Executive Summary
Community Leveraged Expanded air Network in Cleveland (CLEANinCLE)

Project Description: The CLEANinCLE project will expand Cleveland's air monitoring network into historically redlined Cleveland neighborhoods that are still experiencing negative health outcomes. Community members will participate in the meaningful design of an expanded air monitoring network through public forums, the establishment of a resident advisory committee, and through a series of residential interviews. The outputs and outcomes will take the form of public engagement with marginalized communities, expanded air monitoring networks informed by the community, increased data/access, and public health interventions.

Project Period: 11/1/2022 through 9/30/2025

Project Location: The CLEANinCLE project will cover an area in the Cleveland community that is locally referred to as the "Cleveland Crescent." The neighborhoods that are in the Cleveland Crescent represent the historically redlined communities that still present with poor health outcomes including diabetes, hypertension, and pediatric asthma. This region represents approximately 48 percent of Cleveland residents.

Project Partners:

Better Health Partnership, Dr. Christopher Mundorf

Case Western Reserve University

> Department of Population and Quantitative Health, Dr. Andrew Curtis

> Institute for Smart, Secure and Connected Cities, Nick Barendt

Cleveland Clinic Foundation, Respiratory Institute, Dr. A=Maeve MacMurdo

Cleveland Neighborhood Progress, Divya Sridhar

Ohio Environmental Protection Agency, Robert Hodanbosi

Overall Project Activities
Cleveland Division of Air Quality (CDAQ) will expand Cleveland's ambient air monitoring network in neighborhoods that are experiencing adverse health outcomes due to air pollution exposure. The Community Leveraged Expanded Air Network in Cleveland (CLEANinCLE) project will focus on historically redlined communities. The historical racist practice has a modern day impact on the health of City of Cleveland (CoC) residents in a series of neighborhoods often referred to locally as the Cleveland Crescent. These communities present with poorer health outcomes, including diabetes, hypertension and pediatric asthma,[1] and have been disproportionately impacted by COVID-19. This region represents approximately 99 census tracts and almost 48% of the CoC residents.

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[1] https://experience.arcgis.com/experience/22c7182a162d45788dd52a2362f8ed65 from https://www.cdc.gov/places. Accessed 3/11/2022.

The expanded air monitoring network will include a Federal Equivalent Method (FEM) particulate matter monitor, an Automated Equivalent Method (AEM) ozone analyzer, and a network of low cost air quality sensors (sensors) to better understand the air pollution exposure rates within the Cleveland Crescent. The expanded monitoring network will service communities that experience environmental justice concerns as evidenced by diagnosed health data, proximity and density of known air pollution sources, resident demographics, and communities that exceed the 85th percentile in air pollution categories in the EPA Environmental Justice (EJ) Screen Tool.   Specific site selection will be determined by public forums, residential interviews, and through a Resident Advisory Committee. The qualitative and quantitative data obtained in this project will be used to inform local medical providers on the barriers residents are experiencing to asthma management, which will enable the development of neighborhood specific communications to asthma management. We expect the results from this project to make dramatic steps towards improving health outcomes in this underserved area of the city.

One (1FEM) monitor will be purchased and deployed and one (1) Teledyne (AEM) ozone analyzer will be deployed. CDAQ will purchase and deploy a continuous FEM monitor for fine (PM 2.5) and coarse (PM 10) particulate matter such as the Teledyne T640x. CDAQ will deploy a continuous AEM ozone analyzer such as a Teledyne T400. The monitoring site will also collect meteorological data including temperature, humidity, wind speed, and wind direction. The FEM monitor and ozone analyzer will be housed in a temperature controlled mobile monitoring shelter (MMS), which is mounted to a trailer. There will be two monitoring sites selected for this project period. The MMS will be sited for up to one-year at each location to allow for seasonal data collection. General location will be determined by respiratory health data, social vulnerability, and a lack of coverage by the existing EPA monitoring network. Within neighborhood placement will be informed by community feedback from resident interviews, the Resident Advisory Committee, and public forums. Monitor data will be collected through an onsite data logger and will be managed through Ohio Environmental Protection Agency's (OEPA) Air-Vision software. This data will be transmitted to a Software as a Service (SaaS) interface data visualization website that will provide the public with near real-time access to outputs. The MMS will be designed to allow for additional air pollution monitors and analyzers to be added at a later time

