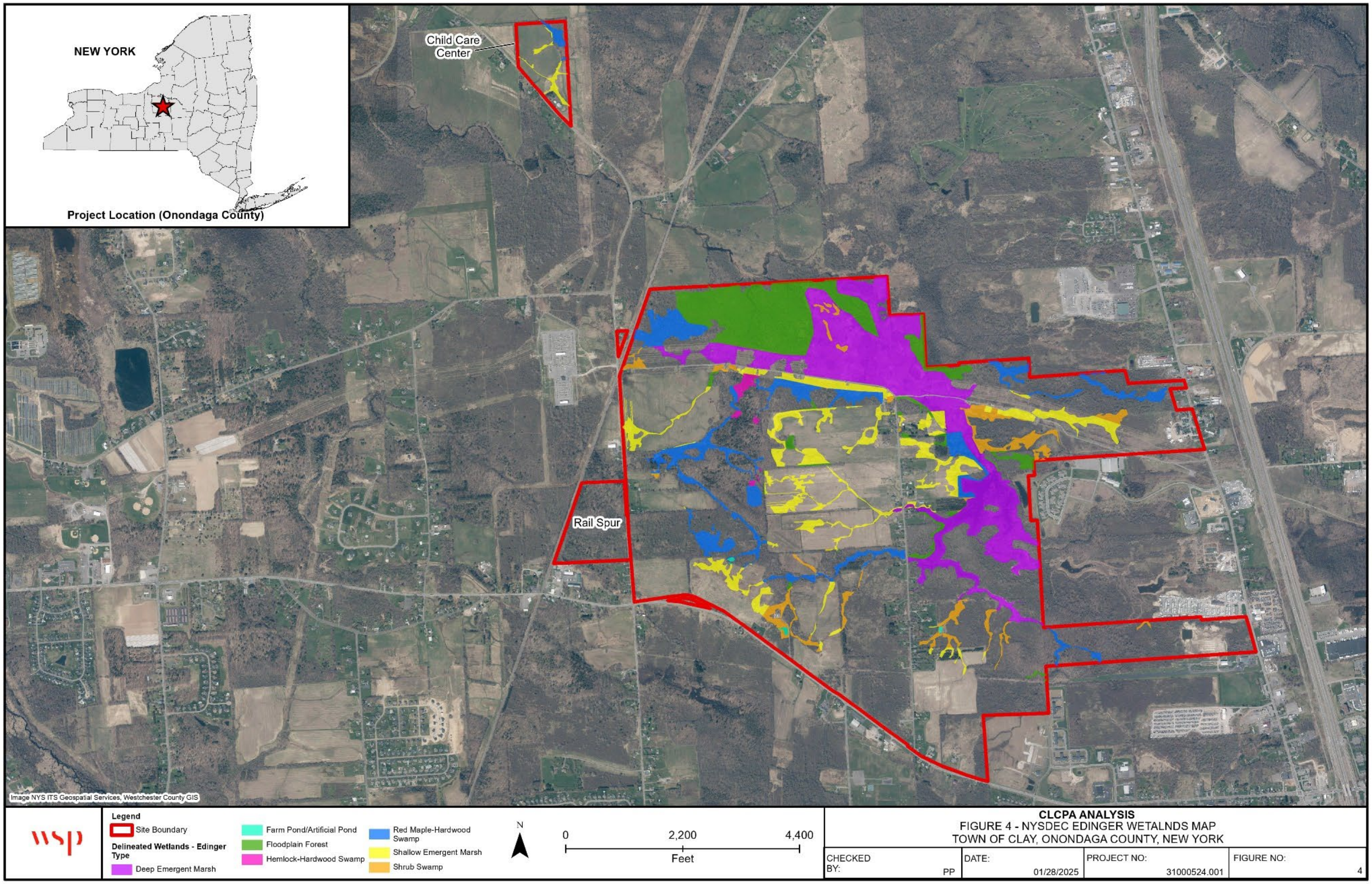


Image NYS ITS Geospatial Services, Westchester County GIS

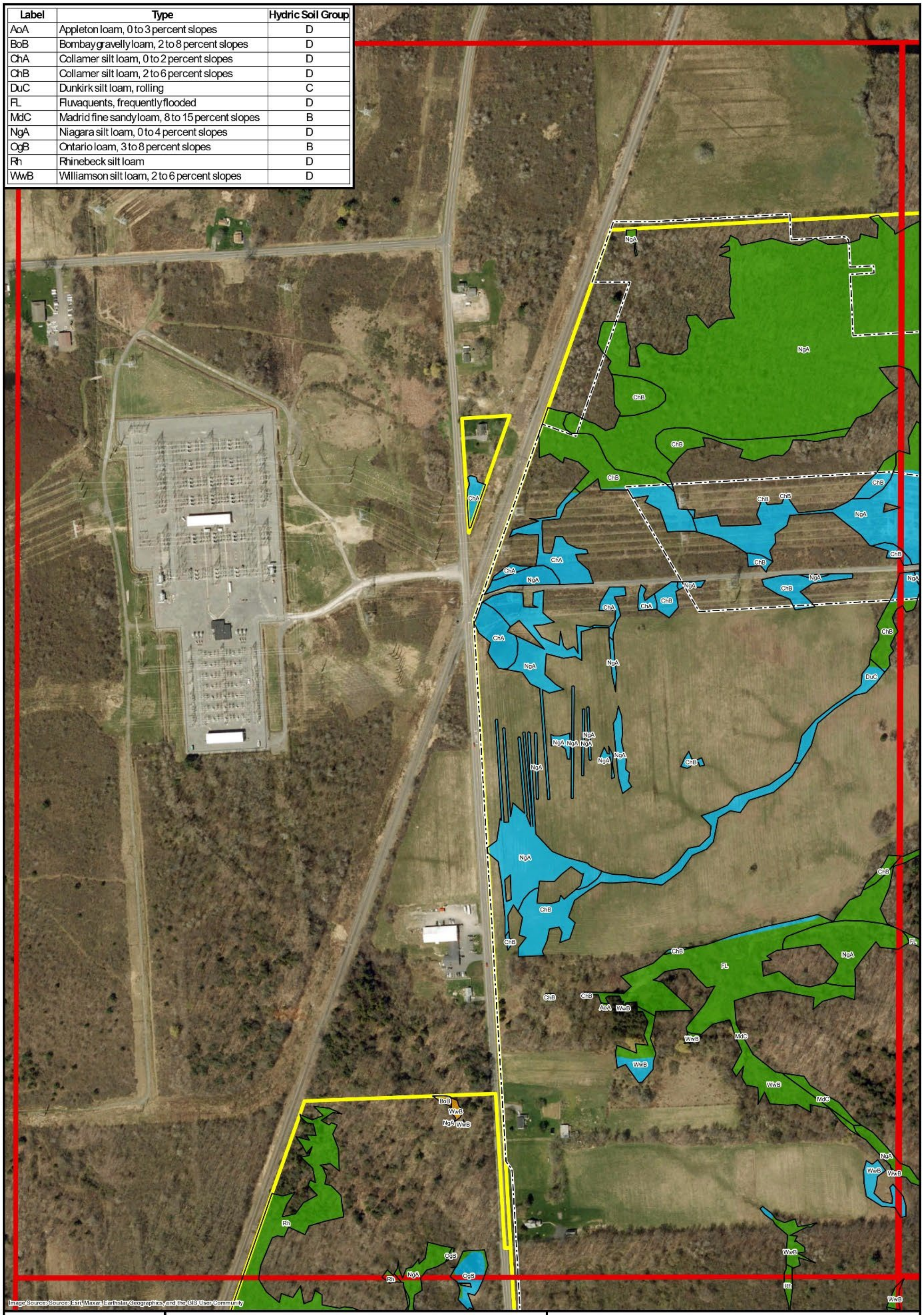
CLCPA ANALYSIS
FIGURE 3 - NYSDEC WETLANDS MAP
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	01/28/2025	31000524.001	3



CLCPA ANALYSIS
FIGURE 4 - NYSDEC EDINGER WETALNDS MAP
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY: PP	DATE: 01/28/2025	PROJECT NO: 31000524.001	FIGURE NO: 4



Label	Type	Hydric Soil Group
AoA	Appleton loam, 0 to 3 percent slopes	D
BoB	Bombay gravelly loam, 2 to 8 percent slopes	D
ChA	Collamer silt loam, 0 to 2 percent slopes	D
ChB	Collamer silt loam, 2 to 6 percent slopes	D
DuC	Dunkirk silt loam, rolling	C
FL	Fluvaquents, frequently flooded	D
MdC	Madrid fine sandy loam, 8 to 15 percent slopes	B
NgA	Niagara silt loam, 0 to 4 percent slopes	D
OgB	Ontario loam, 3 to 8 percent slopes	B
Rh	Rhinebeck silt loam	D
WwB	Williamson silt loam, 2 to 6 percent slopes	D

Image Source: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Limit of Disturbance (LOD)
- Micron Campus Boundary
- Map Block Extent
- Soil Type Boundary

Wetland Type

- 🟦 PEM
- 🟩 PFO
- 🟧 PUB

N

0 300 600
Feet

CLCPA ANALYSIS
FIGURE 5A - MICRON CAMPUS SOIL TYPES
MAP BLOCK A
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	5A

Label	Type	Hydric Soil Group
Cd	Canandaigua mucky silt loam	D
ChB	Collamer silt loam, 2 to 6 percent slopes	D
FL	Fluvaquents, frequently flooded	D
MdC	Madrid fine sandy loam, 8 to 15 percent slopes	B
NgA	Niagara silt loam, 0 to 4 percent slopes	D
Pb	Palms muck	D
Rh	Rhinebeck silt loam	D
WwB	Williamson silt loam, 2 to 6 percent slopes	D
WwC	Williamson silt loam, rolling	D

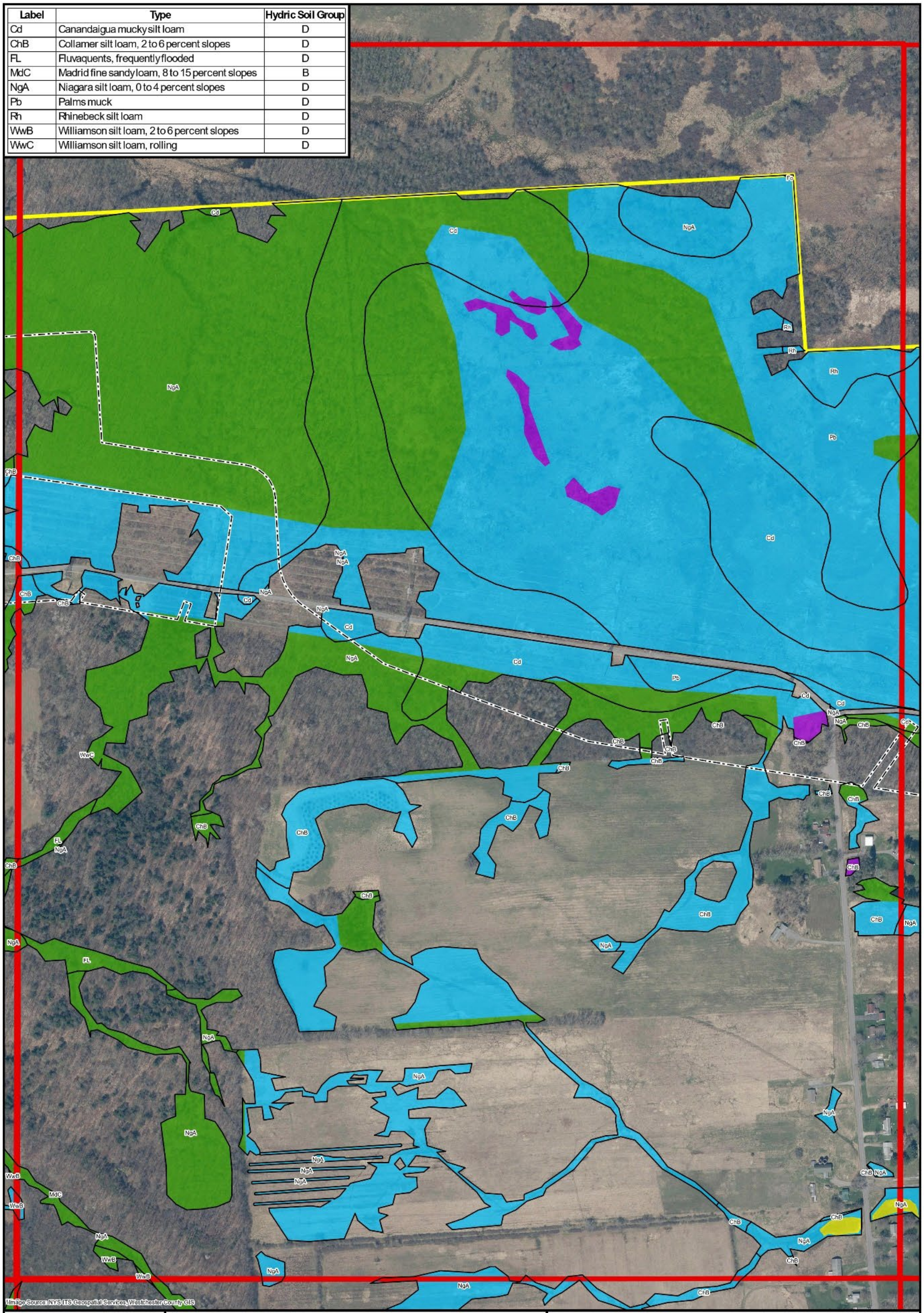


Image Source: NYS ITS Geospatial Services, Westchester County GIS

Legend

- Limit of Disturbance (LOD)
- Micron Campus Boundary
- Map Block Extent
- Soil Type Boundary

Wetland Type

- 🟦 PEM
- 🟩 PFO
- 🟨 POW
- 🟪 PSS

N

0 300 600

Feet

wsp

CLCPA ANALYSIS

FIGURE 5B - MICRON CAMPUS SOIL TYPES

MAP BLOCK B

TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
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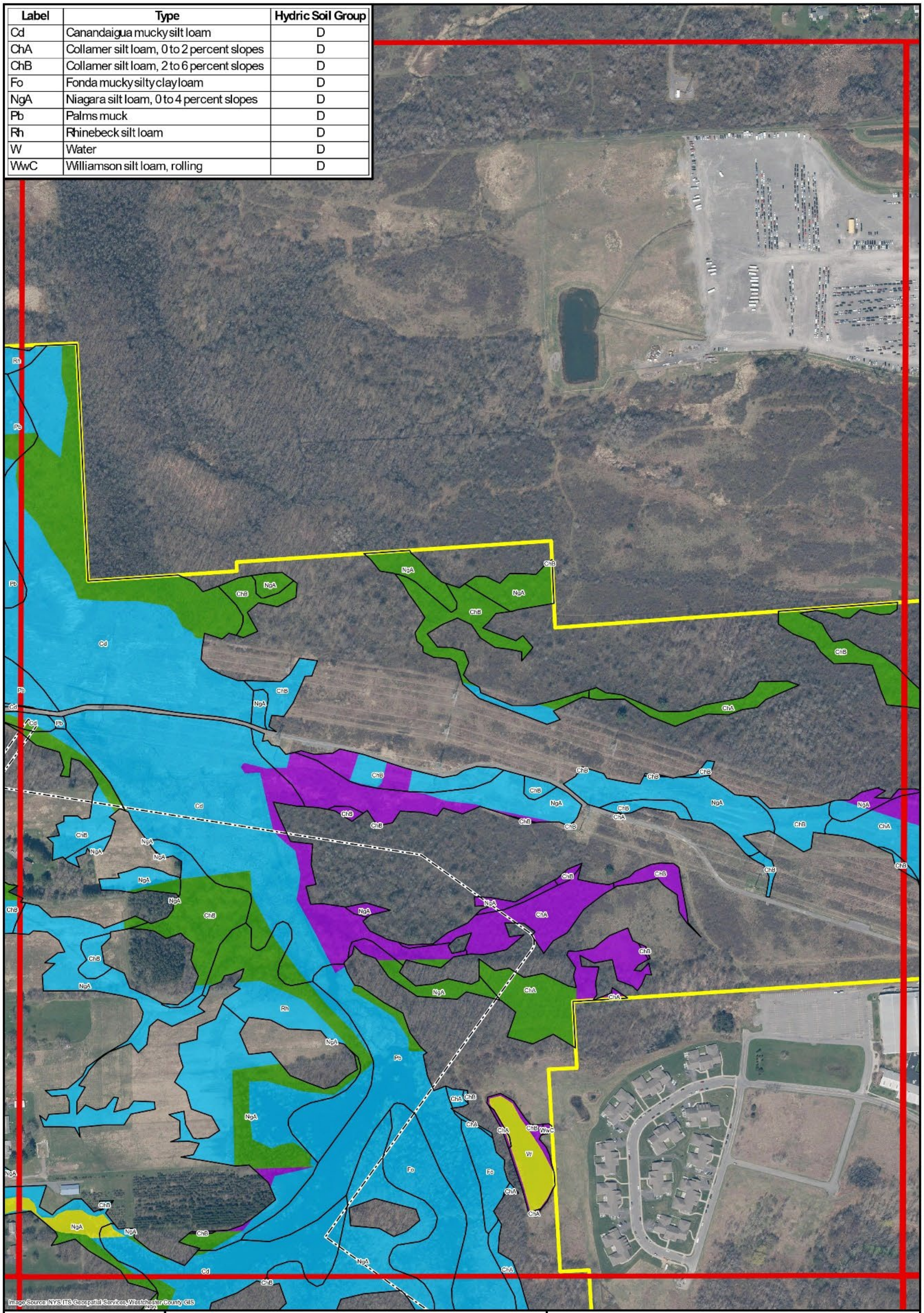

Label	Type	Hydric Soil Group
Cd	Canandaigua mucky silt loam	D
ChA	Collamer silt loam, 0 to 2 percent slopes	D
ChB	Collamer silt loam, 2 to 6 percent slopes	D
Fo	Fonda mucky silty clay loam	D
NgA	Niagara silt loam, 0 to 4 percent slopes	D
Pb	Palms muck	D
Rh	Rhinebeck silt loam	D
W	Water	D
WwC	Williamson silt loam, rolling	D

Image Source: NYS ITS Geospatial Services, Westchester County GIS

Legend

- Limit of Disturbance (LOD)
- Micron Campus Boundary
- Map Block Extent
- Soil Type Boundary

Wetland Type

- 🟦 PEM
- 🟩 PFO
- 🟨 POW
- 🟪 PSS

N

0 300 600

Feet

CLCPA ANALYSIS

FIGURE 5C - MICRON CAMPUS SOIL TYPES

MAP BLOCK C

TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	5C

Label	Type	Hydric Soil Group
ChA	Collamer silt loam, 0 to 2 percent slopes	D
ChB	Collamer silt loam, 2 to 6 percent slopes	D
MgB	Madrid gravelly loam, 2 to 8 percent slopes	B
MtB	Minoa fine sandy loam, 2 to 6 percent slopes	D
NgA	Niagara silt loam, 0 to 4 percent slopes	D
WwB	Williamson silt loam, 2 to 6 percent slopes	D

