THE OHIO STATE UNIVERSITY
JOHN GLENN COLLEGE OF PUBLIC AFFAIRS

# Integrating Drones into Police Patrol Operations

An Implementation Study of the
Columbus Division of Police's RAVEN Pilot Program


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# EXECUTIVE SUMMARY

With support from the Ohio Office of Criminal Justice Services (OCJS), researchers from The Ohio State University's John Glenn College of Public Affairs conducted an implementation study of the Columbus Division of Police's (CDP) Rapid Aerial Vehicle Enforcement Network (RAVEN) Pilot Program, a patrol-based drone initiative designed to integrate drone technology into routine policing operations. Unlike Drone as First Responder (DFR) programs that deploy drones remotely from fixed locations, the RAVEN program enables FAA-certified officers to transport and deploy drones from patrol vehicles in support of calls for service and other authorized law enforcement activities. The purpose of the study was to document how CDP has incorporated drones into patrol operations, identify promising practices and implementation challenges encountered, and develop recommendations to support future program development. The study also sought to capture lessons learned that may assist other Ohio law enforcement agencies considering the adoption or expansion of similar patrol-based drone programs.

## Study Description & Findings

The study employed a mixed-methods case study design that combined quantitative and qualitative data sources. Researchers analyzed drone flight records and Computer-Aided Dispatch (CAD) data, conducted interviews with the RAVEN program manager, aviation-unit leadership, and drone pilots, reviewed relevant policies and program documents, and conducted field observations of drone operations during two major public events.

The analysis found that the RAVEN program was successfully integrated into CDP's patrol operations and demonstrated operational value across a wide range of policing activities. Between November 2025 and July 2026, the program recorded 1,315 drone flights, including 637 flights associated with 308 unique CAD incidents. Drones were deployed in support of both citizen-generated and officer-initiated events and were used for a variety of activities including suspect searches, missing-person searches, scene overwatches, public events, and protest response operations. Nearly half (48%) of all drone-supported calls for service involved Priority 1 or Priority 2 calls, indicating that drones were frequently deployed during incidents requiring elevated levels of police response and enhanced situational awareness.

Interviews, field observations, and analysis of administrative data indicated that drones provided real-time situational awareness for officers and incident commanders. Personnel reported that drones improved monitoring of evolving incidents, enhanced search operations, assisted with perimeter management, and provided information that helped officers assess potentially hazardous situations before committing personnel. Researchers observed these benefits firsthand during large public events, where aerial perspectives improved commanders' awareness of crowd movements and changing situations. Thermal-imaging capabilities of drones were also identified as particularly valuable during suspect and missing-person searches.

# Implementation Challenges

This study also identified several implementation challenges affecting the efficiency, responsiveness, and long-term scalability of the RAVEN program. The most significant challenge stemmed from the patrol-based deployment model. Because drone pilots were required to travel to a suitable launch location before deploying an aircraft, aerial support was often delayed. As a result, drones were reported to be not first on scene in most requested deployments. While drones provided significant value during searches, special events, and other extended incidents, these deployment delays limited their ability to contribute during the earliest stages of rapidly evolving calls for service. This limitation was particularly evident in Priority 1 incidents, where reported effectiveness was lower than for less time-sensitive events that allowed greater opportunity for aerial support to be deployed and integrated into operations.

Staffing capacity emerged as a second major implementation challenge. Drone pilots performed aerial-support responsibilities in addition to their regular patrol duties, meaning that pilot availability was often influenced by patrol staffing levels, competing assignments, and supervisory decisions regarding officer deployment. Participants also identified inconsistent availability of trained visual observers, further constraining deployment capacity.

The assessment also identified opportunities to improve training, policy development, and performance measurement. Pilots expressed support for additional refresher training, while interviews highlighted the need for standardized visual-observer training and increased supervisor awareness of drone capabilities and operational uses. The study further found that existing data systems do not yet support rigorous evaluation of program outcomes such as response times, apprehensions, officer safety, or operational efficiency.