CDAQ will purchase thirty low cost air quality sensors to deploy into neighborhoods within the Cleveland Crescent. The sensors will collect data on PM2.5, PM10, temperature, and humidity and will use a Long Range Wide Area Network (LoRaWAN) to transmit data.   The LoRaWAN's communication technology allows for a single gateway device to wirelessly communicate with multiple sensors. This allows the use of battery-powered sensors rather than mainline power, simplifying deployment. As a result, broad geographic coverage can be achieved with reduced deployment and operations costs. The sensor type will be an iaconnects SEN558 or equivalent model. The data will be transmitted to a cloud service provider for storage and visualization. This will allow for near-real time public access to all data generated from the sensors. One of the sensors will be collocated with the FEM monitor in the MMS, another sensor will be collocated with an existing EPA FEM monitor for purposes of validation.

Seventeen (17) resident narratives will be collected and mapped. CDAQ will conduct a series of resident interviews to gain a better understanding of the community's perceptions of air quality and how their health is impacted utilizing Spatial Video Narrative (SVG) techniques[2]. SVGs record the reflections and insights of an individual as they move through a landscape as a "go-along" interview. This structure provides an opportunity to gain insights into the lived experience of neighborhood residents that can be examined both thematically and spatially. Memories and informed interpretation

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[2] Curtis, A., J.W. Curtis, J. Ajayakumar, E. Jefferis, and S. Mitchell. (2019) Same Space - Different Perspectives: comparative analysis of geographic context through sketch maps and spatial video geonarratives. **International Journal of Geographical Information Science** 33 (6), 1224-1250

of events are triggered by the surrounding environment. These comments are captured along with a spatially encoded video recording. Project collaborators have previously utilized SVG to explore the lived experience of Cleveland pediatric asthma patients.

A Resident Advisory Committee will be established comprised of six (6) residents that will be engaged in all aspects of the project throughout the full award period. The Advisory Committee will consist of community members who represent critical neighborhoods within the Cleveland Crescent. The Committee will be established through an application process that is managed by project partner Cleveland Neighborhood Progress. The Resident Advisor's role will be to communicate community level concerns, provide guidance on sensor locations, share [3]information about the project with their community members, and encourage community participation in public forums. The resident will receive a stipend for their contribution.

CDAQ will coordinate nine (9) public forums per year of the project and three (3) virtual sessions
CDAQ will host a series of community in-person meetings and virtual meetings throughout the project period. The in-person meetings will rotate between targeted neighborhoods within the Cleveland Crescent. Residents will be encouraged to share their lived experiences, identify potential areas of concern, and provide feedback on project decision points. Some of the key decision points that will be addressed include sensor placement locations, data interpretation of collected information, data visualization prototypes, and draft language for community specific health and air quality messaging. The decision points will be presented to the Resident Advisory Committee in advance of the community meetings.

CDAQ will work with 100 medical providers within the Cleveland Crescent to collect information on the barriers to asthma treatment with their patients. Providers will be surveyed on current asthma education practices, and barriers to treatment access. Results will be analyzed by Better Health Partnership to identify common themes, and reviewed during public forums for additional community input. CDAQ will report the results back to Better Health Partnership, who will then work with the participating practices to develop quality improvement processes to modify provider behavior. A follow-up survey will be conducted at the end of the study to determine changes in how providers deliver asthma related services. Additionally, clinical metrics from partnering practices will be able to identify changes at a patient level. This would include asthma diagnoses, usage of asthma plans, asthma controller medications, and asthma exacerbations

Community Partnerships
CDAQ is the lead applicant on the CLEANinCLE project and will be the Project Manager. CDAQ will purchase, deploy, oversee operation/maintenance, and troubleshooting of all equipment. CDAQ will be responsible for quality assurance/quality control measures, interpretation and dissemination of collected data, and community messaging. CDAQ will oversee all aspects of the grant management, administration and reporting requirements.