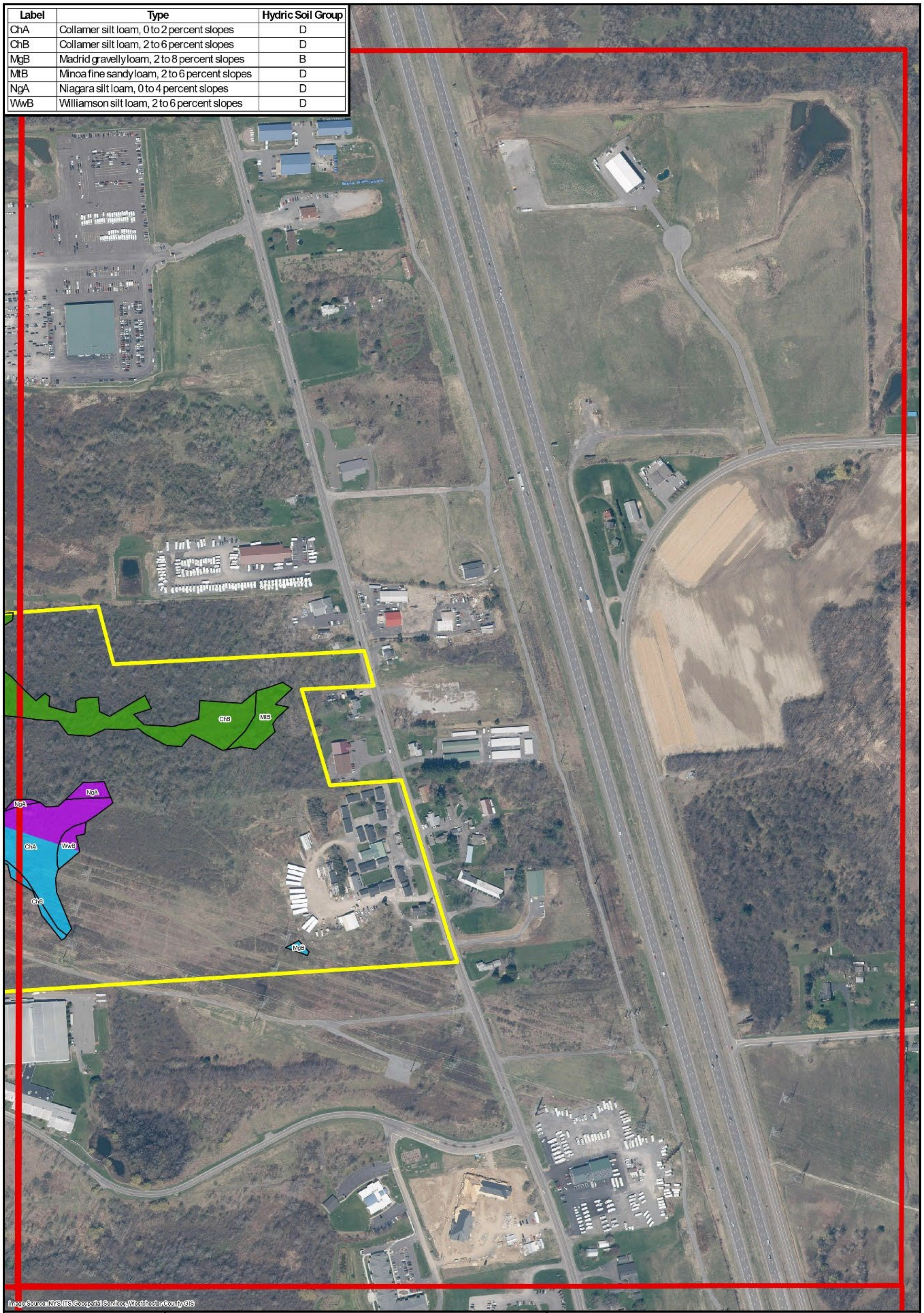

Image Source: NYS ITS Geospatial Services, Westchester County GIS

Legend

- 🟨 Micron Campus Boundary
- 🟥 Map Block Extent
- ☐ Soil Type Boundary

Wetland Type

- 🟦 PEM
- 🟩 PFO
- 🟪 PSS

CLCPA ANALYSIS

FIGURE 5D - MICRON CAMPUS SOIL TYPES
MAP BLOCK D
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
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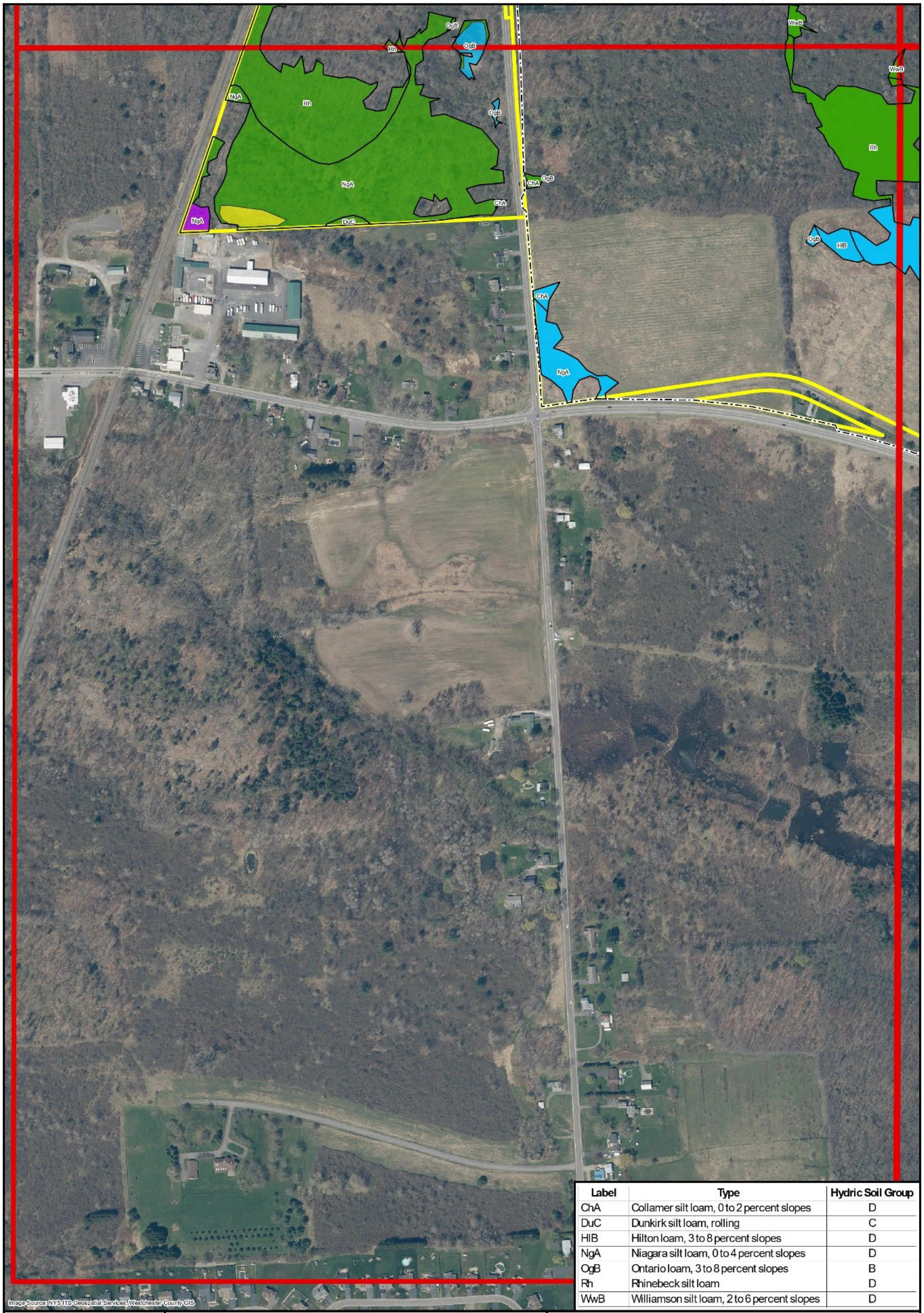

Label	Type	Hydric Soil Group
ChA	Collamer silt loam, 0 to 2 percent slopes	D
DuC	Dunkirk silt loam, rolling	C
HlB	Hilton loam, 3 to 8 percent slopes	D
NgA	Niagara silt loam, 0 to 4 percent slopes	D
OgB	Ontario loam, 3 to 8 percent slopes	B
Rh	Rhinebeck silt loam	D
WwB	Williamson silt loam, 2 to 6 percent slopes	D

Legend

- ⬚ Limit of Disturbance (LOD)
- 🟨 Micron Campus Boundary
- 🟥 Map Block Extent
- ☐ Soil Type Boundary

Wetland Type

- 🟦 PEM
- 🟩 PFO
- 🟨 POW
- 🟪 PSS

CLCPA ANALYSIS

FIGURE 5E - MICRON CAMPUS SOIL TYPES
MAP BLOCK E
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	5E

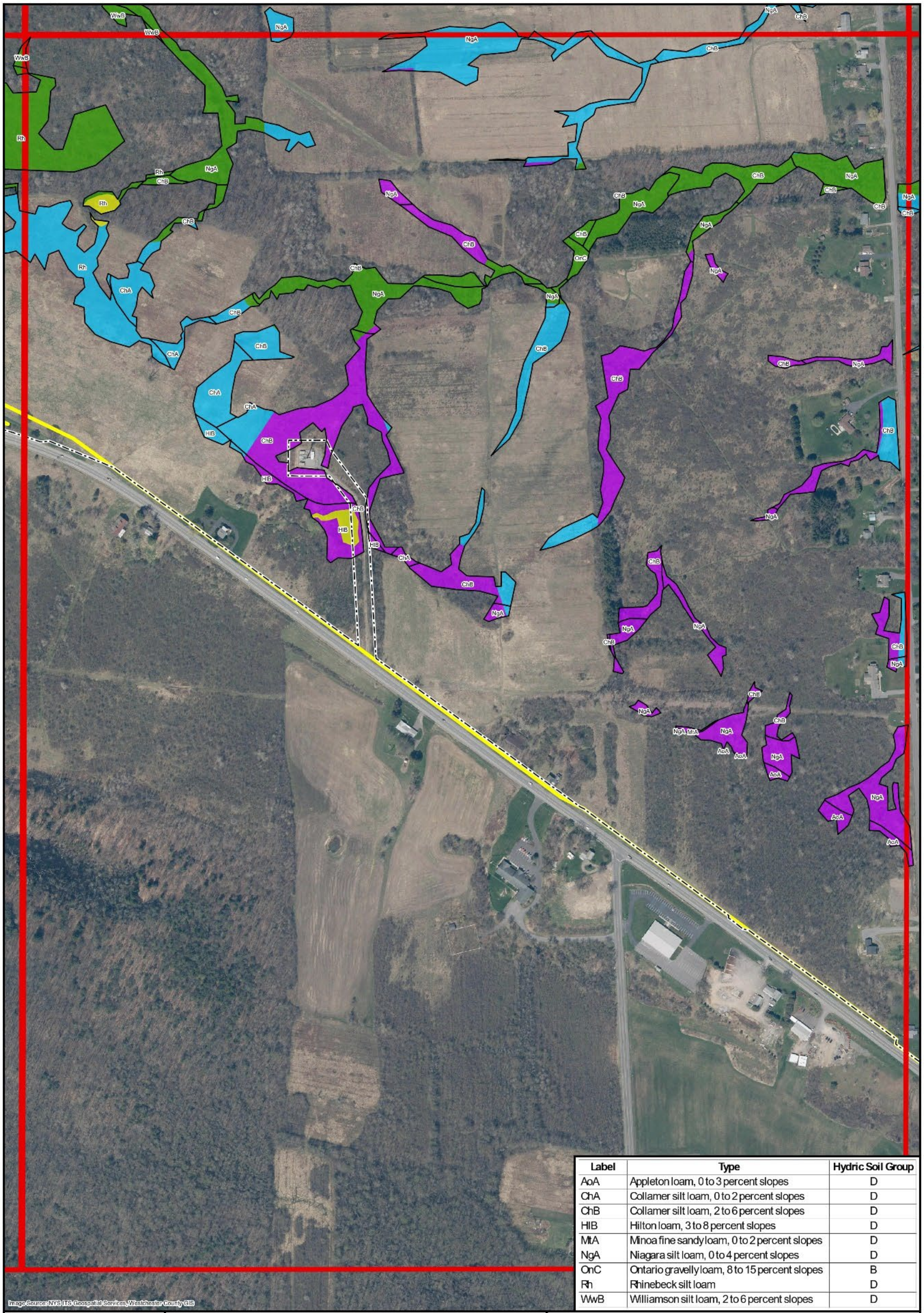

Image Source: NYS ITS Geospatial Services, Westchester County GIS

Label	Type	Hydric Soil Group
AoA	Appleton loam, 0 to 3 percent slopes	D
ChA	Collamer silt loam, 0 to 2 percent slopes	D
ChB	Collamer silt loam, 2 to 6 percent slopes	D
HlB	Hilton loam, 3 to 8 percent slopes	D
MtA	Minoa fine sandy loam, 0 to 2 percent slopes	D
NgA	Niagara silt loam, 0 to 4 percent slopes	D
OnC	Ontario gravelly loam, 8 to 15 percent slopes	B
Rh	Rhinebeck silt loam	D
WwB	Williamson silt loam, 2 to 6 percent slopes	D

Legend

- Limit of Disturbance (LOD)
- Micron Campus Boundary
- Map Block Extent
- Soil Type Boundary

Wetland Type

- 🟦 PEM
- 🟩 PFO
- 🟨 POW
- 🟪 PSS

N

0 300 600
Feet

CLCPA ANALYSIS
FIGURE 5F - MICRON CAMPUS SOIL TYPES
MAP BLOCK F
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	5F

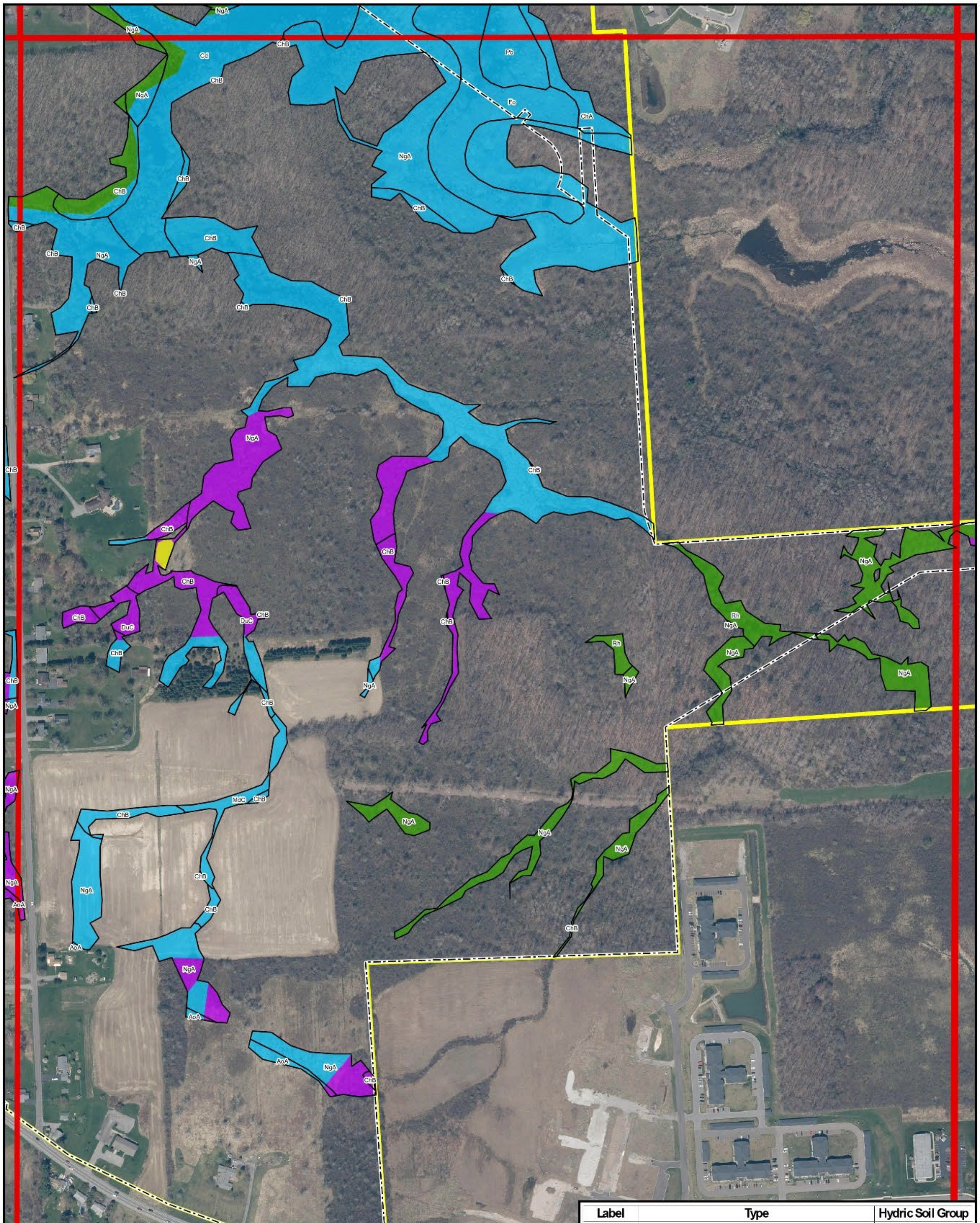

Image Source: NYS ITS Geospatial Services, Westchester County GIS

Label	Type	Hydric Soil Group
AoA	Appleton loam, 0 to 3 percent slopes	D
Cd	Canandaigua mucky silt loam	D
ChA	Collamer silt loam, 0 to 2 percent slopes	D
ChB	Collamer silt loam, 2 to 6 percent slopes	D
DuC	Dunkirk silt loam, rolling	C
Fo	Fonda mucky silty clay loam	D
MdC	Madrid fine sandy loam, 8 to 15 percent slopes	B
NgA	Niagara silt loam, 0 to 4 percent slopes	D
Pb	Palms muck	D
Rh	Rhinebeck silt loam	D

Legend

- ⬚ Limit of Disturbance (LOD)
- 🟨 Micron Campus Boundary
- 🟥 Map Block Extent
- ⬜ Soil Type Boundary

Wetland Type

- 🟦 PEM
- 🟩 PFO
- 🟨 POW
- 🟪 PSS

N

0 300 600
Feet

CLCPA ANALYSIS
FIGURE 5G - MICRON CAMPUS SOIL TYPES
MAP BLOCK G
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	5G

Label	Type	Hydric Soil Group
MtB	Minoa fine sandy loam, 2 to 6 percent slopes	D
NgA	Niagara silt loam, 0 to 4 percent slopes	D
WwB	Williamson silt loam, 2 to 6 percent slopes	D

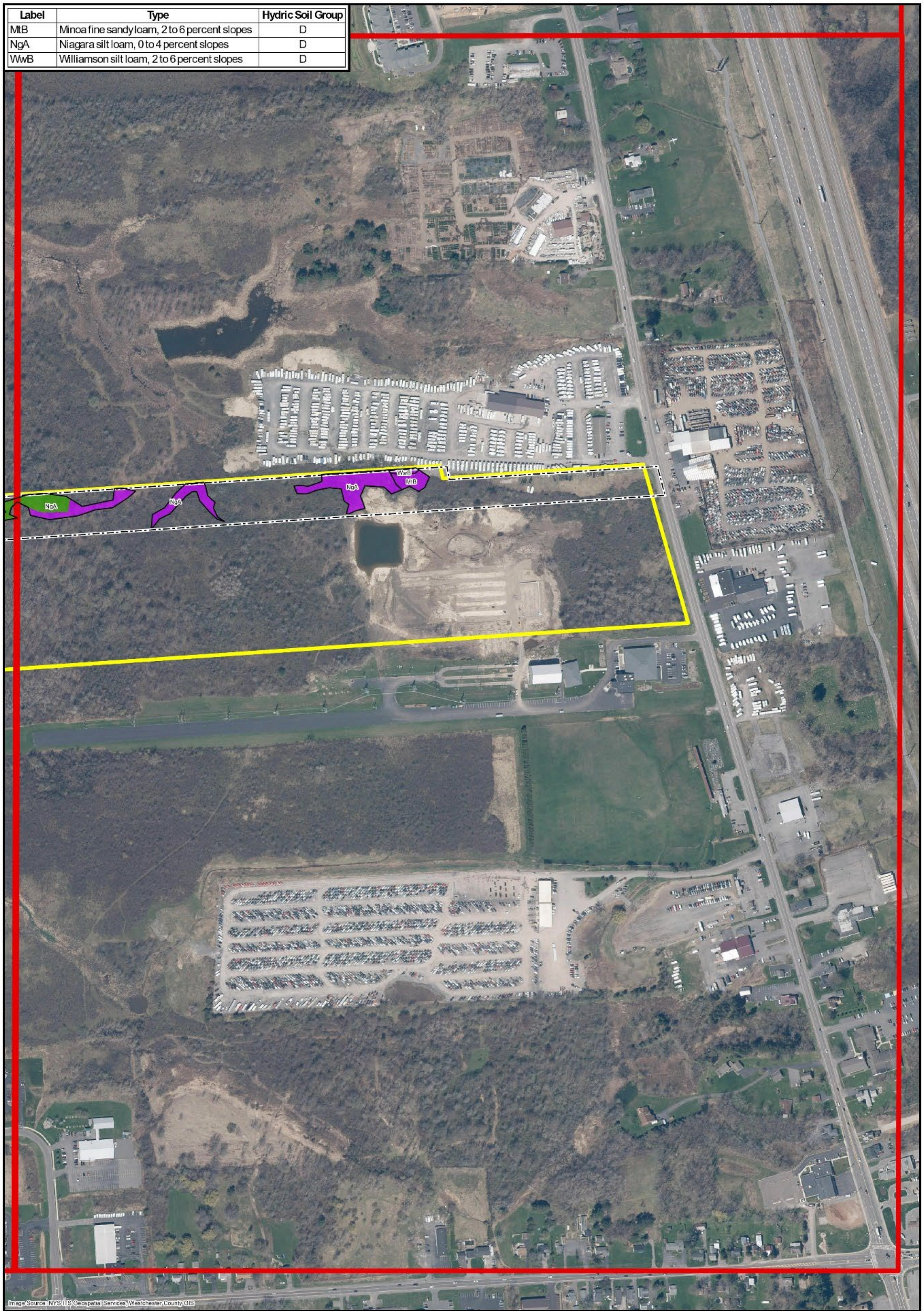

Image Source: NYS ITS Geospatial Services, Westchester County GIS

Legend

- Limit of Disturbance (LOD)
- Micron Campus Boundary
- Map Block Extent
- Soil Type Boundary