# Recommendations

Four strategic priorities emerged from the assessment. First, CDP should strengthen operational capacity by expanding pilot and drone availability and evaluating alternative staffing models, including dedicated drone operators. Second, CDP should improve deployment effectiveness by exploring alternative deployment approaches and strategically positioning drone resources in areas with high operational demand. Third, CDP should strengthen data integration and performance measurement systems to support future evaluations of operational outcomes and return on investment. Finally, continued attention should be given to governance, accountability, transparency, privacy protections, and community engagement as the program expands.

# Lessons Learned

The RAVEN pilot offers several important lessons for law enforcement agencies considering the adoption or expansion of drone programs.

(1) Agencies should clearly define their operational objectives and prioritize deployments in situations where drones provide the greatest value.

(2) While patrol-based deployments offer flexibility, they may not provide the same response-time advantages as fixed-site Drone as First Responder (DFR) programs.

(3) Successful implementation requires sustained investments in staffing, training, and supervisory support.

(4) Agencies should establish data collection systems early in program development to support accountability, continuous improvement, and future program evaluation.

(5) Transparency, privacy protections, and clear policies governing drone operations should be incorporated from the outset to maintain public trust and confidence in the use of this technology.

# 1. BACKGROUND AND PROJECT GOALS

In November 2025, the Columbus Division of Police (CDP) launched the Rapid Aerial Vehicle Enforcement Network (RAVEN) Pilot Program to explore the integration of small Unmanned Aircraft Systems (sUAS), commonly known as drones, into patrol operations. The program provides patrol officers and incident commanders with an additional operational resource that can support calls for service and other policing activities, including crowd management at public events. Unlike Drone as First Responder (DFR) programs, which launch drones remotely from fixed locations in response to calls for service, the RAVEN program employs a mobile, patrol-based deployment model that operates in compliance with federal visual line-of-sight (VLOS) requirements. Federal Aviation Administration (FAA) Part 107-certified officers transport drones using their patrol vehicles and deploy them from suitable locations near the incident with the assistance of trained visual observers who maintain visual line of sight with the aircraft, monitor surrounding airspace, and support safe flight operations. Officers and supervisors may request drone assistance for calls for service and other authorized activities. Rather than serving as a centralized aerial response system like a DFR program, the RAVEN program provides patrol personnel with an on-scene aerial capability that can be deployed in support of calls for service and other authorized law enforcement activities. Officers and supervisors may request drone assistance when operationally appropriate.

Law enforcement agencies across the United States have increasingly adopted drone technology to enhance situational awareness, support incident response, improve search capabilities, and provide officers and commanders with real-time information during critical events. Although much of the recent attention surrounding police drone programs has focused on Drone as First Responder (DFR) models, many agencies continue to rely on patrol-based deployment models that integrate drone operations directly into routine policing functions. While both patrol-based and DFR programs provide aerial situational awareness and tactical support, they differ substantially in their staffing, deployment, operational, and regulatory requirements.

Despite the growing use of drones in policing, limited research has examined how these programs are implemented in practice, the organizational and operational challenges agencies encounter, or the factors that contribute to their successful adoption and their effects on police operational performance and public safety outcomes. This knowledge gap is particularly pronounced for patrol-based drone programs. Implementation assessments can help address these gaps by documenting agency experiences, identifying promising practices and common challenges, and generating evidence-based guidance for agencies considering the adoption or expansion of patrol-based drone programs.

With funding support from the Ohio Office of Criminal Justice Services (OCJS), a research team led by Drs. Robin S. Engel and Russell S. Hassan at The Ohio State University's John Glenn College of Public Affairs conducted an implementation study of CDP's RAVEN Pilot Program. The purpose of this study was to examine how CDP has integrated patrol-based drone

operations into routine patrol functions and to identify promising practices, lessons learned, and opportunities for improvement that can inform future program development. The study also sought to identify lessons from CDP's RAVEN program implementation experience that may inform other Ohio law enforcement agencies considering the adoption of patrol-based drone programs or similar drone deployment models.

Consistent with these stated objectives, the study addressed four primary research questions:

1. How are drones deployed in the RAVEN Pilot Program, including the frequency, purpose, timing, and geographic distribution of deployments?
2. What operational procedures and training practices guide drone deployment, and how consistently are they followed?
3. What successes and challenges have emerged as drones have been incorporated into routine patrol operations?
4. What lessons from CDP's experience can inform the continued development of the RAVEN program and similar initiatives in other jurisdictions?