CLEANinCLE project partners have established and successful relationships in collaborating on air quality, sensor deployment community engagement, and community health activities. CDAQ collaborated with Case Western Reserve University's (CWRU) Institute for Smart, Secure and Connected Cities (ISSACs) and Cleveland Neighborhood Progress (CNP) on a National Science Foundation funded project to deploy 50 battery operated, wi-fi enabled air sensors to neighborhoods in Cuyahoga County. The purpose of the project was to identify potential correlations between particulate matter exposure

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[3] https://www.census.gov/quickfacts/clevelandcityohio. Accessed 3/23/2022

and instances of COVID-19 diagnosis. This project demonstrated that a major barrier to sensor deployment was access to wireless internet and power. This work informed the use of LoRaWan sensors in this proposal[4]. The EPA EJ Screen Tool demonstrates that Cleveland Crescent communities tend to exceed the 80th percentile in Broadband Gaps, which would be prohibitive in sensor deployment.

Cleveland Neighborhood Progress (CNP)
CNP is a local community development funding and capacity intermediary with 30 years of experience investing in community revitalization work in Greater Cleveland. CNP will serve as the administrative manager for the Resident Advisory Committee and will oversee logistical coordination of the public forums. CNP will secure support services that reduce barriers to public participation at the Neighborhood Forums including childcare, translators, and transcribers. CNP will be responsible for administering stipends and managing other administrative processes for the members of the Resident Advisory Board. Between 2016 and 2019, CNP developed and managed the Climate Ambassador Program in which resident leaders stewarded neighborhood level implementation of the climate resiliency projects, and informed the 2018 update to Cleveland's Climate Action Plan[5]. This ground up approach has enabled CNP to understand the impacts of poor environmental quality exacerbated by climate change, and to represent community voices in decision making through an intersectional lens. CNP led efforts to explore establishing an Environmental Justice and Cumulative Impact Ordinance (EJ-CIO). CDAQ participated in a 2020 peer learning exchange opportunity coordinated by CNP to visit the Ironbound Community Corporation in Newark, NJ and learn about their EJ-CIO ordinance. CNP, CDAQ and additional local stakeholders have been working to identify opportunities to implement a similar ordinance locally. CNP has also been involved in discussions around updating the City of Cleveland Air Pollution Control Ordinances that were adopted in 1977. Data and feedback gained from the SVG interviews, neighborhood forums, and Resident Advisory Committee may be used to inform the adoption of an EJ-CIO ordinance or updates to the City of Cleveland Air Pollution Code.

Case Western Reserve University (CWRU)
Case Western Reserve University's role will be a joint effort between the Institute for Smart, Secure and Connected Cities (ISSACS) and the Population and Quantitative Health Sciences Department (PQHS) GIS Health & Hazards Lab (GHH) in the School of Medicine (SOM). CWRU launched the Institute for Smart, Secure and Connected Systems (ISSACS) in the spring of 2016 with a focus on activities on the Industrial Internet of Things (IIoT). ISSACS partners with faculty, students and staff across the university's schools to include experts in engineering, anthropology, sociology, mathematics, management, medicine, nursing, law and ethics. ISSACS works with on-campus and off-campus partners to advance research, education, and economic development in Greater Cleveland. ISSACS will provide technical support for all components of the LoRaWAN sensors including setting up the iaconnects sensors to deploy to a LoRaWan network, developing a data storage mechanism, and creating data visualization. ISSACS faculty and staff have over a half a century of combined experience in building, deploying and managing data collection networks for a wide range of uses. ISSACS provides deep experience in the data sensing, collection, storage, analysis and visualization pipelines that leverage embedded devices, cloud services and Low Power Wide Area Networks (LPWAN) including LoRaWAN.

PQHS integrates health research across multiple geographic scales, from the genome to the community,

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[4] Loparo K., Barendt N., Yoka C. "Increasing our Understanding of PM2.5 Particulate Pollution Monitoring Through a Network of Low-Cost Air Quality Monitors." Swetland Center for Environmental Health Virtual Seminar Series. 3/22/2022.