Wetland Type

- 🟩 PFO
- 🟪 PSS

CLCPA ANALYSIS
FIGURE 5H - MICRON CAMPUS SOIL TYPES
MAP BLOCK H
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	5H

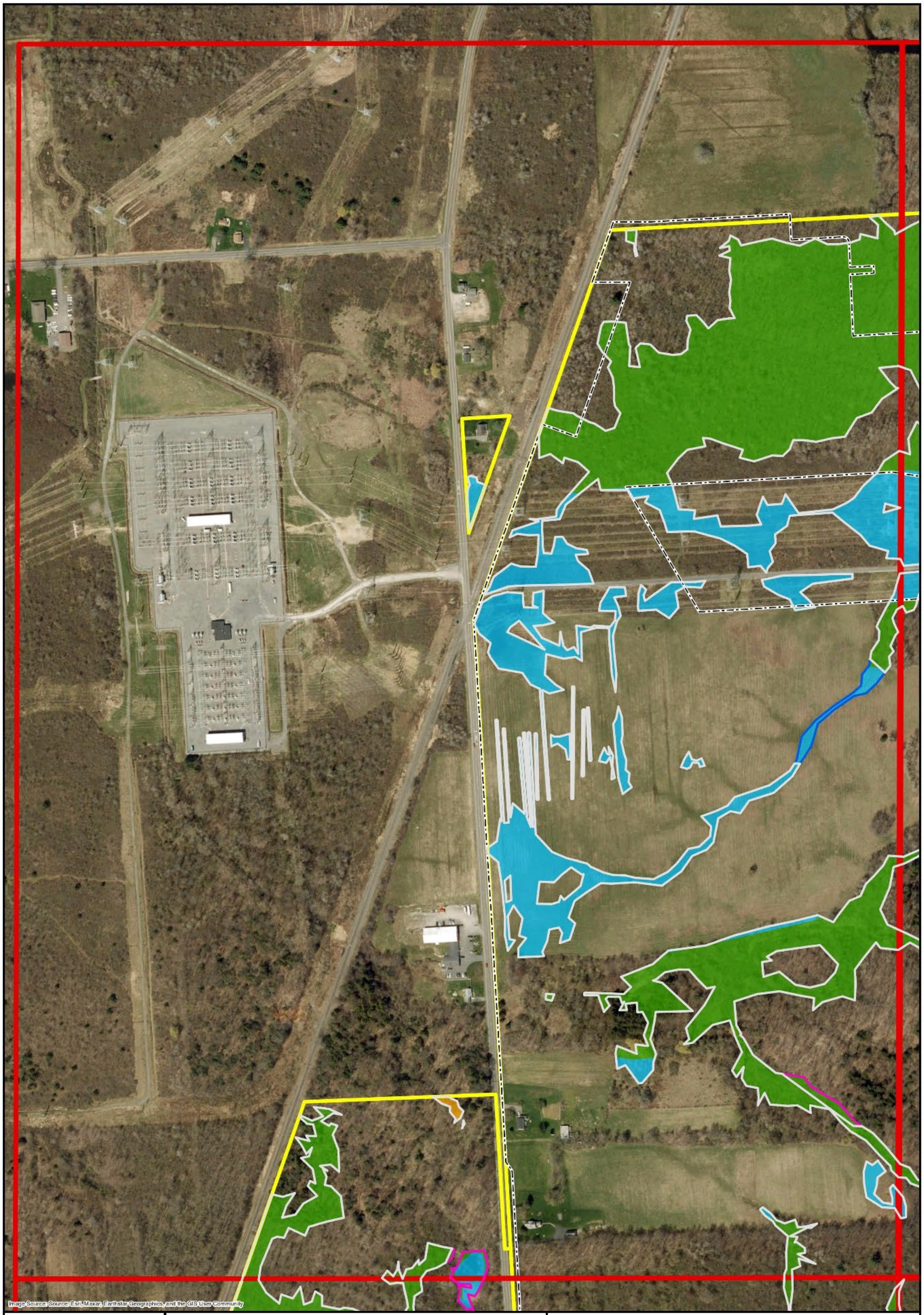

Image Source: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- ▭ Limit of Disturbance (LOD)
- ▭ Micron Campus Boundary
- ▭ Map Block Extent

Hydric Soil Group

- ▭ B
- ▭ C
- ▭ D

Wetland Type

- 🟦 PEM
- 🟩 PFO
- 🟧 PUB

N

0 300 600

Feet

CLCPA ANALYSIS

FIGURE 6A - MICRON CAMPUS HYDRIC SOIL GROUPS
MAP BLOCK A
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
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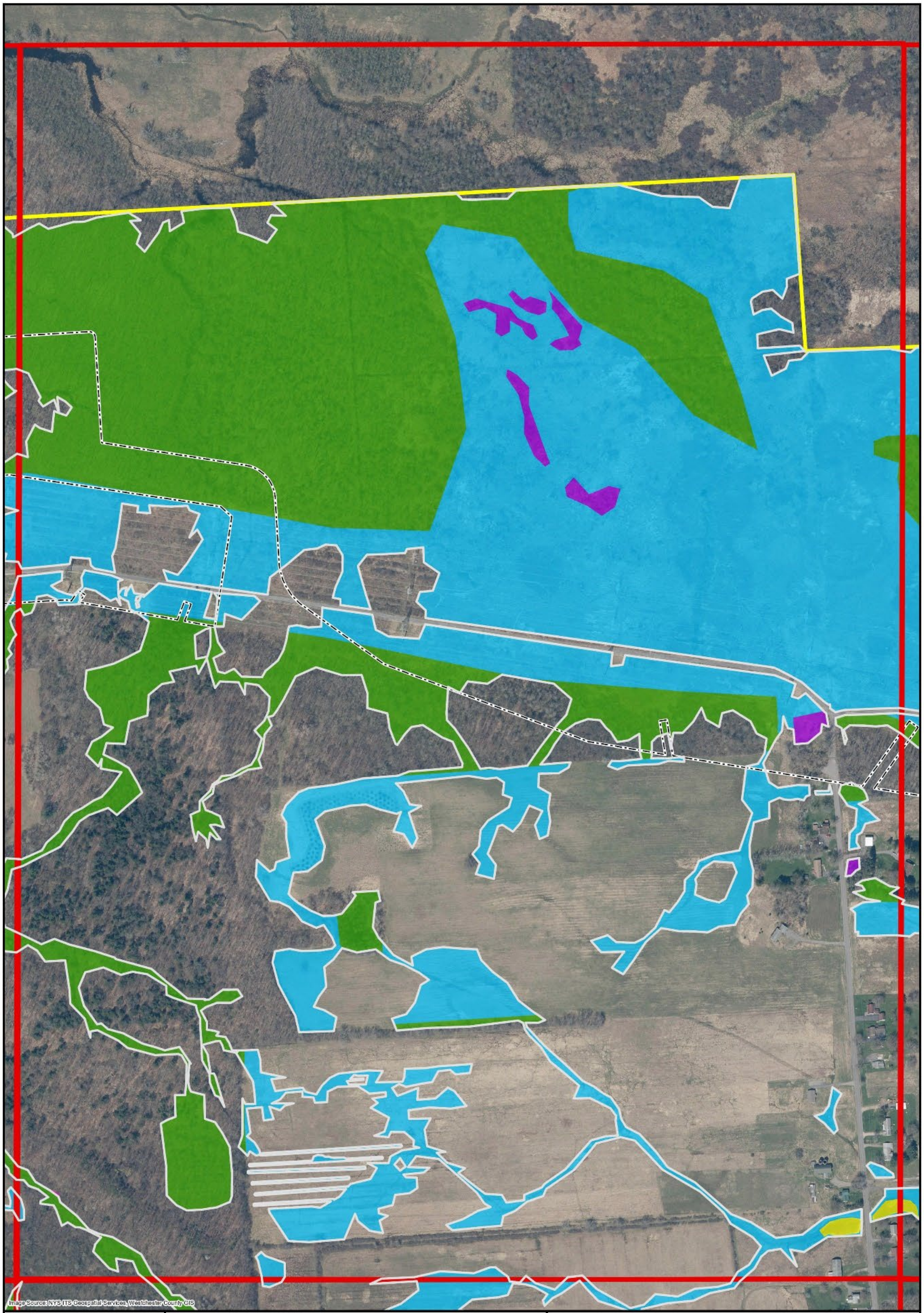