The research team employed a mixed-methods case study design to address these questions. Quantitative descriptive analyses of RAVEN flight records and associated Computer-Aided Dispatch (CAD) data from November 2025 through July 2026 were used to examine patterns of drone deployment and available indicators of operational performance. These analyses were complemented by a review of relevant policies, standard operating procedures (SOPs), and internal reports; field observations of drone deployments during two major public events, the Columbus Pride Parade and the Sonic Temple Art & Music Festival; and interviews with personnel involved in program operations, including the RAVEN program manager, the commander of CDP's Aviation Unit, supervisors, and drone pilots assigned to different patrol zones. These data sources provide a richer and more comprehensive understanding of how the RAVEN program functions in practice than any single source of information could provide.

The analyses presented in this report are primarily descriptive. The report documents when, where, why, and how frequently drones were deployed during the study period and examines available measures of operational performance. It also identifies implementation successes, challenges, and lessons learned during the program implementation. These findings provide guidance for CDP as it continues to refine and expand the program and may inform other law enforcement agencies considering, implementing, or evaluating similar drone initiatives.

The findings of this implementation assessment should not be interpreted as evidence of the impacts of the RAVEN program on operational or public safety outcomes. Conducting a rigorous impact evaluation would require larger datasets, longer observation periods, and a research design capable of comparing drone-supported incidents with similar incidents that did not receive drone support. While such analyses are beyond the scope of the present study, developing the data infrastructure and methodological framework needed to support them is an important priority for future research and evaluation efforts.

The remainder of this report is organized as follows. Section 2 describes the data sources, analytic sample, and research methods used in the assessment. Section 3 examines patterns of RAVEN program activity, including overall flight activity, the characteristics of drone-supported police incidents, and the geographic distribution of drone deployments. Section 4 analyzes drone mission objectives and available indicators of operational performance. Section 5 examines program implementation, including operational procedures, training, and staffing capacity. Section 6 summarizes the program's key accomplishments and implementation challenges. Section 7 presents recommendations for strengthening and expanding the RAVEN program. Finally, Section 8 highlights lessons learned from CDP's experience that may inform other law enforcement agencies considering the implementation of similar drone programs.

# 2. DATA SOURCES AND ANALYTIC APPROACH

## Data Sources

The study draws on multiple sources of quantitative and qualitative data to examine the implementation and operation of CDP's RAVEN pilot program. The quantitative analyses use Skydio flight reports and Computer-Aided Dispatch (CAD) data covering the period from November 2025 through July 2026. These datasets were obtained from the RAVEN program manager and the City of Columbus's Division of Support Services and were linked using CAD incident numbers. The Skydio flight reports contain important information on individual drone flights, including flight date and time, flight duration, launch location, mission objectives, equipment performance, operational issues, and reported mission outcomes. For flights associated with a CAD incident, the linked data also provide information about the underlying police event, including call source, event priority, incident type, and geographic location.

The qualitative component of the study draws on interviews with CDP personnel directly involved in the development, management, and operation of the RAVEN program, including the program manager, the commander of CDP's Aviation Unit, and certified drone pilots. These interviews provided insights into program implementation, training, operational decision-making, perceived benefits, implementation challenges, and opportunities for program improvement. To better understand the program's evolution over time, the research team also participated in weekly meetings with the RAVEN program manager between May and August 2026. These meetings provided ongoing information about implementation challenges, operational successes, and emerging issues encountered during the period. The qualitative data are supplemented by a review of relevant policies, standard operating procedures, and internal reports, as well as field observations of drone operations during the Columbus Pride Parade and the Sonic Temple Art & Music Festival. Detailed notes were maintained for all interviews, weekly meetings, and observational activities and were used to document

implementation experiences, operational challenges, and lessons learned throughout the assessment.

# Construction of the Administrative Analytic Sample

Following each deployment, pilots complete a UAS Deployment Report Checklist within the Skydio platform that records information about the mission, including the associated incident, mission objectives, equipment readiness, deployment timelines, flight activity, mission outcomes, equipment performance, operational challenges, and perceived effectiveness. These records provide a valuable source of implementation data, allowing researchers to examine how the program operates in practice and identify opportunities to strengthen data collection, performance measurement, and program oversight as the initiative develops.