[5] Cleveland Climate Action Plan 2018 Update: Building Thriving and Resilient Neighborhoods for All." Accessed from https://www.sustainablecleveland.org/climate_action on 3/23/2022.

with a focus on improving the quality of life for individuals, communities, and populations. This breadth of research is seen in the various sub-disciplines, including (but not limited to) population health scientists, health data scientists, biostatisticians, cancer and genetic epidemiologists. Collaborations extend to major hospital systems in northeast Ohio, and many county and city public health departments. PQHS also has an extensive research record of working within neighborhood areas and with community groups. The GHH team created the spatial video geonarrative (SVG) methodology to capture on-the-ground community perspectives that will be used in this project. This approach, which utilizes software designed by GHH, has been applied across Ohio, the United States, and even globally to create contextual maps of granular environments at risk. The collaboration between CDPH and GHH is well established as they continue to support the health department in their Cleveland Covid-19 response. For this proposal, GHH will oversee all SVG data collection and analysis, as well as providing geospatial support for the other project components. Insights gained from these SVG maps, and from the project as a whole, will be disseminated through the academic and local communities served by GGH.

Better Health Partnership (BHP)
Founded in 2007, Better Health Partnership is a regional health improvement collaborative that works collectively with health care and other sectors to advance data-informed improvements in adult, child, and infant/maternal health, while also reducing health disparities. BHP collects individual-level data from health care organizations across Northeast Ohio. BHP aggregates this data and works with public partners to communicate health prevalence in the community. This project will help the BHP health care members better identify barriers to support children with asthma and help develop improved care for them. CDAQ is currently collaborating with Better Health Partnership (BHP) to develop a referral service for individuals diagnosed with asthma to CDAQ's Indoor Air Quality program. This service will offer in-home assessments and education for individuals diagnosed with asthma. CDAQ has served on the BHP Health Metrics Advisory Committee (HMAC) since 2019, in which pediatric asthma has been identified as a major concern. The need to develop this program has been informed by CDAQ's partnership with BHP as well as community feedback received through various engagement activities.

Ohio EPA Division of Air Pollution Control
Ohio EPA will serve as an external agency performing quality assurance activities on the FEM and AEM equipment in the MMS. They will also provide access to data that is generated at CDAQ's monitoring sites and allow that data to be added to a real-time map. CDAQ has been the delegated local air agency for Ohio EPA since 1972.

Cleveland Clinic Respiratory Institute
Cleveland Clinic's Respiratory Institute (CCF RI) provides world-class patient care by combining strengths in clinical care, research and education. With more than 170 pulmonologists, allergists/immunologists, infectious disease experts and critical care specialists, CCF RI serves more than 7000 patients with a diagnosis of asthma yearly. A member of the CCF RI team will serve as an expert advisor on in the impacts of air pollution on health. They will participate in stakeholder meetings, review collected data, and provide insight how the data can be used to improve health outcomes

Budget

The CLEANinCLE project has been funded at $500,000 and expects to provide $221,358 of in-kind support through existing Cleveland Division of Air Quality personnel and use of surplus AEM ozone analyzer equipment. The equipment that will be purchased includes: $125,000 for the MMS and approximately $36,000 for the sensors. CNP will receive administrative fees to manage the resident advisory committee and will administer Participant Support Cost.   Their budget also includes public forum expenses. CWRU will be a sub-awardee with financial support for two separate Departments: $63,211 (PQHS) and $99,698 (ISSACS). The ISSACs budget includes $1,500 for supplies and $1,500 for a monthly storage charge for hosting the dashboard for 30-months. BHP will receive $24,000 for coordination of medical providers and data analysis. Ohio EPA and the CCF-RI are not requesting any financial support for their roles. Approximately 60% of the budget will be requested in year one to purchase equipment, supplies, and begin engineering the dashboard. Once sensors are deployed and the dashboard has been developed, personnel time will be reduced. The funding in years 2 and 3 will support CDAQ staff, geospatial and SVG support, the resident advisory committee, public forums, and medical provider engagement.