Image Source: NYS ITS Geospatial Services, Westchester County GIS

wsp

Legend

- Limit of Disturbance (LOD)
- Micron Campus Boundary
- Map Block Extent

Hydric Soil Group

- B
- D

Wetland Type

- PEM
- PFO
- POW
- PSS

N

0 300 600

Feet

CLCPA ANALYSIS

FIGURE 6B - MICRON CAMPUS HYDRIC SOIL GROUPS
MAP BLOCK B
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	6B

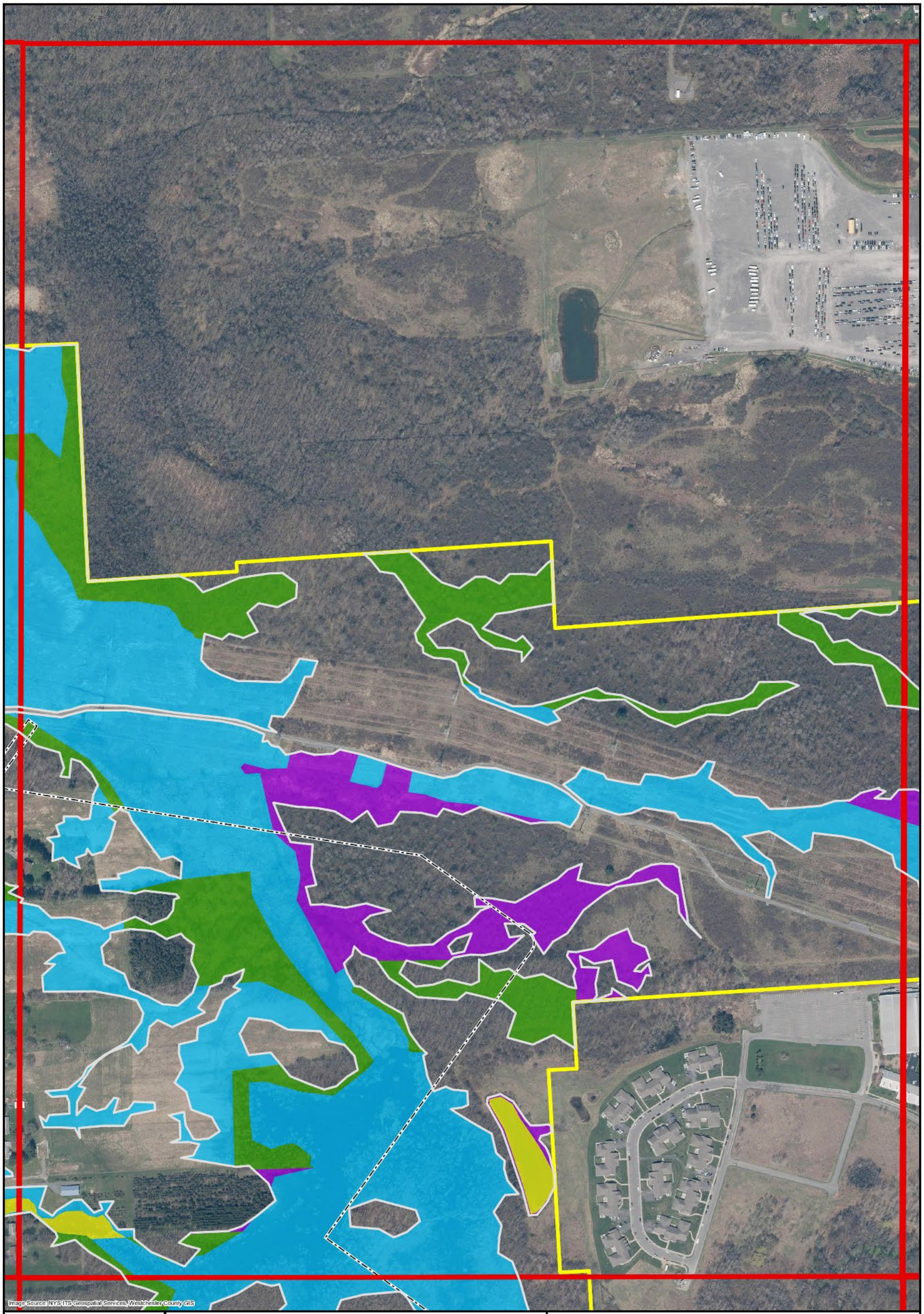


Image Source: NYS ITS Geospatial Services, Westchester County GIS

Legend

- ▭ Limit of Disturbance (LOD)
- 🟨 Micron Campus Boundary
- 🟥 Map Block Extent

Hydric Soil Group

- ▭ D

Wetland Type

- 🟦 PEM
- 🟩 PFO
- 🟨 POW
- 🟪 PSS

N

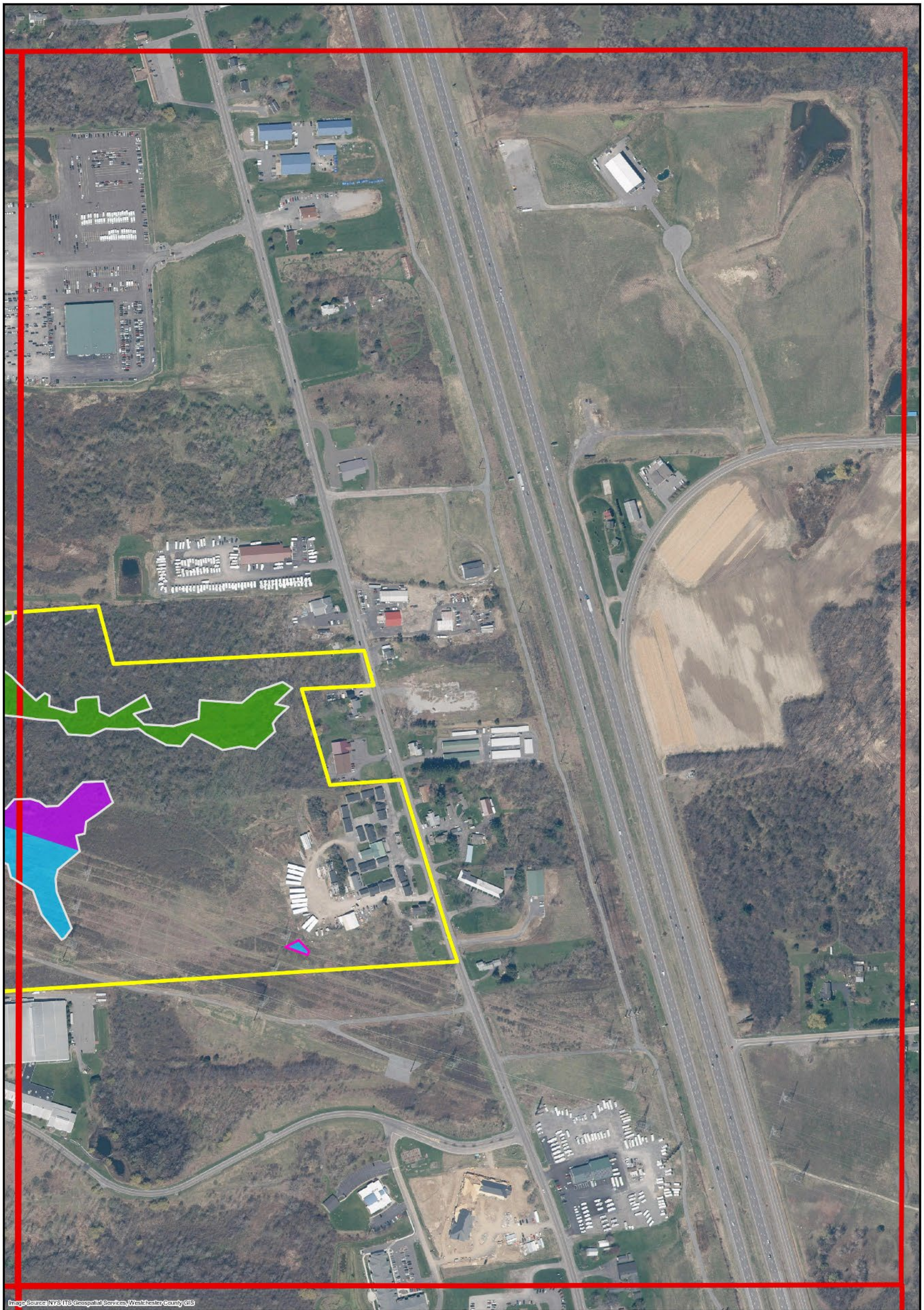
0 300 600

Feet

CLCPA ANALYSIS

FIGURE 6C - MICRON CAMPUS HYDRIC SOIL GROUPS
MAP BLOCK C
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	6C



CLCPA ANALYSIS

FIGURE 6D - MICRON CAMPUS HYDRIC SOIL GROUPS
MAP BLOCK D
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	6D

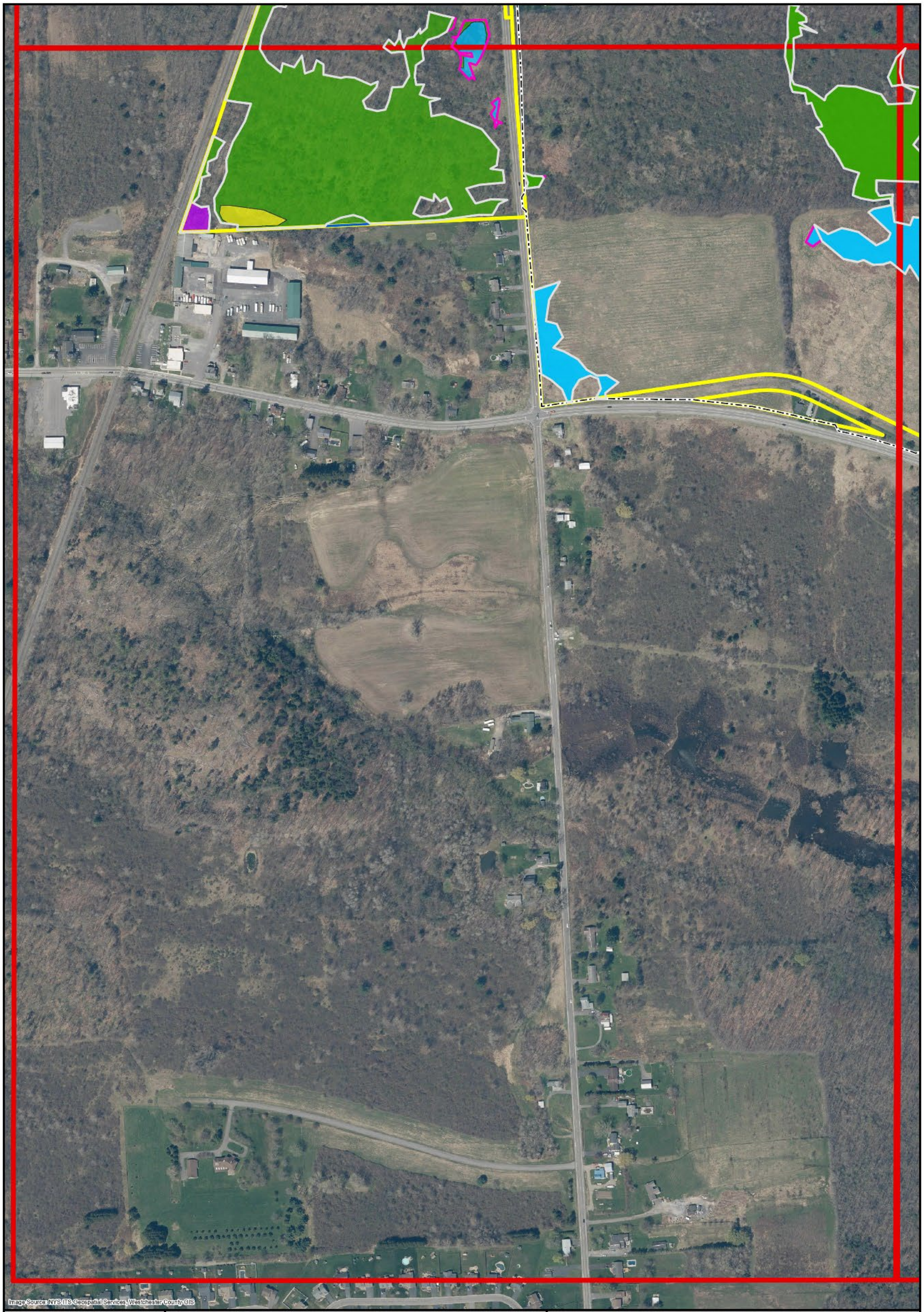


Image Source: NYS ITS Geospatial Services, Westchester County GIS

wsp

Legend

- Limit of Disturbance (LOD)
- Micron Campus Boundary
- Map Block Extent

Hydric Soil Group

- B
- C
- D

Wetland Type

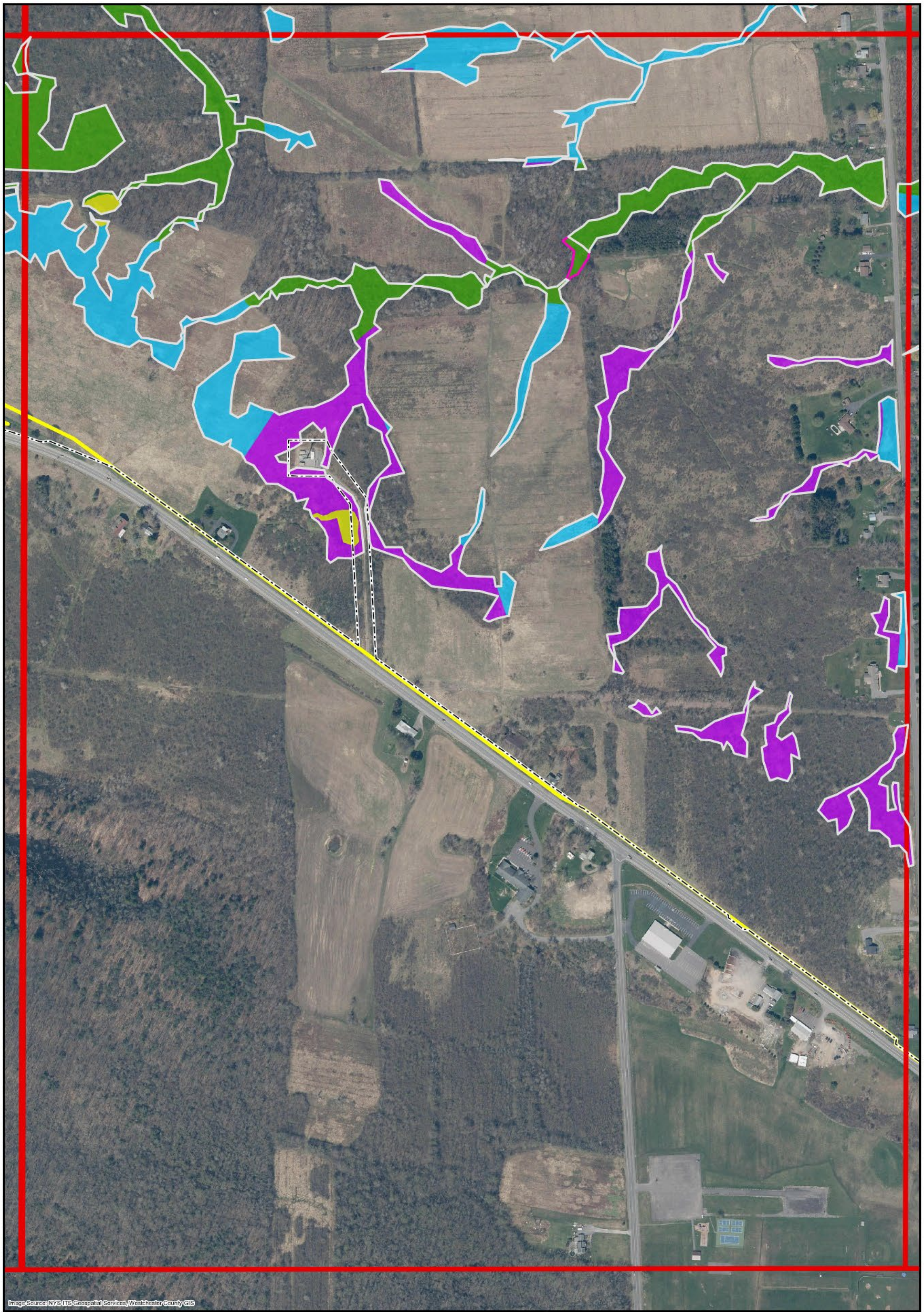
- 🟦 PEM
- 🟩 PFO
- 🟨 POW
- 🟪 PSS

N

0 300 600
Feet

CLCPA ANALYSIS
FIGURE 6E - MICRON CAMPUS HYDRIC SOIL GROUPS
MAP BLOCK E
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	6E



CLCPA ANALYSIS

FIGURE 6F - MICRON CAMPUS HYDRIC SOIL GROUPS
MAP BLOCK F
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	6F

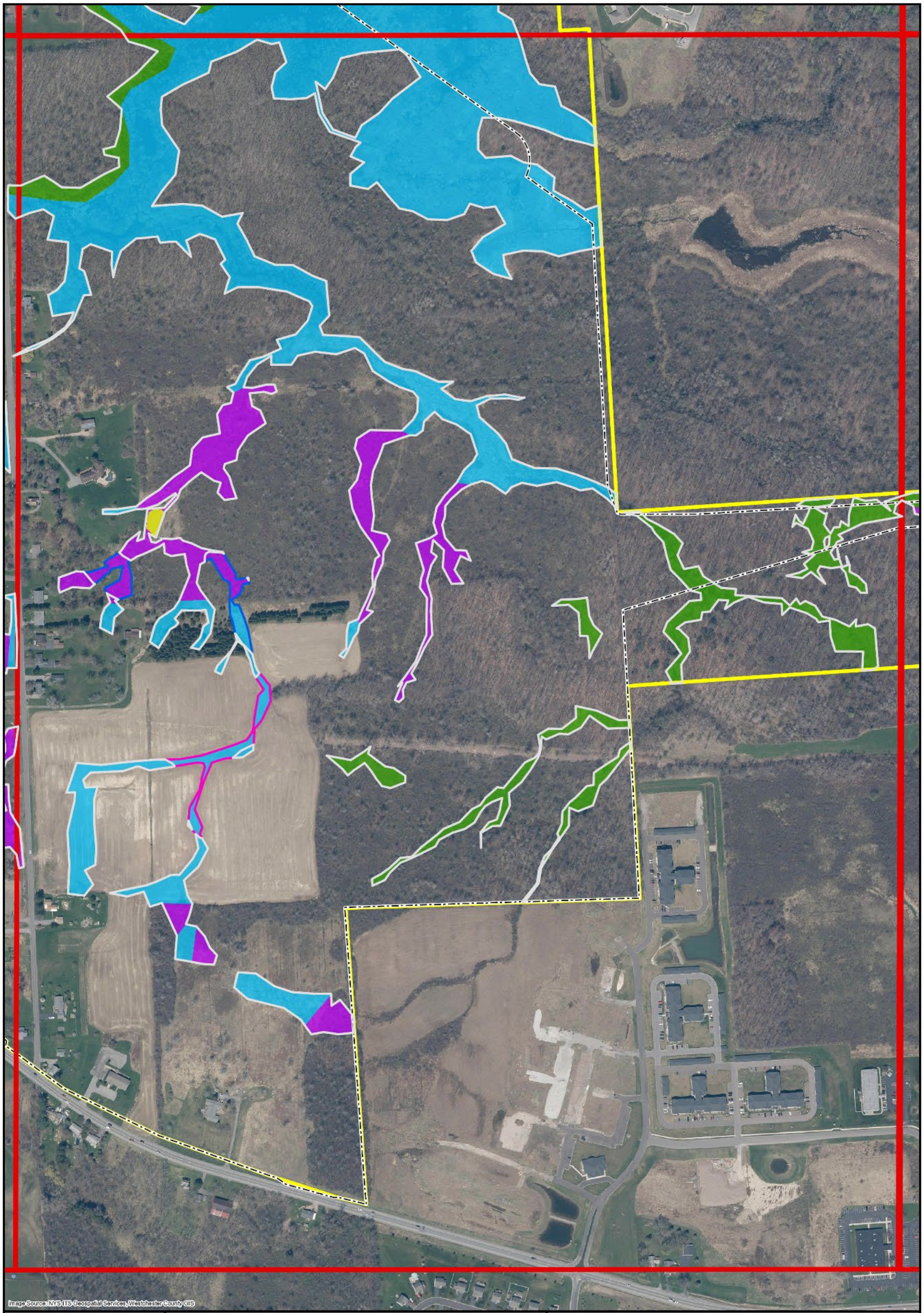


Image Source: NYS ITS Geospatial Services, Westchester County GIS

Legend

- ⬚ Limit of Disturbance (LOD)
- 🟨 Micron Campus Boundary
- 🟥 Map Block Extent

Hydric Soil Group

- ▭ B
- ▭ C
- ▭ D

Wetland Type

- 🟦 PEM
- 🟩 PFO
- 🟨 POW
- 🟪 PSS

N

0 300 600
Feet

CLCPA ANALYSIS

FIGURE 6G - MICRON CAMPUS HYDRIC SOIL GROUPS
MAP BLOCK G
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	6G

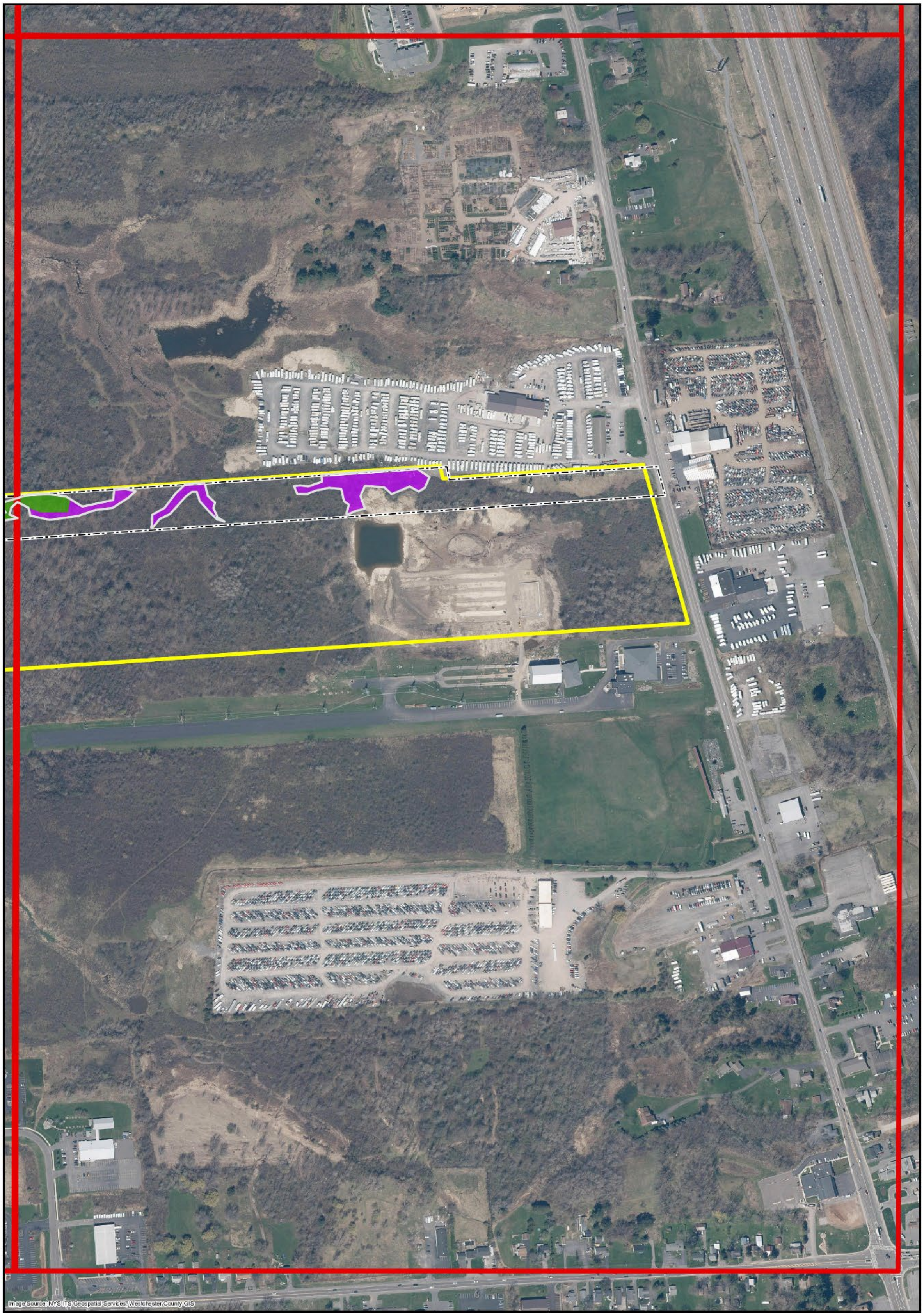


Image Source: NYS ITS Geospatial Services, Westchester County GIS

CLCPA ANALYSIS

FIGURE 6H - MICRON CAMPUS HYDRIC SOIL GROUPS
MAP BLOCK H
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	10/25/2024	31000524.001	6H

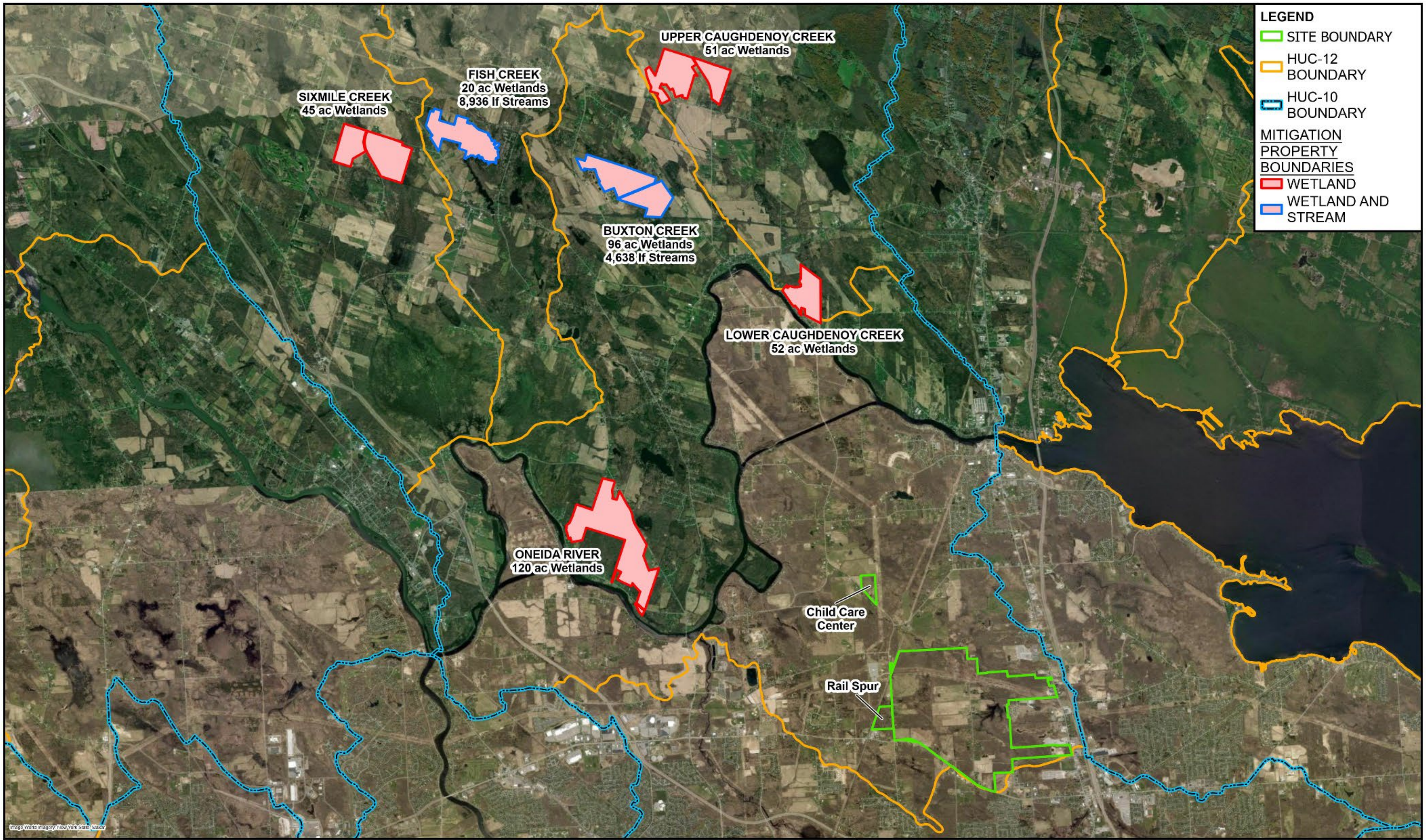


Image World Imagery: New York State, Maxar

wsp

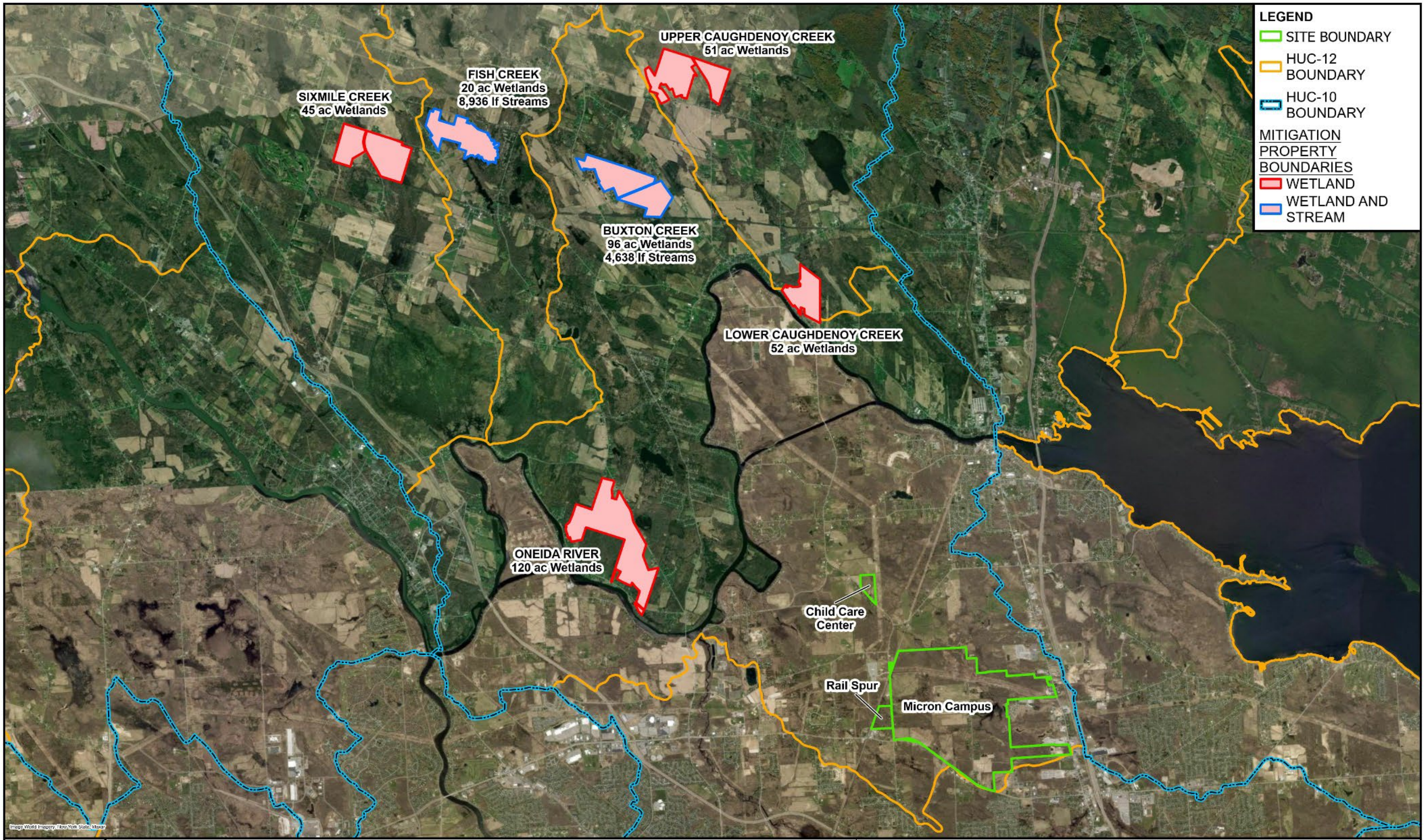
Notes:
LF = Linear Feet

N

0 1.25 2.5
Miles

CLCPA ANALYSIS
FIGURE 7A - WETLAND MITIGATION SITES MAP
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	02/11/2025	31000524.001	7A



wsp

Notes:
LF = Linear Feet

CLCPA ANALYSIS
FIGURE 7B - MITIGATION KEY MAP
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	02/11/2025	31000524.001	7B

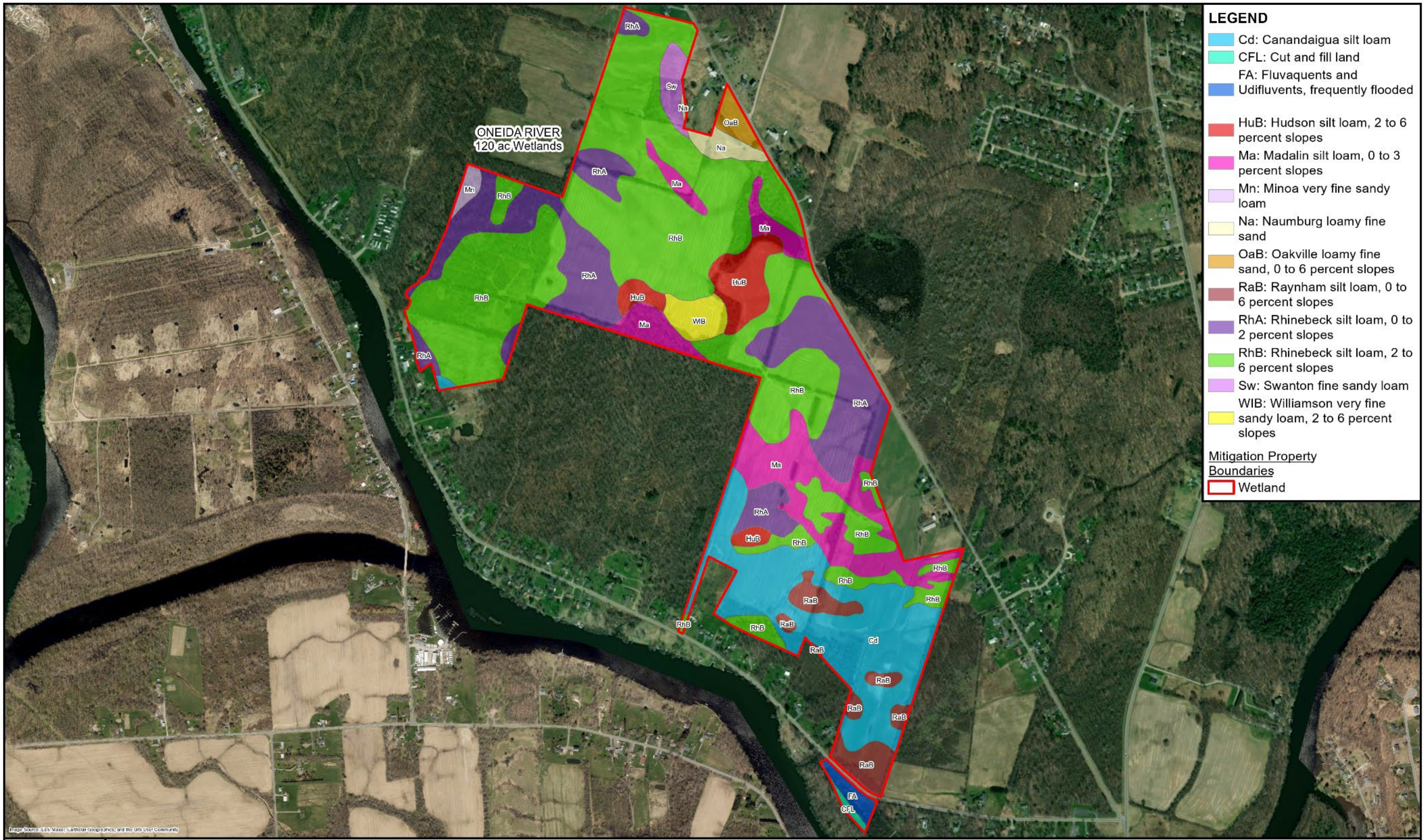
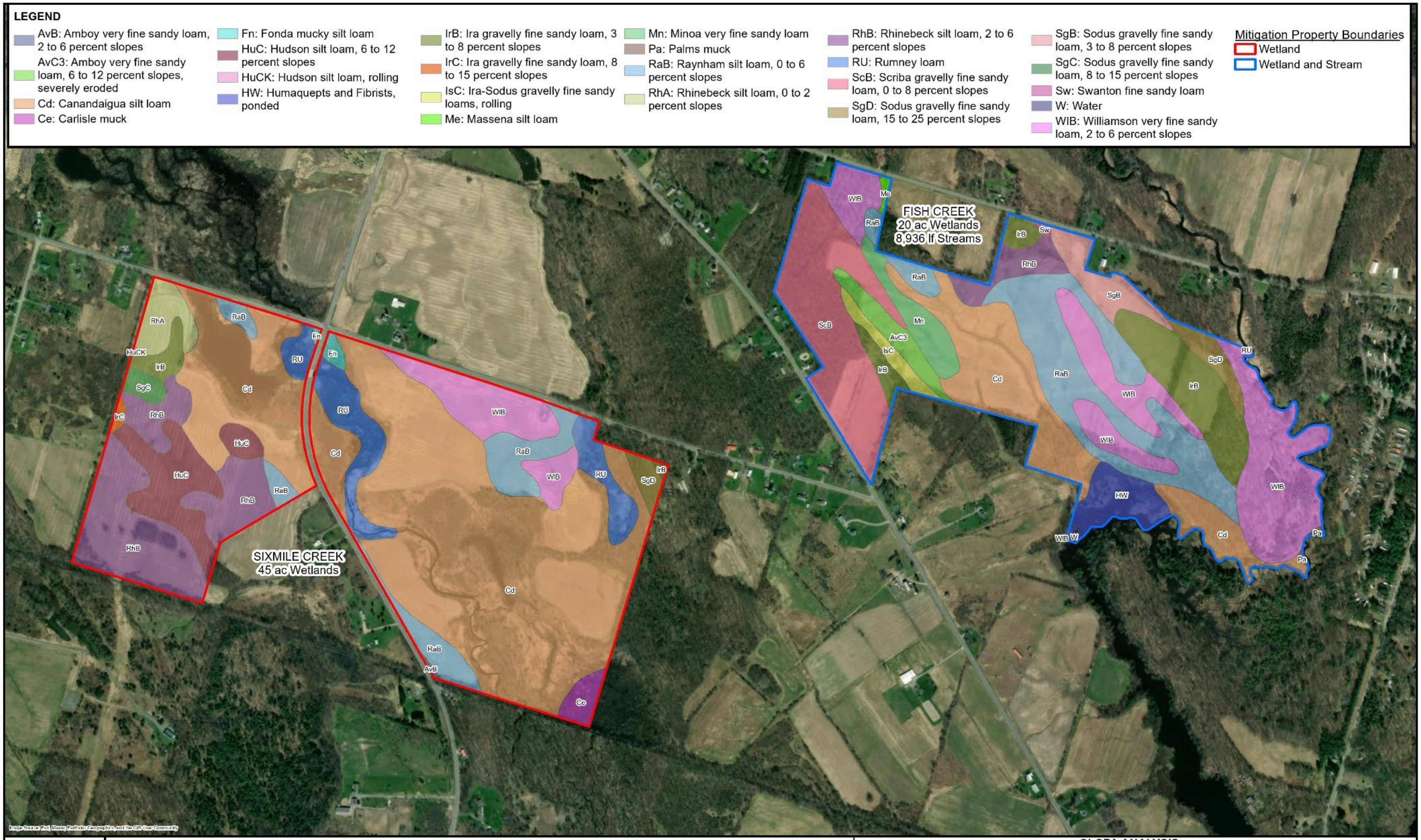


Image Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

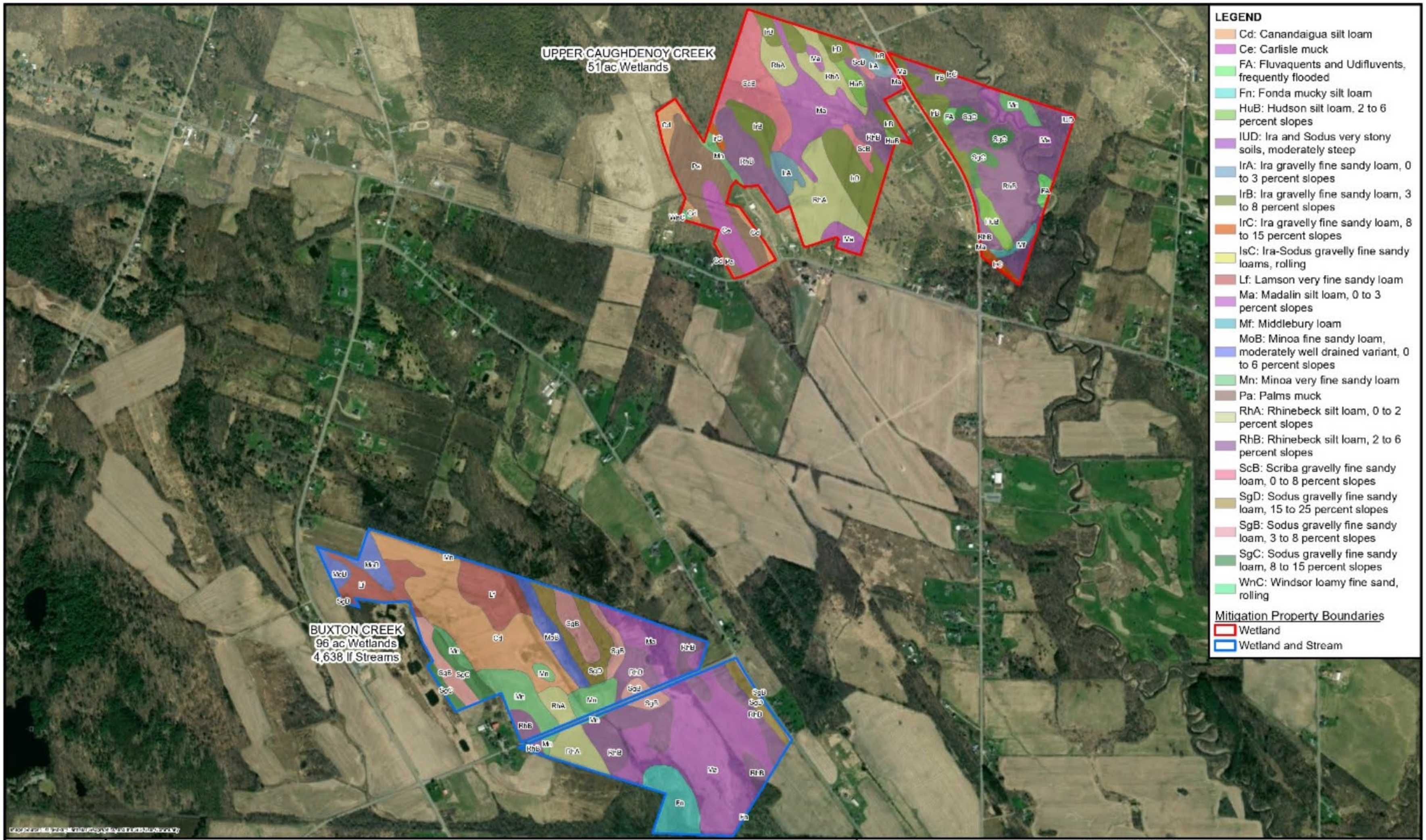
CLCPA ANALYSIS
FIGURE 8A - WETLAND MITIGATION SITES SOIL MAP
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	02/11/2025	31000524.001	8A



CLCPA ANALYSIS
FIGURE 8B - WETLAND MITIGATION SITES SOIL MAP
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	02/11/2025	31000524.001	8B



CLCPA ANALYSIS
FIGURE 8C - WETLAND MITIGATION SITES SOIL MAP
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	02/11/2025	31000524.001	8C

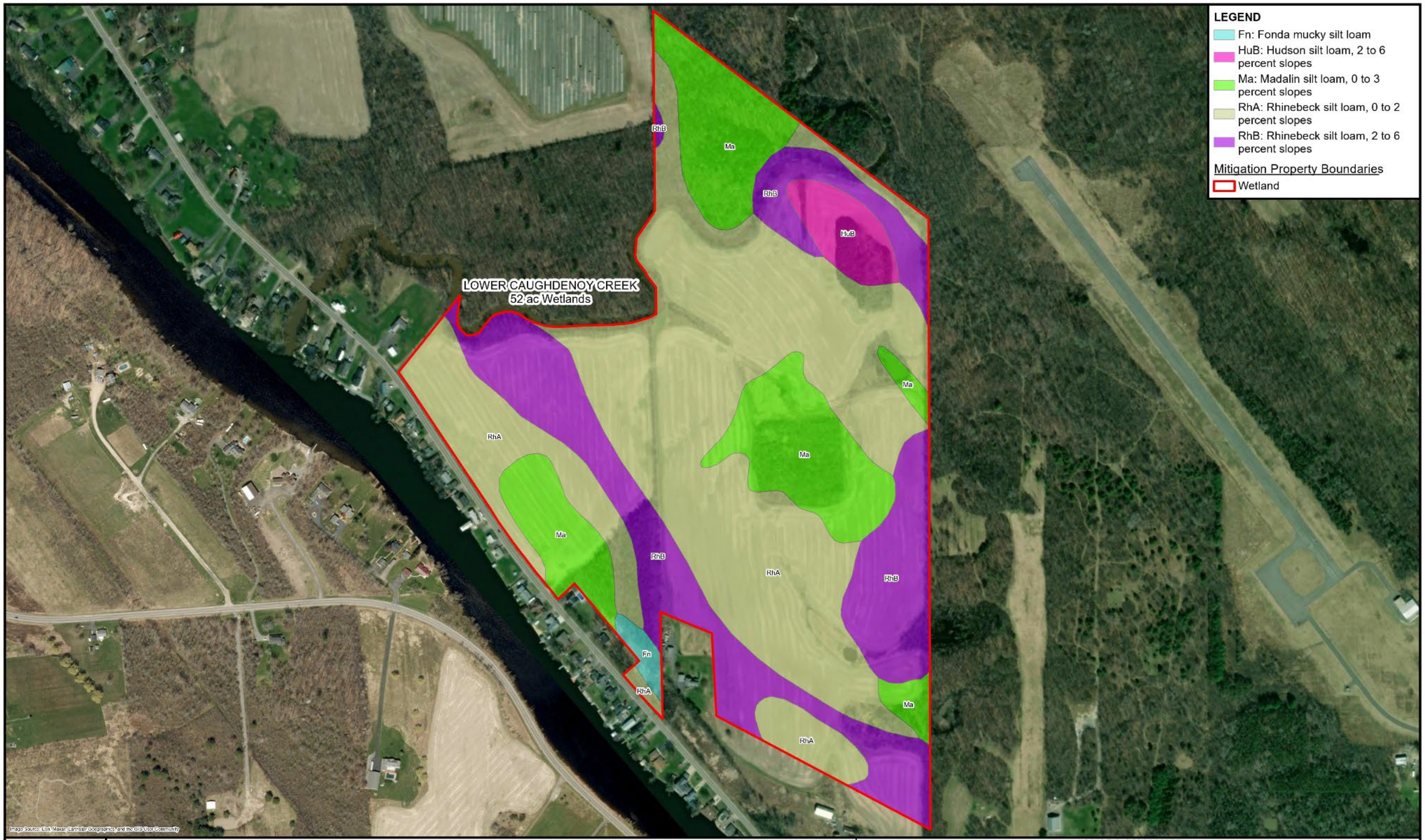
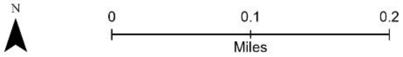


Image Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

wsp



CLCPA ANALYSIS
FIGURE 8D - WETLAND MITIGATION SITES SOIL MAP
TOWN OF CLAY, ONONDAGA COUNTY, NEW YORK

CHECKED BY:	DATE:	PROJECT NO:	FIGURE NO:
CH	02/11/2025	31000524.001	8D

Appendix A

Revised Draft Proposed CLCPA Wetland Impact Procedures Dated September 4, 2024

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wsp.com

Revised Draft Memorandum

Date:	September 4, 2024
From:	Charles R. Harman, Senior PWS Vice-President, Biologist Technical Director
To:	Kevin M. Balduzzi Regional Permit Administrator, Division of Environmental Permits New York State Department of Environmental Conservation, Region 7
cc:	Jesse McMahon; Micron Brittany Sanders, Micron David Strohm, Trinity Consultants Brian S. Noel, P.E.; Trinity Consultants Bruce Wattle; WSP
Subject:	**Micron New York Semiconductor Manufacturing LLC** **DEC ID: 7-3124-00575/00003** **Proposed CLCPA Wetland Impact Assessment Procedures**

Introduction

Micron New York Semiconductor Manufacturing LLC (Micron) is proposing to construct a chip manufacturing facility to be located on a 1400-acre piece of property currently owned by the Onondaga County Industrial Development Agency (OCIDA) outside of the town of Clay, New York (the Site). As a result of the extent of development on what is known as the White Pine Campus, approximately 204 acres of wetlands will be impacted by the construction and operation of the new facility. A Joint Permit Application (JPA) requesting approval to impact the wetlands has been submitted to both the U.S. Army Corps of Engineers (NYSDEC) under Section 404 of the Clean Water Act and to the New York State Department of Environmental Conservation (NYSDEC) under Article 24 of the Environmental Conservation Law.

At a meeting with NYSDEC held on June 5, 2024, Micron was informed that as part of the JPA for the Article 24 permit and consistent with the planned National Environmental Protection Act (NEPA) Environmental Impact Statement (EIS) currently under development, Micron would need to be consistent with the requirements of the Climate Leadership and Community Protection Act (CLCPA) law of 2019 with respect to climate change and greenhouse gas emissions.

CLCPA Section 7(2) requires the NYSDEC to consider whether agency administrative decisions, including but not limited to, issuing permits, licenses and the execution of grants, loans, and contracts, are inconsistent with or will interfere with the attainment of the emission limits set by the Department.

Addressing potential GHG implications with respect to proposed wetland impacts, while a requirement of the CLCPA rules, is a relatively novel activity. As such, at the June 5 meeting, the NYSDEC requested that Micron propose procedures by which the proposed loss of wetlands on the Micron Campus could be equated to changes in GHG emissions for the Site. This Draft Memorandum outlines the procedures by which Micron will assess the association of the wetland loss with GHG concentrations and the potential for any association with climate change. Following agreement of the Proposed Procedures below, the resulting report from this effort will be included with other CLCPA documentation developed for stationary and non-stationary air emission sources as an Appendix to the DEIS.

Proposed Procedures

As a means of performing the CLCPA evaluation for GHG emissions related to wetland loss, Micron proposes to focus on the roles that wetlands and wetland plants may play in the carbon (C) cycle in which plants remove carbon dioxide (CO_2) from the atmosphere and cycle carbon to the soil where it is sequestered. Additionally, the evaluation will consider the generation of methane (CH_4), another GHG, often seen by wetlands.

There is an intrinsic connection between forests and soils with respect to carbon and carbon cycling (Berryman et al., . Forested wetlands accumulate carbon through their basic photosynthetic processes in which carbon dioxide is removed from the atmosphere and converted to plant tissue, and oxygen is returned to the atmosphere (Binkley et al., 2004). Plants then cycle carbon both to the atmosphere and to soil through processes of decomposition.

Organic matter is a key component of soil, which affects its physical, chemical, and biological properties, contributing greatly to its proper functioning on which human societies depend (Woodbury et al., 2006). Benefits of soil organic matter (SOM) include improvement of soil quality through increased retention of water and nutrients, resulting in greater productivity of plants in natural environments and agricultural settings. Globally, the soil C pool is about four times larger than the atmospheric pool, and consequently, any change in the flux of CO_2 from soil to atmosphere has paramount importance in the balance of atmospheric CO_2 (Luo and Zhou, 2006). Carbon dioxide is one of the major greenhouse gases, amounting to approximately 72% of the total anthropogenic greenhouse gases. Further, CO_2 is considered as a primary agent of global warming (Ahmed, 2018).

Among different terrestrial ecosystems, forest soil contains more than two thirds of the global soil organic C reserve, although forest occupies only 30% land of the earth surface, creating the highest carbon-rich domain among different land use- based ecosystems. Histosols, a type of wetland soil with a high moisture content, has some of the highest soil carbon sequestration potential (Lol, 2004).

Studies in the open literature have been conducted to show the rates and tonnage of carbon that is typically removed from the atmosphere and sequestered in wetland soils through the carbon cycle. As the focus of this CLCPA analysis is on wetlands, Micron proposes to use that data to estimate what the loss of wetlands onsite would mean in terms of increased flux of carbon back into the atmosphere (Ji et al., 2020). That estimated quantity would amount to a one-time increase in GHG contribution from the site. Based on published information, Micron would use a value of 30 tons of CO_2 per year per acre of forested wetlands sequestered in soil that would be lost with the removal of forested wetlands from the site as part of a permitting activity (Kilgore, 2024, Clairborne, 2012). As some of the wetlands onsite are emergent wetlands, Micron would propose to use a sequestration rate of 0.5 tons of CO_2 per acre per year for the loss of emergent wetlands based on scientific studies that have suggested a much less rate of carbon turnover in grassland areas than in forests (Lawn Institute, 2021). Micron will us a value of 95.19 acres of lost emergent wetlands, 87.91 acres of lost forested wetlands, and 18.98 acres of lost shrub/scrub wetlands in

While soil does serve as a sink for carbon in the carbon cycle process, a significant portion of carbon stored in soil is released back into the atmosphere because of soil respiration. Wetlands are well documented as being hot spots for GHG production through the generation and release of large amounts of methane (CH_4). Estimates from the scientific literature has suggested the loss of as much as 4 tons of CH_4 per acre per year (Gomez, 2016; Blais et al, 2010). Micron will include a discussion of how the loss of wetlands will eliminate the production of that quantity of CH_4.

To balance those factors, Micron would then look at the increase in soil retention of carbon resulting from wetland mitigation efforts outside of the Site. Micron is proposing a comprehensive package of wetlands mitigation creation projects totally approximately 408 acres. Science has looked at how reforestation increases the ability of the new forest to take up an increased amount of carbon over time. Studies have shown that it takes 50 to 60 years for a planted forest to reach a point where it is storing carbon at the same rate as when the forest was taken down. Micron will use that time frame and a range of forest storage rates of 4.5 tons of CO_2 per acre per year in a newly planted state to 40.7 tons of CO_2 per acre per year at the end of the 60-year development period. Emergent wetland mitigation development will use a sequestration rate of 0.5 tons of CO_2 per acre per year.

The wetlands assessment will evaluate the status of the wetland loss, mitigations, reforestation and other factors impacting GHG for the full four (4) Fab scenario and will quantify emissions for the CLCPA measurement years of 2030 and 2050. This information will be provided in a concise report and included as part of an CLCPA analysis including stationary and mobile air emissions sources and will be presented as appendix to the DEIS.

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Appendix B

NYSDEC Response to WSP and Micron CLCPA Wetland Impact Assessment Procedures Dated October 8, 2024

Appendix C

NYSDEC Comments to WSP and Micron Draft CLCPA Wetland Impact Assessment Dated March 12, 2025

To clarify, the main outstanding issue staff sees with the CLCPA wetlands analysis is that the initial "pulse" emissions from carbon stock losses are not clearly accounted for as currently written. As was stated in the 10/8/2024 memo, DEC needs accounting for both the initial pulse and the "elimination of the…emission sources and removals as a result of the elimination of the existing wetland." It is possible that the applicant has accounted for these "pulse" emissions, but this needs to be much clearer in the appendix and any related text in the GHG chapter of the DEIS.

To remedy this problem, can you please have the applicant itemize the pulse emissions from carbon stock losses as follows:

1. Estimate one time/pulse emissions due to loss of soil/biomass carbon stocks:
    a. Provide the area of forest/forested wetland removed for the project (in hectares), and multiply this by the standing biomass carbon stock provided in the 10/8/2024 memo (304,000 kg CO2/hectare). Provide the total in kg CO2.
    b. Provide the area of wetlands with mineral soils (in hectares) that will be filled, multiply this by the soil carbon stock indicated in the 10/8/2024 memo (from cold, temperate, moist entry in Table 5.2 of 2013 IPCC wetlands supplement) (469,333 kg CO2/hectare). Provide the total in kg CO2.
    c. Provide the area of wetlands with organic soils (in hectares) that will be filled, multiply this by the soil carbon stock indicated in the 10/8/2024 memo (from Eastern Mountains & Upper Midwest region in Nahlik and Fennessy, 2016) (550,000 kg CO2/hectare). Provide the total in kg CO2.

2. Itemize the following changes in annual emissions/emissions removals that will happen as a result of wetland filling. If the applicant can provide DEC with both the areas and the emission/emission removal factors that they

use, DEC will be able to confirm their calculations. It was not possible to do this in the format that was provided.

The applicant can estimate changes in annual emissions/emission removals due to wetland filling by:

a. Providing the area of wetlands (in hectares) that will be filled, multiplying this by the methane emission factor from the 10/8/2024 memo (157 kg CH4 emission/hectare/year), and providing the total in kg CH4/year
b. Providing the area of wetlands to be filled (hectares), multiplying this by the CO2 emission removal factor for wetland soils from the 10/8/2024 memo (5647 kg CO2 emission removal/hectare/year), and providing the total in kg CO2/year
c. Providing the areas of emergent--, scrub shrub--, and forested-wetland to be filled, and multiplying them by their respective CO2 emission removal factors for wetland biomass, and providing the totals for each type of wetland in kg CO2/year. DEC did not provide those emission removal factors in the 10/8/2024 memo, but DEC can do so if needed. If the applicant chooses the emission removal factors for wetland biomass, then they should provide those factors in their response.

Please let us know if this needs to be discussed further before the applicant can address the above issues.

Appendix D

CLCPA Master Worksheet

Table 1. CO2 Fluxes & Citations

current Micron (March 2025 CLCPA analysis)	
	tons CO2/acre/year
annual CO2 flux into emergent wetland (PEM)	**15.38**
annual CO2 flux into scrub shrub and forested wetland (PSS, PFO)	**30**

DEC proposal			
CO2 Fluxes	tons C/ha/year	kg CO2/hectare/year	tons CO2/acre/year
Current NYS inventory (soil carbon flux, existing wetlands)	1.54	5647	**2.285259826**
USFS NYS 2019 average (tree and litter biomass flux without soil)			**1.276048869**

Carbon Stocks	kg CO2/hectare	tons CO2/acre
organic wetland soil carbon stock (Nahlik and Fennessy 2016)	550000	**222.5771037**
USFS NYS 2019 (tree and litter biomass stock without soil)		**167.3825482**

Table 2. CH4 Fluxes & Citations

	DEC inventory		current Micron (March 2025 CLCPA analysis)
	kg CH4/hectare/year	tons CH4/acre/year	tons CH4/acre/year
CH4 emitted by wetlands	157	**0.064**	**0.427**

Table 3. PFO Restoration

	Acres	Acres	Acres	years	tons CO2/acre	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)
year	PFO restored	PSS restored	PEM restored	time since rest	PFO flux sched	PFO restored in 2027	PFO restored in 2028	PFO restored in 2029	PFO restored in 2030
2027	23.996	2.807	15.486	0.000	0.000	0.000			
2028	47.992	5.614	30.972	1.000	0.178	-4.273	0.000		
2029	71.988	8.421	46.458	2.000	0.356	-8.546	-4.273	0.000	
2030	95.984	11.228	61.944	3.000	0.534	-12.819	-8.546	-4.273	0.000
2031	119.980	14.035	77.430	4.000	0.712	-17.091	-12.819	-8.546	-4.273
2032	143.976	16.842	92.916	5.000	0.890	-21.364	-17.091	-12.819	-8.546
2033	167.972	19.649	108.402	6.000	1.068	-25.637	-21.364	-17.091	-12.819
2034	191.968	22.456	123.888	7.000	1.246	-29.910	-25.637	-21.364	-17.091
2035	215.964	25.263	139.374	8.000	1.425	-34.183	-29.910	-25.637	-21.364
2036	**239.960**	**28.070**	**154.860**	9.000	1.603	-38.456	-34.183	-29.910	-25.637
2037	239.960	28.070	154.860	10.000	1.781	-42.729	-38.456	-34.183	-29.910
2038	239.960	28.070	154.860	11.000	1.959	-47.001	-42.729	-38.456	-34.183
2039	239.960	28.070	154.860	12.000	2.137	-51.274	-47.001	-42.729	-38.456
2040	239.960	28.070	154.860	13.000	2.315	-55.547	-51.274	-47.001	-42.729
2041	239.960	28.070	154.860	14.000	2.493	-59.820	-55.547	-51.274	-47.001
2042	239.960	28.070	154.860	15.000	2.671	-64.093	-59.820	-55.547	-51.274
2043	239.960	28.070	154.860	16.000	2.849	-68.366	-64.093	-59.820	-55.547
2044	239.960	28.070	154.860	17.000	3.027	-72.639	-68.366	-64.093	-59.820
2045	239.960	28.070	154.860	18.000	3.205	-76.911	-72.639	-68.366	-64.093
2046	239.960	28.070	154.860	**19.000**	3.383	-81.184	-76.911	-72.639	-68.366
2047	239.960	28.070	154.860	20.000	3.561	-85.457	-81.184	-76.911	-72.639
2048	239.960	28.070	154.860	21.000	3.561	-85.457	-85.457	-81.184	-76.911
2049	239.960	28.070	154.860	22.000	3.561	-85.457	-85.457	-85.457	-81.184
2050	239.960	28.070	154.860	23.000	3.561	-85.457	-85.457	-85.457	-85.457

Table 3. PFO Restoration (cont.)

	Acres	Acres	Acres	years	tons CO2/acre	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)
year	PFO restored	PSS restored	PEM restored	time since rest	PFO flux sched	PFO restored in 2031	PFO restored in 2032	PFO restored in 2033	PFO restored in 2034	PFO restored in 2035	PFO restored in 2036
2027	23.996	2.807	15.486	0.000	0.000						
2028	47.992	5.614	30.972	1.000	0.178						
2029	71.988	8.421	46.458	2.000	0.356						
2030	95.984	11.228	61.944	3.000	0.534						
2031	119.980	14.035	77.430	4.000	0.712	0.000					
2032	143.976	16.842	92.916	5.000	0.890	-4.273	0.000				
2033	167.972	19.649	108.402	6.000	1.068	-8.546	-4.273	0.000			
2034	191.968	22.456	123.888	7.000	1.246	-12.819	-8.546	-4.273	0.000		
2035	215.964	25.263	139.374	8.000	1.425	-17.091	-12.819	-8.546	-4.273	0.000	
2036	**239.960**	**28.070**	**154.860**	9.000	1.603	-21.364	-17.091	-12.819	-8.546	-4.273	0.000
2037	239.960	28.070	154.860	10.000	1.781	-25.637	-21.364	-17.091	-12.819	-8.546	-4.273
2038	239.960	28.070	154.860	11.000	1.959	-29.910	-25.637	-21.364	-17.091	-12.819	-8.546
2039	239.960	28.070	154.860	12.000	2.137	-34.183	-29.910	-25.637	-21.364	-17.091	-12.819
2040	239.960	28.070	154.860	13.000	2.315	-38.456	-34.183	-29.910	-25.637	-21.364	-17.091
2041	239.960	28.070	154.860	14.000	2.493	-42.729	-38.456	-34.183	-29.910	-25.637	-21.364
2042	239.960	28.070	154.860	15.000	2.671	-47.001	-42.729	-38.456	-34.183	-29.910	-25.637
2043	239.960	28.070	154.860	16.000	2.849	-51.274	-47.001	-42.729	-38.456	-34.183	-29.910
2044	239.960	28.070	154.860	17.000	3.027	-55.547	-51.274	-47.001	-42.729	-38.456	-34.183
2045	239.960	28.070	154.860	18.000	3.205	-59.820	-55.547	-51.274	-47.001	-42.729	-38.456
2046	239.960	28.070	154.860	**19.000**	3.383	-64.093	-59.820	-55.547	-51.274	-47.001	-42.729
2047	239.960	28.070	154.860	20.000	3.561	-68.366	-64.093	-59.820	-55.547	-51.274	-47.001
2048	239.960	28.070	154.860	21.000	3.561	-72.639	-68.366	-64.093	-59.820	-55.547	-51.274
2049	239.960	28.070	154.860	22.000	3.561	-76.911	-72.639	-68.366	-64.093	-59.820	-55.547
2050	239.960	28.070	154.860	23.000	3.561	-81.184	-76.911	-72.639	-68.366	-64.093	-59.820

Table 3. PFO Restoration (cont.)

	Acres	Acres	Acres	years	tons CO2/acre	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)
year	PFO restored	PSS restored	PEM restored	time since rest	PFO flux sched	PFO restored in 2037	PFO restored in 2038	PFO restored in 2039	PFO restored in 2040	PFO restored in 2041	PFO restored in 2042	PFO restored in 2043
2027	23.996	2.807	15.486	0.000	0.000							
2028	47.992	5.614	30.972	1.000	0.178							
2029	71.988	8.421	46.458	2.000	0.356							
2030	95.984	11.228	61.944	3.000	0.534							
2031	119.980	14.035	77.430	4.000	0.712							
2032	143.976	16.842	92.916	5.000	0.890							
2033	167.972	19.649	108.402	6.000	1.068							
2034	191.968	22.456	123.888	7.000	1.246							
2035	215.964	25.263	139.374	8.000	1.425							
2036	**239.960**	**28.070**	**154.860**	9.000	1.603							
2037	239.960	28.070	154.860	10.000	1.781	0.000						
2038	239.960	28.070	154.860	11.000	1.959	0.000	0.000					
2039	239.960	28.070	154.860	12.000	2.137	0.000	0.000	0.000				
2040	239.960	28.070	154.860	13.000	2.315	0.000	0.000	0.000	0.000			
2041	239.960	28.070	154.860	14.000	2.493	0.000	0.000	0.000	0.000	0.000		
2042	239.960	28.070	154.860	15.000	2.671	0.000	0.000	0.000	0.000	0.000	0.000	
2043	239.960	28.070	154.860	16.000	2.849	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2044	239.960	28.070	154.860	17.000	3.027	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2045	239.960	28.070	154.860	18.000	3.205	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2046	239.960	28.070	154.860	**19.000**	3.383	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2047	239.960	28.070	154.860	20.000	3.561	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2048	239.960	28.070	154.860	21.000	3.561	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2049	239.960	28.070	154.860	22.000	3.561	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2050	239.960	28.070	154.860	23.000	3.561	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 3. PFO Restoration (cont.)

	Acres	Acres	Acres	years	tons CO2/acre	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)
year	PFO restored	PSS restored	PEM restored	time since rest	PFO flux sched	PFO restored in 2044	PFO restored in 2045	PFO restored in 2046	PFO restored in 2047	PFO restored in 2048	PFO restored in 2049	PFO restored in 2050
2027	23.996	2.807	15.486	0.000	0.000							
2028	47.992	5.614	30.972	1.000	0.178							
2029	71.988	8.421	46.458	2.000	0.356							
2030	95.984	11.228	61.944	3.000	0.534							
2031	119.980	14.035	77.430	4.000	0.712							
2032	143.976	16.842	92.916	5.000	0.890							
2033	167.972	19.649	108.402	6.000	1.068							
2034	191.968	22.456	123.888	7.000	1.246							
2035	215.964	25.263	139.374	8.000	1.425							
2036	**239.960**	**28.070**	**154.860**	9.000	1.603							
2037	239.960	28.070	154.860	10.000	1.781							
2038	239.960	28.070	154.860	11.000	1.959							
2039	239.960	28.070	154.860	12.000	2.137							
2040	239.960	28.070	154.860	13.000	2.315							
2041	239.960	28.070	154.860	14.000	2.493							
2042	239.960	28.070	154.860	15.000	2.671							
2043	239.960	28.070	154.860	16.000	2.849							
2044	239.960	28.070	154.860	17.000	3.027	0.000						
2045	239.960	28.070	154.860	18.000	3.205	0.000	0.000					
2046	239.960	28.070	154.860	**19.000**	3.383	0.000	0.000	0.000				
2047	239.960	28.070	154.860	20.000	3.561	0.000	0.000	0.000	0.000			
2048	239.960	28.070	154.860	21.000	3.561	0.000	0.000	0.000	0.000	0.000		
2049	239.960	28.070	154.860	22.000	3.561	0.000	0.000	0.000	0.000	0.000	0.000	
2050	239.960	28.070	154.860	23.000	3.561	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2051												**-7840.695**

Table 4. PSS Restoration

years	tons CO2/acre	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)
time since restoration	PSS flux schedule	PSS restored in 2027	PSS restored in 2028	PSS restored in 2029	PSS restored in 2030	PSS restored in 2031	PSS restored in 2032	PSS restored in 2033	PSS restored in 2034	PSS restored in 2035	PSS restored in 2036	PSS restored in 2037	PSS restored in 2038
0.000	0.000	0.000											
1.000	0.229	-0.641	0.000										
2.000	0.457	-1.283	-0.641	0.000									
3.000	0.686	-1.924	-1.283	-0.641	0.000								
4.000	0.914	-2.566	-1.924	-1.283	-0.641	0.000							
5.000	1.143	-3.207	-2.566	-1.924	-1.283	-0.641	0.000						
6.000	1.371	-3.849	-3.207	-2.566	-1.924	-1.283	-0.641	0.000					
7.000	1.600	-4.490	-3.849	-3.207	-2.566	-1.924	-1.283	-0.641	0.000				
8.000	1.828	-5.132	-4.490	-3.849	-3.207	-2.566	-1.924	-1.283	-0.641	0.000			
9.000	2.057	-5.773	-5.132	-4.490	-3.849	-3.207	-2.566	-1.924	-1.283	-0.641	0.000		
10.000	**2.285**	-6.415	-5.773	-5.132	-4.490	-3.849	-3.207	-2.566	-1.924	-1.283	-0.641	0.000	
11.000	2.285	-6.415	-6.415	-5.773	-5.132	-4.490	-3.849	-3.207	-2.566	-1.924	-1.283	0.000	0.000
12.000	2.285	-6.415	-6.415	-6.415	-5.773	-5.132	-4.490	-3.849	-3.207	-2.566	-1.924	0.000	0.000
13.000	2.285	-6.415	-6.415	-6.415	-6.415	-5.773	-5.132	-4.490	-3.849	-3.207	-2.566	0.000	0.000
14.000	2.285	-6.415	-6.415	-6.415	-6.415	-6.415	-5.773	-5.132	-4.490	-3.849	-3.207	0.000	0.000
15.000	2.285	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-5.773	-5.132	-4.490	-3.849	0.000	0.000
16.000	2.285	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-5.773	-5.132	-4.490	0.000	0.000
17.000	2.285	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-5.773	-5.132	0.000	0.000
18.000	2.285	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-5.773	0.000	0.000
19.000	2.285	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	0.000	0.000
20.000	2.285	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	0.000	0.000
21.000	2.285	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	0.000	0.000
22.000	2.285	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	0.000	0.000
23.000	2.285	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	-6.415	0.000	0.000

Table 4. PSS Restoration (Cont.)

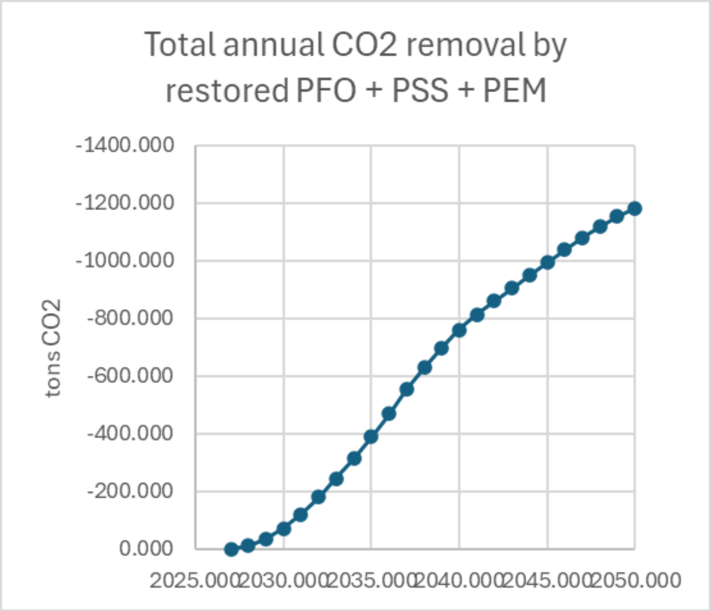
years	tons CO2/acre	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)
time since restoration	PSS flux schedule	PSS restored in 2039	PSS restored in 2040	PSS restored in 2041	PSS restored in 2042	PSS restored in 2043	PSS restored in 2044	PSS restored in 2045	PSS restored in 2046	PSS restored in 2047	PSS restored in 2048	PSS restored in 2049	PSS restored in 2050
0.000	0.000												
1.000	0.229												
2.000	0.457												
3.000	0.686												
4.000	0.914												
5.000	1.143												
6.000	1.371												
7.000	1.600												
8.000	1.828												
9.000	2.057												
10.000	**2.285**												
11.000	2.285												
12.000	2.285	0.000											
13.000	2.285	0.000	0.000										
14.000	2.285	0.000	0.000	0.000									
15.000	2.285	0.000	0.000	0.000	0.000								
16.000	2.285	0.000	0.000	0.000	0.000	0.000							
17.000	2.285	0.000	0.000	0.000	0.000	0.000	0.000						
18.000	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
19.000	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
20.000	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
21.000	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
22.000	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
23.000	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
													-898.061

Table 5. PEM Restoration

years	tons CO2/acre	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)
time since restoration	PEM flux schedule	PEM restored in 2027	PEM restored in 2028	PEM restored in 2029	PEM restored in 2030	PEM restored in 2031	PEM restored in 2032	PEM restored in 2033	PEM restored in 2034	PEM restored in 2035	PEM restored in 2036	PEM restored in 2037
0	0.000	0.000										
1	0.457	-7.078	0.000									
2	0.914	-14.156	-7.078	0.000								
3	1.371	-21.234	-14.156	-7.078	0.000							
4	1.828	-28.312	-21.234	-14.156	-7.078	0.000						
5	**2.285**	-35.390	-28.312	-21.234	-14.156	-7.078	0.000					
6	2.285	-35.390	-35.390	-28.312	-21.234	-14.156	-7.078	0.000				
7	2.285	-35.390	-35.390	-35.390	-28.312	-21.234	-14.156	-7.078	0.000			
8	2.285	-35.390	-35.390	-35.390	-35.390	-28.312	-21.234	-14.156	-7.078	0.000		
9	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-28.312	-21.234	-14.156	-7.078	0.000	
10	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-28.312	-21.234	-14.156	-7.078	0.000
11	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-28.312	-21.234	-14.156	0.000
12	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-28.312	-21.234	0.000
13	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-28.312	0.000
14	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	0.000
15	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	0.000
16	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	0.000
17	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	0.000
18	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	0.000
19	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	0.000
20	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	0.000
21	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	0.000
22	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	0.000
23	2.285	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	-35.390	0.000

Table 5. PEM Restoration (Cont.)

years	tons CO2/acre	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)
time since restoration	PEM flux schedule	PEM restored in 2038	PEM restored in 2039	PEM restored in 2040	PEM restored in 2041	PEM restored in 2042	PEM restored in 2043	PEM restored in 2044	PEM restored in 2045	PEM restored in 2046	PEM restored in 2047	PEM restored in 2048	PEM restored in 2049	PEM restored in 2050
0	0.000													
1	0.457													
2	0.914													
3	1.371													
4	1.828													
5	**2.285**													
6	2.285													
7	2.285													
8	2.285													
9	2.285													
10	2.285													
11	2.285	0.000												
12	2.285	0.000	0.000											
13	2.285	0.000	0.000	0.000										
14	2.285	0.000	0.000	0.000	0.000									
15	2.285	0.000	0.000	0.000	0.000	0.000								
16	2.285	0.000	0.000	0.000	0.000	0.000	0.000							
17	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000						
18	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
19	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
20	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
21	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
22	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
23	2.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
														-5839.273


Total annual CO2 removal by restored PFO + PSS + PEM

	PFO	PSS	PEM
years to reach max growth rate	20.000	10.000	5.000

Table 6. CO2 Wetland Removal

	Acres	Acres	Acres	CO2 (tons)	CO2 (tons)	CO2 (tons)	CO2 (tons)
year	cumulative area of PFO removed	cumulative area PSS removed	cumulative area PEM removed	wetland soil carbon stock loss/pulse emission via removal	tree and litter biomass stock loss/pulse emission via removal	foregone sequestration in wetland soil	foregone sequestration in tree biomass
2027	**55.8**	**8.96**	**39.4**	23183.63112	9339.946191	238	71
2028	55.8	8.96	39.4	0	0	238	71
2029	55.8	8.96	39.4	0	0	238	71
2030	**67.26**	**17.83**	**83.13**	14258.28926	1918.204003	384	86
2031	67.26	17.83	83.13	0	0	384	86
2032	67.26	17.83	83.13	0	0	384	86
2033	67.26	17.83	83.13	0	0	384	86
2034	67.26	17.83	83.13	0	0	384	86
2035	67.26	17.83	83.13	0	0	384	86
2036	67.26	17.83	83.13	0	0	384	86
2037	67.26	17.83	83.13	0	0	384	86
2038	67.26	17.83	83.13	0	0	384	86
2039	67.26	17.83	83.13	0	0	384	86
2040	67.26	17.83	83.13	0	0	384	86
2041	67.26	17.83	83.13	0	0	384	86
2042	67.26	17.83	83.13	0	0	384	86
2043	67.26	17.83	83.13	0	0	384	86
2044	67.26	17.83	83.13	0	0	384	86
2045	67.26	17.83	83.13	0	0	384	86
2046	67.26	17.83	83.13	0	0	384	86
2047	67.26	17.83	83.13	0	0	384	86
2048	67.26	17.83	83.13	0	0	384	86
2049	67.26	17.83	83.13	0	0	384	86
2050	67.26	17.83	83.13	0	0	384	86
				total stock loss:	**48700**	total foregone sequestra	**10803**

Table 7. CH4 Generation

	Acres	Acres	tons CH4	tons CH4	tons CH4
year	area removed	area added	avoided CH4 emission	CH4 emission	total project CH4 emissions
2027	104.16	42.289	-6.617872882	2.686858932	-3.931013951
2028	104.16	84.578	-6.617872882	5.373717863	-1.244155019
2029	104.16	126.867	-6.617872882	8.060576795	1.442703913
2030	168.22	169.156	-10.68796636	10.74743573	0.059469365
2031	168.22	211.445	-10.68796636	13.43429466	2.746328296
2032	168.22	253.734	-10.68796636	16.12115359	5.433187228
2033	168.22	296.023	-10.68796636	18.80801252	8.12004616
2034	168.22	338.312	-10.68796636	21.49487145	10.80690509
2035	168.22	380.601	-10.68796636	24.18173038	13.49376402
2036	168.22	422.89	-10.68796636	26.86858932	16.18062295
2037	168.22	422.89	-10.68796636	26.86858932	16.18062295
2038	168.22	422.89	-10.68796636	26.86858932	16.18062295
2039	168.22	422.89	-10.68796636	26.86858932	16.18062295
2040	168.22	422.89	-10.68796636	26.86858932	16.18062295
2041	168.22	422.89	-10.68796636	26.86858932	16.18062295
2042	168.22	422.89	-10.68796636	26.86858932	16.18062295
2043	168.22	422.89	-10.68796636	26.86858932	16.18062295
2044	168.22	422.89	-10.68796636	26.86858932	16.18062295
2045	168.22	422.89	-10.68796636	26.86858932	16.18062295
2046	168.22	422.89	-10.68796636	26.86858932	16.18062295
2047	168.22	422.89	-10.68796636	26.86858932	16.18062295
2048	168.22	422.89	-10.68796636	26.86858932	16.18062295
2049	168.22	422.89	-10.68796636	26.86858932	16.18062295
2050	168.22	422.89	-10.68796636	26.86858932	16.18062295
			-244.3009122	523.9374917	**279.6365794**

Table 8. 2050 Totals

	tons	tons CO2e	tons CO2e
		GWP20-AR5	GWP100-AR5
<u>Gross Emissions Summary</u>			
CO2 emitted by carbon stock loss of wetland soil and biomass	48700	48700	48700
CH4 emitted by restored wetland (up to year 2050)	524	44011	14670
Total (gross emissions)		**92711**	**63370**
<u>Net Emissions Summary</u>			
Net CO2 (biomass and soil stock loss + foregone sequestration by removed wetland + sequestration by restored wetland (up to	44925	44925	44925
Net CH4 (avoided emission from removed wetland + emission from restored wetland (up to year 2050))	280	23489	7830
Total (net emissions)		**68415**	**52755**

APPENDIX D CLCPA MITIGATION AND ALTERNATIVE EMISSION QUANTIFICATION METHODOLOGIES

Micron - Clay, NY 4 Fabs
GHG Emissions Alternatives and Mitigation Summary

Table M0-1. Pre Alternatives and Mitigation GHG Emissions

Emissions Source	Direct CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total PTE CO_2e (20-yr) (tpy)
F-GHGs and N_2O Used in Thin Films	636,933	-	636,933
F-GHGs Used in Plasma Etch	187,146	-	187,146
Direct use of CO_2 and CH_4	4,060	-	4,060
Thermal Oxidation byproducts	59,463	-	59,463
Fuel Combustion in PEECs, POUs, and RCS	390,649	297,322	687,971
Fuel Combustion in RCTOs	315,320	239,989	555,308
Fuel Combustion in WBVs	708,538	541,112	1,249,650
Fuel Combustion in Boilers	4,370,684	3,337,897	7,708,581
Fuel Combustion in Emergency Generators	82,512	26,117	108,628
Heat Transfer Fluids	254,094	-	254,094
Fuel Combustion in Fire Pump Engine	52	17	69
Biological Wastewater Treatment (Micron Campus and Oak Orchard IWWTP)	182,294	-	182,294
Circuit Breakers	7,017	-	7,017
Oak Orchard IWWTP Combustion	18,299	2,995	21,295
Total	**7,217,062**	**4,445,448**	**11,662,509**

Table M0-2. Avoided GHG Emissions due to Alternatives and Mitigation

Emissions Source	Direct CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total PTE CO_2e (20-yr) (tpy)	Mitigation	Alternative
F-GHGs and N_2O Used in Thin Films	129,617	-	129,617	-	X
F-GHGs Used in Plasma Etch	-	-	0	-	-
Direct use of CO_2 and CH_4	-	-	0	-	-
Thermal Oxidation byproducts	-	-	0	-	-
Fuel Combustion in PEECs, POUs, and RCS	21,919	16,683	38,602	-	X
Fuel Combustion in RCTOs	-	-	0.00	-	-
Fuel Combustion in WBVs	627,655	479,341	1,106,996	X	-
Fuel Combustion in Boilers	4,231,772	3,231,809	7,463,582	X	-
Fuel Combustion in Emergency Generators	66,009	20,894	86,903	-	X
Heat Transfer Fluids	31,551	-	31,551	-	X
Fuel Combustion in Fire Pump Engine	-	-	0	-	-
Biological Wastewater Treatment (Micron Campus and Oak Orchard IWWTP)	175,494	-	175,494	-	X
Circuit Breakers	-	-	0	-	-
Oak Orchard IWWTP Combustion	-	-	-	-	-
Transportation of Aggregate Material	7,006	2,221	9,226	X	-
Construction Worker Transportation	8,928	4,385	13,312	X	-
Solar Panel	504	-	504	X	-
EV Chargers	2,032	898	2,930	X	-
Total	**5,302,488**	**3,756,229**	**9,058,717**	**-**	**-**

Table M0-3. Post Alternatives and Mitigation GHG Emissions

Emissions Source	Direct CO_2e (20-yr) (tpy)	Upstream CO_2e (20-yr) (tpy)	Total PTE CO_2e (20-yr) (tpy)	Mitigation	Alternative
F-GHGs and N_2O Used in Thin Films	507,315	-	507,315	-	X
F-GHGs Used in Plasma Etch	187,146	-	187,146	-	-
Direct use of CO_2 and CH_4	4,060	-	4,060	-	-
Thermal Oxidation byproducts	59,463	-	59,463	-	-
Fuel Combustion in PEECs, POUs, and RCS	368,730	280,639	649,370	-	X
Fuel Combustion in RCTOs	315,320	239,989	555,308	-	-
Fuel Combustion in WBVs	80,883	61,771	142,654	X	-
Fuel Combustion in Boilers	138,912	106,087	244,999	X	-
Fuel Combustion in Emergency Generators	16,502	5,223	21,726	-	X
Heat Transfer Fluids	222,544	-	222,544	-	X
Fuel Combustion in Fire Pump Engine	52	17	69	-	-
Biological Wastewater Treatment (Micron Campus and Oak Orchard IWWTP)	6,799	-	6,799	-	X
Circuit Breakers	7,017	-	7,017	-	-
Oak Orchard IWWTP Combustion	18,299	2,995	21,295	-	-
Rail Spur Rail Car	-7,006	-2,221	-9,226	X	-
Shuttle Buses	-8,928	-4,385	-13,312	X	-
Solar Panel	-504	-	-504	X	-
EV Chargers	-2,032	-898	-2,930	X	-
Total	**1,914,574**	**689,218**	**2,603,792**	**-**	**-**

1. Biological wastewater treatment emissions differ from those presented in the March 25, 2025 CLCPA analysis since Micron proposes to only operate the wastewater treatment plant aerobically.

Micron - Clay, NY 4 Fabs
Truck Traffic Avoided Emissions

Table M1-1. Rail Spur Conveyance System GHG Emissions

Engine Rating (hp)	Engine Fuel	Heat Input Rating (MMBtu/hr)	Annual Operating Hours (hr/yr)
416	Diesel	1.06	4,000

Table M1-2. Rail Spur Conveyance GHG Emissions

Pollutant	GHG Emission Factors[1] (kg/MMBtu)	Conveyance System GHG Emissions (tpy)
CO_2	73.96	345.3
CH_4	0.0030	0.014
N_2O	0.00060	0.003
Direct CO_2e - 20-yr[3]	--	347.2
Upstream CO_2e - 20-yr[4]	23.54	109.9

1. CO_2, N_2O and CH_4 emission factors based on 40 CFR Part 98 Table C-1 and C-2 Default diesel emissions factors.
3. 20-yr Global warming potentials per 6 NYCRR Part 496.
4. Upstream CO_2e emission factor per Appendix of 2024 NYS Statewide GHG Emissions Report.

Table M1-2. Rail Transportation GHG Emissions

Fuel Type	Rail Transportation Information			Distance Traveled w/ Full Cars (miles/trip)[2]	Annual Miles Travelled w/ Full Cars (miles/yr)	Fuel Consumed[3] (gal/yr)	Total Heat Content Consumed (MMBtu/yr)
	Rail Cars per Train[1]	Train Deliveries (trips/day)[1]	Average Material Transferred[1] (tons/day)				
Diesel	60	1	8,010	102.5	37,413	709,456	97,408

1. Based on Micron's current projected aggregate material demand.
2. Based on an average of 55 to 150 miles from potential aggregate material sources and the Micron Campus.
3. Based on CSX's 2024 fleetwide average fuel efficiency: 528 ton-miles/gal

A factor of 1.25 is added to account for the return trip of empty railcars to the quarry. The empty cars are conservatively assumed to weight 25% of the weight of full cars.

'https://www.csx.com/index.cfm/about-us/the-csx-advantage/fuel-efficiency/

Table M1-2. Rail Transportation GHG Emissions

Pollutant	GHG Emission Factors[1,2]	Emission Factor Units	Rail Car GHG Emissions (tpy)
CO_2	10.21	kg/gallon	7,985
CH_4	0.80	g/gallon	0.63
N_2O	0.26	g/gallon	0.20
Direct CO_2e - 20-yr[3]	--	--	8,091
Upstream CO_2e - 20-yr[4]	23,540	g/mmbtu	2,528

1. Emission Factor for CO_2 is based on Table 2 of EPA's 2025 GHG Emission Factors Hub.
2. Emission Factor for CH_4 and N_2O is based on Table 5 of EPA's 2025 GHG Emission Factors Hub for locomotives.
3. 20-yr Global warming potentials per 6 NYCRR Part 496.
4. Upstream CO_2e emission factor per Appendix of 2024 NYS Statewide GHG Emissions Report.

Table M1-4. Truck Traffic GHG Emissions

Vehicle Information	Vehicle Model Year	Vehicle Fuel Type	Truck Information			Annual Total Miles Travelled (vehicle miles/yr)	Annual Total Fuel Usage (gal/yr)	Annual Heat Content (MMBtu/yr)
			Average Fuel Economy[1] (mpg)	Truck Traffic (Trucks/Day)	Truck Distance Traveled (vehicle miles/truck-trip)			
Heavy-Duty Vehicles	2007-2022	Diesel	5.3	550	36	7,227,000	1,363,585	187,220

[1] Default fuel economy for diesel heavy-duty vehicles from Department of Energy's Technology Integration Program's Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) tool.

Table M1-5. Truck Traffic GHG Emissions

Pollutant	Emission Factors[1,2]	Emission Factor Units	Avoided Truck Traffic GHG Emissions (tpy)
CO_2	10.21	kg/gallon	15,347
CH_4	0.0095	g/vehicle mile	0.08
N_2O	0.0431	g/vehicle mile	0.34
Direct CO_2e - 20-yr[3]	--	--	15,444
Upstream CO_2e - 20-yr[4]	23,540	g/mmbtu	4,858

1. Emission Factor for CO_2 is based on Table 2 of EPA's 2025 GHG Emission Factors Hub.
2. Emission Factor for CH_4 and N_2O is based on Table 4 of EPA's 2025 GHG Emission Factors Hub for heavy duty vehicle models 2007-2022.
3. 20-yr Global warming potentials per 6 NYCRR Part 496.
4. Upstream CO_2e emission factor per Appendix of 2024 NYS Statewide GHG Emissions Report.

Table M1-6. Avoided GHG Emissions

Pollutant	Total Rail Transportation GHG Emissions (tpy)	Truck Traffic GHG Emissions (tpy)	Avoided Emissions (tpy)
CO_2	8,330	15,347	7,017
CH_4	0.64	0.08	0.56
N_2O	0.21	0.34	0.14
Direct CO_2e - 20-yr	8,438	15,444	7,006
Upstream CO_2e - 20-yr	2,637	4,858	2,221

Conversions

1 gal diesel = 0.1373 MMBTU - High heat content of diesel per Table A4 of Appendix to the 2024 NYS Statewide GHG Emissions Report

Micron - Clay, NY 4 Fabs
Shuttle Transportation Avoided Emissions

For construction personnel mandated to use the shuttle service to and from the Campus

Table M2-1. Shuttle Trips

Year	Daily Shuttle Trips[1] (trips/day)	Average Trip Travel[2] (miles/trip)	Total Vehicle Miles (vehcile miles/yr)	Vehicle Fuel Type	Average Fuel Economy[3] (mpg)	Annual Total Fuel Usage (gal/yr)	Annual Heat Content (MMBtu/yr)
2031	211	12	924,180	Diesel	4.4	210,041	28,839
2041	240	12	1,051,200	Diesel	4.4	238,909	32,802

1. Daily shuttle trips based on most recent project traffic model.
2. The average miles travelled per trip is based on the approximate distance between the site and Downtown Syracuse, which will have the most shuttle options.
3. The default fuel economy for diesel fuel transit bus is based on Department of Energy's Technology Integration Program's Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) tool.

Table M2-2. Shuttle Trip GHG Emissions

Pollutant	Emission Factors[1,2]	Emission Factor Units	2031 Annual Emissions (tpy)	2041 Annual Emissions (tpy)
CO_2	10.21	kg/gallon	2,364	2,689
CH_4	0.0095	g/vehicle mile	0.01	0.01
N_2O	0.0431	g/vehicle mile	0.04	0.05
Direct CO_2e - 20-yr[3]	--	--	2,376	2,703
Upstream CO_2e - 20-yr[4]	23,540	g/mmbtu	748	851

1. Emission Factor for CO_2 is based on Table 2 of EPA's 2025 GHG Emission Factors Hub.
2. Emission Factor for CH_4 and N_2O is based on Table 4 of EPA's 2025 GHG Emission Factors Hub for heavy duty vehicle models 2007-2022.
3. 20-yr Global warming potentials per 6 NYCRR Part 496.
4. Upstream CO_2e emission factor per Appendix of 2024 NYS Statewide GHG Emissions Report.

Table M2-3. Individual Worker Trips

Year	Daily Worker Trips[1] (trips/day)	Average Trip Travel[2] (miles/trip)	Total Vehicle Miles (vehicle miles/yr)	Vehicle Fuel Type	Average Fuel Economy[3] (mpg)	Annual Total Fuel Usage (gal/yr)	Annual Heat Content (MMBtu/yr)
2031	8,880	10	32,412,000	Gasoline	30.7	1,055,765	126,903
2041	10,080	10	36,792,000	Gasoline	30.7	1,198,436	164,545

1. Daily worker trips based on most recent project traffic model.
2. The average miles travelled per trip is estimated by Micron to be shorter than the average shuttle trip
3. The default fuel economy for gasoline is based on Department of Energy's Technology Integration Program's Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) tool.

Table M2-4. Individual Worker Trip GHG Emissions

Pollutant	Emission Factors[1,2]	Emission Factor Units	2031 Annual Emissions (tpy)	2041 Annual Emissions (tpy)
CO_2	8.78	kg/gallon	10,218	11,599
CH_4	0.005	g/vehicle mile	0.18	0.20
N_2O	0.0014	g/vehicle mile	0.05	0.06
Direct CO_2e - 20-yr[3]	--	--	10,246	11,631
Upstream CO_2e - 20-yr[2]	28,866	g/mmbtu	4,038	5,236

1. Emission Factor for CO_2 is based on Table 2 of EPA's 2025 GHG Emission Factors Hub.
2. Emission Factors for CH_4 and N_2O are based on Table 4 of EPA's 2025 GHG Emission Factors Hub for Model Year 2022 gasoline passenger cars. Assuming Model Year 2022 results in a conservatively low estimate of GHG emissions avoided.
3. 20-yr Global warming potentials per 6 NYCRR Part 496.
4. Upstream CO_2e emission factor per Appendix of 2024 NYS Statewide GHG Emissions Report.

Table M2-5. Avoided GHG Emissions

Pollutant	2031 Avoided Emissions (tpy)	2041 Annual Emissions (tpy)
CO_2	7,854	8,910
CH_4	0.17	0.19
N_2O	0.01	0.01
Direct CO_2e - 20-yr	7,870	8,928
Upstream CO_2e - 20-yr	3,290	4,385

Conversions

1 lb =	453.59 g
1 gal gasoline =	0.1202 MMBTU - High heat content of gasoline per Table A4 of Appendix to the 2024 NYS Statewide GHG Emissions Report
1 gal diesel =	0.1373 MMBTU - High heat content of diesel per Table A4 of Appendix to the 2024 NYS Statewide GHG Emissions Report
1 year =	8,760 hours

Micron - Clay, NY 4 Fabs
Solar Panel Avoided Emissions

Table M3-1. Electricity Generated by Solar Panels

Solar Panel Rating (MW)	Average Daily Sun Peak Hours[1] (hrs/day)	Annual Peak Sun Hours (hrs/yr)	Solar Panel Efficiency[2] (%)	Estimated Electricity Generated (MWh/yr)
4	3.8	1,387	25	4,161

1. The average daily sun peak hours are based on using the tool https://www.goosolarpower.com/2024/02/peak-sun-hours-calculator.html for Clay, NY .

2. The solar panel efficiency of 25% has been assumed for commercially available solar panels based on U.S. Energy Information Administration's Independent Statistics and Analysis.

Table M3-2. Avoided GHG Emissions

Pollutant	Location-Based Emissions Factor[1] (lb/MWh)	Avoided Emissions (tpy)
CO_2	241	501.4
CH_4	0.011	2.29E-02
N_2O	0.001	2.08E-03
CO_2e - 20-yr[2]	--	504

1. The location-based emission factors are based on EPA's eGRID 2023 Summary Tables for the NYUP Subregion.

2. 20-yr Global warming potentials per 6 NYCRR Part 496.

Micron - Clay, NY 4 Fabs
NF3 Chamber Cleaning Avoided Emissions

Table M4-1. NF3 Usage Remote Clean

NF_3 Usage (lbs/yr)	NF_3 Utilization (%)	NF_3 Needed for Cleaning (lb/yr)
1,733,065	98.2%	1,701,869

Table M4-2. NF3 Usage In-situ Clean

NF_3 Needed for Cleaning (lb/yr)	NF_3 utilization	NF_3 Supplied (lb/yr)
1,701,869	80.0%	2,127,337

Table M4-3. NF3 In-situ Clean GHG Emissions

Pollutant	Emission Factor[1]	Pre-Control Emissions	PEEC Fraction Managed	Post Control Emissions	
		(lb/yr)		(lb/yr)	(tpy)
Nitrogen trifluoride	0.20	425,467	0.95	21,273	10.64
Tetrafluoromethane	0.037	78,711	0.89	8,658	4.33
Direct CO_2e - 20-yr[2]	--	5,830,094,139	--	314,551,423	157,276

1. Emission factors based on the IPCC 2019 Refinement Table 6.11
2. 20-yr Global warming potentials per 6 NYCRR Part 496.

Table M4-4. NF3 Remote Clean GHG Emissions

Pollutant	Emission Factor[1]	Pre-Control Emissions	PEEC Fraction Managed	Post Control Emissions	
		(lb/yr)		(lb/yr)	(tpy)
Nitrogen trifluoride	0.018	31,195	0.95	1,560	0.78
Tetrafluoromethane	0.038	65,856	0.89	7,244	3.62
Direct CO_2e - 20-yr[2]	--	720,677,584	--	55,316,649	27,658

1. Emission factors based on the IPCC 2019 Refinement Table 6.11
2. 20-yr Global warming potentials per 6 NYCRR Part 496.
3. This comparison assumes that Micron will obtain thermal oxidation systems certified to minimize additional CF4 formation. Micron proposed a permit condition requiring that these thermal oxidation systems are prioritized during design evaluations.

Table M4-5. Avoided GHG Emissions

Pollutant	In-situ Clean GHG Emissions (tpy)	Remote Clean GHG Emissions (tpy)	Avoided GHG Emissions (tpy)
Nitrogen trifluoride	10.64	0.78	9.86
Tetrafluoromethane	4.33	3.62	0.71
Direct CO_2e - 20-yr	157,276	27,658	129,617

Micron - Clay, NY 4 Fabs
Regenerative Catalytic System (RCS) Combustion Avoided Emissions

Table M5-1. Natural Gas Usage Avoided Due to RCS

Equipment Description	Natural Gas Usage Avoided[1]	
	(m^3/day)	(MMscf/yr)
Regenerative Catalytic System	28,160	363

1. The amount of natural gas avoided is estimated based on the daily natural gas demand of additional POUs that would be required to replace the RCS.

Table M5-2. GHG Emissions Avoided Due to RCS

Pollutant	Emission Factor[1,3] (lb/MMscf)	Avoided Emissions	
		(lb/hr)	(tpy)
CO_2	120,000	4,972	21,779
CH_4	2.3	0.10	0.42
N_2O	2.2	0.09	0.40
Direct CO_2e - 20-yr	-	5,004	21,919
Upstream CO_2e - 20-yr	91,921	3,809	16,683

1. Emission Factors from AP-42 Section 1.4 Table 1.4-1 and 1.4-2 for Small Boilers.
2. 20-yr Global warming potentials per 6 NYCRR Part 496.
3. Upstream CO_2e emission factor per Appendix of 2024 NYS Statewide GHG Emissions Report: 40,877 g/MMBtu

Conversions

1 lb =	453.59 g
1 scf NG =	1,020 BTU - Average heat content of NG from AP-42 1.4.1.
1 year =	8,760 hours

Micron - Clay, NY 4 Fabs
Natural Gas Boiler Combustion Avoided Emissions

Table M6-1. Total Boilers Avoided

Alternative Heat Supply	Number of Boilers Avoided[1,2]	Boiler Rating
		(MMBtu/hr)
Electric Boilers	20	28
Heat Recirculation	268	28
	Total	8,064

1. The number of NG Boilers avoided was calculated by estimating the number of 28 MMBTU/hr NG boilers required to satisfy same heat demand met by the alternative heat supply options.
2. The avoided boilers are assumed to be continuously operational (8,760 hours per year).

Table M6-2. Avoided GHG Emissions

Pollutant	Emission Factor[3] (lb/MMscf)	Avoided Emissions	
		(lb/hr)	(tpy)
CO_2	120,000	948,706	4,155,332
CH_4	2.3	18.2	79.6
N_2O	0.64	5.06	22.2
Direct CO_2e - 20-yr[1]	-	951,569	4,167,873
Upstream CO_2e - 20-yr[2]	91,921	726,714	3,183,009

1. Emission factors from AP-42 Section 1.4 Tables 1.4-1 and 1.4-2 for Small Boilers, assuming use of low-NOx burners
2. 20-yr Global warming potentials per 6 NYCRR Part 496.
3. Upstream CO_2e emission factor per Appendix of 2024 NYS Statewide GHG Emissions Report: 40,877 g/MMBtu

Conversions

1 lb =	453.59	g
1 year =	8,760	hr
1 scf NG =	1,020	BTU - Average heat content of NG from AP-42 1.4.1.
1 year =	525,600	minutes
1 lb-mole of gas (@ 20C) =	385.3	Cubic feet
1 hr=	60	minutes

Micron - Clay, NY 4 Fabs
Heat Transfer Fluid Avoided Emissions

NOTE: Detailed calculations of HTF emissions have been omitted to protect confidential business information (CBI).

Table M7-3. Avoided GHG Emissions

Pollutant	Projected HTF Emissions (tpy)	Theoretical "Traditional" HTF Emissions (tpy)	Avoided GHG Emissions (tpy)
Direct CO_2e - 20-yr	222,544	254,094	31,551

Micron - Clay, NY 4 Fabs
Wastewater Treatment Process Avoided Emissions

NOTE: Confidential business information (CBI) has been omitted from this appendix. As a result, the tables below are not comprehensive of all CO2 and CH4 generation.

Table M8-1: Micron Campus WWTP Aerobic Digestion Emissions

Emission Chemical		MW	Carbon	Mass Degraded in Aerobic Zones	CO_2 from Aerobic Zone	Total CO_2
CAS No.	**Name**	**(lb/lbmol)**	**Count**	**(lb/day)**	**(lb/day)**	**(tpy)**
75-59-2	Tetramethylammonium hydroxide	91.2	4.00	348.3	672.6	122.8
67-63-0	Isopropanol	60.1	3.00	9,486	20,838	3,803
872-50-4	1-Methyl-2-pyrrolidone	99.1	5.00	2,081	4,620	843.2
288-88-0	1,2,4-Triazole	69.1	2.00	2.68	3.42	0.62
929-06-6	2-(2-aminoethoxy)ethanol	105.1	4.00	10.1	16.9	3.09
77-92-9	Citric acid	192.1	6.00	5.92	8.13	1.48
64-19-7	Acetic acid	60.1	2.00	4.64	6.81	1.24
107-21-1	Ethanediol	62.1	2.00	3.08	4.36	0.80
67-56-1	Methanol	32.0	1.00	0.03	0.04	0.01

1. This scenario represents the GHG emissions that will be generated from the Micron Campus wastewater treatment operations, which will be conducted aerobically. The emissions presented with Permit Application 2 represented partial anaerobic digestion.

Table M8-2. Oak Orchard IWWTP Aerobic Digestion Emissions

Emission Chemical		MW	Carbon	Mass Degraded	CO_2 Generated	
CAS No.	**Name**	**(lb/lbmol)**	**Count**	**(lb/day)**	**(lb/day)**	**(tpy)**
75-59-2	Tetramethylammonium hydroxide	91.2	4.00	0.09	0.17	0.03
67-63-0	Isopropanol	60.1	3.00	4,689	10,299.93	1,880
872-50-4	1-Methyl-2-pyrrolidone	99.1	5.00	109.6	243.18	44.4
288-88-0	1,2,4-Triazole	69.1	2.00	2.59E-03	3.30E-03	6.03E-04
929-06-6	2-(2-aminoethoxy)ethanol	105.1	4.00	4.56	7.64	1.39
77-92-9	Citric acid	192.1	6.00	1.91	2.63	0.48
64-19-7	Acetic acid	60.1	2.00	3.87E-03	5.67E-03	1.03E-03
107-21-1	Ethanediol	62.1	2.00	1.91	2.71	0.49
67-56-1	Methanol	32.0	1.00	2.54E-08	3.49E-08	6.38E-09

Table M8-3. Oak Orchard IWWTP Anaerobic Digestion Emissions

Emission Chemical		MW	Carbon	Mass Degraded	CO_2 Generated		CH_4 Generated	
CAS No.	Name	(lb/lbmol)	Count	(lb/day)	(lb/day)	(tpy)	(lb/day)	(tpy)
75-59-2	Tetramethylammonium hydroxide	91.2	4.00	0.09	0.09	0.02	0.03	0.01
67-63-0	Isopropanol	60.1	3.00	4,689	5149.96	939.9	3,745	683.4
872-50-4	1-Methyl-2-pyrrolidone	99.1	5.00	109.6	121.59	22.2	88.41	16.1
288-88-0	1,2,4-Triazole	69.1	2.00	2.59E-03	1.65E-03	3.01E-04	1.20E-03	2.19E-04
929-06-6	2-(2-aminoethoxy)ethanol	105.1	4.00	4.56	3.82	0.70	2.78	0.51
77-92-9	Citric acid	192.1	6.00	1.91	1.31	0.24	0.96	0.17
64-19-7	Acetic acid	60.1	2.00	3.87E-03	2.83E-03	5.17E-04	2.06E-03	3.76E-04
107-21-1	Ethanediol	62.1	2.00	1.91	1.35	0.25	0.98	0.18
67-56-1	Methanol	32.0	1.00	2.54E-08	1.75E-08	3.19E-09	1.27E-08	2.32E-09

1. This scenario represents the GHG emissions that would be generated if the Oak Orchard wastewater treatment operations were conducted anaerobically.

2. An equal conversion of moles of carbon to CO2 and CH4 has been assumed for anaerobic operations.

Table M8-4. Total Avoided GHG Emissions

Pollutant	Micron WWTP Aerobic Digestion GHG Emissions (tpy)	Micron WWTP Anaerobic Digestion GHG Emissions (tpy)[1]	Oak Orchard WWTP Aerobic Digestion GHG Emissions (tpy)	Oak Orchard WWTP Anaerobic Digestion GHG Emissions (tpy)	Avoided GHG Emissions (tpy)
CO_2	4,861	5,746	1,939	969	84
CH_4	--	1,397	--	705	--
Direct CO_2e - 20-yr	4,861	123,091	1,939	59,203	175,494

1. As presented in Permit Application 2 multiplied by 2 to represent 4 Fabs.

Micron - Clay, NY 4 Fabs
Water Bath Vaporizer Combustion Avoided Emissions

Table M9-1. Water Bath Vaporizer Inventory

Equipment Description	Operating Status	Equipment Count	Avoided Annual Operating Hours (hrs)^{1,2}	Burner Rating (Each)	Natural Gas Flow Rate^{3}	Maximum Stack Flow Rate
				(MMBtu/hr)	(scfh)	(scfm)
Water Bath Vaporizers	Active	8	6,760	42.8	42,000	22,500
Water Bath Vaporizers	Redundant	8	8,760	42.8	42,000	22,500
		Total	15,520	--	**672,000**	**360,000**

1. Micron proposed a permit condition limiting total hours of WBV operation to 8,000 per year for four active WBVs or 2,000 per year for each WBV. Hence, the avoided emissions for each WBV have been calculated based on the difference between continuous (8,760 hours per year) and the proposed limit (2,000 hours per year).

2. Micron proposed that no more than 4 WBV are operated at any given time. Therefore, for the redundant WBV units, the avoided emissions for each of these WBVs have been calculated based on the difference between continuous (8,760 hours per year) and the expected hours of operation (0 hours per year).

3. Natural gas flow rate to the vaporizer based on manufacturer specifications.

Table M9-2. Water Bath Vaporizer GHG Avoided Emissions

Pollutant	Emission Factor^{1} (lb/MMscf)	Avoided Emissions	
		(lb/hr)	(tpy)
CO_2	120,000	80,640	625,766
CH_4	2.3	1.55	12.0
N_2O	0.64	0.43	3.34
Direct CO_2e - 20-yr^{2}	-	80,883	627,655
Upstream CO_2e - 20-yr^{3}	91,921	61,771	479,341

1. Emission Factors from AP-42 Section 1.4 Tables 1.4-1 and 1.4-2 for Small Boilers.

2. 20-yr Global warming potentials per 6 NYCRR Part 496.

3. Upstream CO_2e emission factor per Appendix of 2024 NYS Statewide GHG Emissions Report: 40,877 g/MMBtu

Conversions

1 lb = 453.59 g
1 year = 8,760 hr
1 scf NG = 1,020 BTU - Average heat content of NG from AP-42 1.4.1.
1 year = 525,600 minutes
1 lb-mole of gas (@ 20C) = 385.3 Cubic feet
1 hr= 60 minutes

Micron - Clay, NY 4 Fabs
Natural Gas Boiler Combustion Avoided Emissions

Table M10-1. Total Boiler Burner Rating

Equipment Description	Equipment Count	Avoided Annual Operating Hours[1]	Burner Rating	Maximum Outlet Flow
		(hrs/yr)	(MMBtu/hr)	(scfm)
Natural Gas Boilers	12	2,760	32.7	22,500
		Total	392.4	270,000

1. Micron proposed a permit condition limiting each boiler to 6,000 hours of operation per year. Hence, the avoided emissions were calculated based on the difference between 8,760 hours of operations and 6,000 hours of operation for each boiler.

Table M10-2. Boiler GHG Avoided Emissions

Pollutant	Emission Factor[3] (lb/MMscf)	Avoided Emissions	
		(lb/hr)	(tpy)
CO_2	120,000	46,165	63,707
CH_4	2.3	0.88	1.22
N_2O	0.64	0.25	0.34
Direct CO_2e - 20-yr[1]	-	46,304	63,900
Upstream CO_2e - 20-yr[2]	91,921	35,362	48,800

1. Emission Factors from AP-42 Section 1.4 Tables 1.4-1 and 1.4-2 for Small Boilers.
2. 20-yr Global warming potentials per 6 NYCRR Part 496.
3. Upstream CO_2e emission factor per Appendix of 2024 NYS Statewide GHG Emissions Report: 40,877 g/MMBtu

Conversions

1 lb = 453.59 g
1 year = 8,760 hr
1 scf NG = 1,020 BTU - Average heat content of NG from AP-42 1.4.1.
1 kW = 3,413 BTU - AP-42 appendix A pg. 15
0.85 kW out/kW in
1 year = 525,600 minutes
1 lb-mole of gas (@ 20C) = 385.3 Cubic feet
1 hr= 60 minutes

Micron - Clay, NY 4 Fabs
Diesel Emergency Generator Combustion Avoided Emissions

Table M11-1. Diesel Generator Inventory

Equipment Description	Equipment Count	Avoided Annual Operating Hours (hrs/yr/engine)[1]	Engine Full Load	Engine Power
			HP	**kW**
Diesel Emergency Generators	236	400	3,350	2,498
		Total Load (All Units)	**790,600**	**8,367,272**

1. Micron proposed an operating limit of 100 hours per year for each engine. Therefore, the avoided emissions calculation for each engine has been calculated based on the difference between the limit on emergency engine operation in 6 NYCRR 200.1(cq) (500 hours per year) and the proposed limit (100 hours per year).

Table M11-2. Diesel Emergency Generators Avoided Emissions

Pollutant	GHG Emission Factors[1]	Avoided Emissions	
	(kg/MMBtu)	**(lb/hr)**	**(tpy)**
CO_2	73.96	1,391	65,645
CH_4	0.0030	0.06	2.66
N_2O	0.00060	0.01	0.53
Direct CO_2e - 20-yr[2]	-	1,399	66,009
Upstream CO_2e - 20-yr[3]	23.54	442.7	20,894

1. CO_2, N_2O and CH_4 emission factors based on 40 CFR Part 98 Table C-1 and C-2 Default diesel emissions factors.
2. 20-yr Global warming potentials per 6 NYCRR Part 496.
3. Upstream CO_2e emission factor per Appendix of 2024 NYS Statewide GHG Emissions Report: 23,540 g/MMBtu

Conversions

1 lb =	453.59	g
1 year (Emergency Operation) =	500	hr
Energy Conversion Factor:	392.75	bhp-hr/MMBtu (mechanical) in AP-42 Appendix A
15 ppm S =	0.0015	wt% S
Horsepower (mechanical) =	0.74558	Kilowatts
Diesel Usage Conversion Factor:	0.138	MMBtu/gal

Micron - Clay, NY 4 Fabs
Electronic Vehicle Chargers Mitigation

Table M12-1. Projected EV Charger Usage

Parameter	Value	Units
Number of EV Chargers[1]	58	--
Average Charge Time[2]	8	hr/session
Daily Utilization[2]	3	sessions/day-charger
Average Session Power	4	kW
Electricity Dispensed	32	kWh/session-charger
Electricity Dispensed	2,032,320	kWh/yr
Electricity Conversion[3]	0.03	gasoline gallon equivalent/kWh
EV Fuel Economy[4]	118.2	Miles per gasoline gallon equivalent (MPGGE)
Annual Miles	7,206,607	miles/yr

1. Level 2 chargers are assumed to be utilized at the facility.
2. Assumed average charge time to be the same as the planned Micron shifts i.e. 8 hrs per shift and 3 shifts per day.
3. The electricity conversion is based on US Department of Energy's Fuel Conversion Factors to Gasoline Gallon Equivalent.
4. EV Fuel economy is based on AFLEET's fuel economy for electric vehicles.

Table M12-2. EV Charger Location-Based GHG Emissions

Pollutant	Location-Based Emissions Factor[1] (lb/MWh)	Scope 2 Emissions (tpy)
CO_2	241	244.9
CH_4	0.011	1.12E-02
N_2O	0.001	1.02E-03
CO_2e - 20-yr[2]	--	246.1

1. The location-based emission factors are based on EPA's eGRID 2023 Summary Tables for the NYUP Subregion.
2. 20-yr Global warming potentials per 6 NYCRR Part 496.

Table M12-3. Avoided Gasoline Car Fuel Consumption

Total Vehicle Miles (vehicle miles/yr)	Vehicle Fuel Type	Average Fuel Economy[1] (mpg)	Annual Total Fuel Usage (gal/yr)	Annual Heat Content (MMBtu/yr)
7,206,607	Gasoline	30.7	234,743	28,216

1. The default fuel economy for gasoline is based on Department of Energy's Technology Integration Program's Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) tool.

Table M12-4. Avoided GHG Emissions from Gasoline cars

Pollutant	Emission Factors[1,2]	Emission Factor Units	Annual Emissions (tpy)
CO_2	8.78	kg/gallon	2,272
CH_4	0.005	g/vehicle mile	0.04
N_2O	0.0014	g/vehicle mile	0.01
Direct CO_2e - 20-yr[3]	--	--	2,278
Upstream CO_2e - 20-yr[2]	28,866	g/mmbtu	898

Table M12-5. Avoided GHG Emissions

Pollutant	Avoided Emissions (tpy)
CO_2	2,027
CH_4	0.03
N_2O	0.01
Direct CO_2e - 20-yr	2,032
Upstream CO_2e - 20-yr	898

Conversions

1 lb = 453.59 g

1 gal gasoline = 0.1202 MMBTU - High heat content of gasoline per Table A4 of Appendix to the 2024 NYS Statewide GHG Emissions Report

1 gal diesel = 0.1373 MMBTU - High heat content of diesel per Table A4 of Appendix to the 2024 NYS Statewide GHG Emissions Report

1 year = 8,760 hours