The flight data capture a broader range of activity than drone deployments associated with CAD incidents. In addition to operational deployments, the dataset includes test flights, training exercises, equipment checks, and other activities for which a CAD incident number may not be applicable. Accordingly, this report distinguishes between all recorded drone flights and flights linked to CAD-recorded police incidents. After restricting the data to the study period, 1,315 flights with usable information were recorded between November 2025 and July 2026. Of these flights, 637 were linked to at least one CAD incident, while 678 were not associated with a CAD incident number. The absence of a CAD incident number should not necessarily be interpreted as a reporting deficiency. Interviews with the RAVEN program manager and drone pilots indicated that many non-CAD-linked flights reflected training activities, equipment checks, test flights, and other operational uses for which a CAD incident number was not applicable.

For analyses requiring information about the underlying police incident, the data were restricted to records containing a valid CAD incident number, and duplicate flight-incident combinations were removed. This process yielded 638 unique flight-incident records representing 637 physical drone flights and 308 unique CAD incidents. The unit of analysis varies according to the research question being examined. Analyses of overall flight activity use individual drone flights as the unit of analysis and therefore capture the full range of RAVEN operations. Analyses examining the characteristics of police incidents receiving drone support use unique CAD incidents as the unit of analysis. Consequently, analyses of call source, event priority, incident type, and incident location are based on the 308 unique CAD incidents rather than the 638 flight-incident records. This approach prevents incidents involving multiple drone flights from being counted multiple times when describing the types of incidents that received drone support.

# Analytic Approach

As previously noted, the quantitative analysis is descriptive, designed to examine CDP's utilization of the RAVEN program. We examine the frequency and timing of drone flights, the characteristics of CAD incidents receiving drone support, geographic patterns of deployment,

mission objectives, and available indicators of operational performance. Analyses include frequencies, percentages, cross-tabulations, temporal patterns, and spatial mapping.

Interview notes were analyzed to identify recurring themes concerning program implementation, training, staffing and operational practices, perceived benefits of drone support, implementation challenges, and opportunities for program improvement. Qualitative findings are used both to examine aspects of implementation that cannot be assessed from administrative records and to provide context for patterns observed in the quantitative data. Information from the policy review and field observations is similarly used to assess how formal RAVEN procedures operate in practice and to contextualize findings from the administrative and interview data.

# 3. RAVEN ACTIVITY & DEPLOYMENT PATTERNS

## Overall RAVEN Flight Activity

We first examined the overall level and timing of RAVEN flight activity during the nine-month study period. These analyses use all recorded drone flights rather than only CAD-linked flights and therefore capture the broader range of RAVEN program activity, including operational deployments, test flights, equipment checks, and other flight activity. As shown in Table 1, 1,315 flights with usable date information were recorded from November 2025 through July 2026. Flight activity varied considerably during the study period. The highest volume of flights occurred in November 2025, when 484 flights were recorded, including 430 training flights conducted to prepare personnel. Flight activity declined to 113 flights in December before increasing to 275 flights in January 2026. From February through July, monthly flight activity was considerably more stable, ranging from 68 to 88 flights per month.

**Table 1. RAVEN Flight Activity by Month**

| Month/Year | # of Flights | # of CAD Incidents |
|---|---|---|
| Nov-25 | 484 | 23 |
| Dec-25 | 113 | 39 |
| Jan-26 | 275 | 117 |
| Feb-26 | 70 | 36 |
| Mar-26 | 88 | 26 |
| Apr-26 | 73 | 20 |
| May-26 | 69 | 15 |
| Jun-26 | 68 | 22 |

| Month/Year | # of Flights | # of CAD Incidents |
|---|---|---|
| Jul-26 | 75 | 10 |
| Total | 1,315 | 308 |

The number of unique CAD incidents receiving drone support followed a somewhat different pattern. Despite the large volume of flights in November 2025, only 23 unique CAD incidents received drone support that month. This difference reflects the substantial amount of training and testing conducted during this initial implementation period. The number of drone-supported CAD incidents increased to 39 in December 2025 and peaked at 117 in January 2026. From February through July 2026, the number ranged from 10 to 36 incidents per month.

**Figure 1. RAVEN Flights by Day of Week**

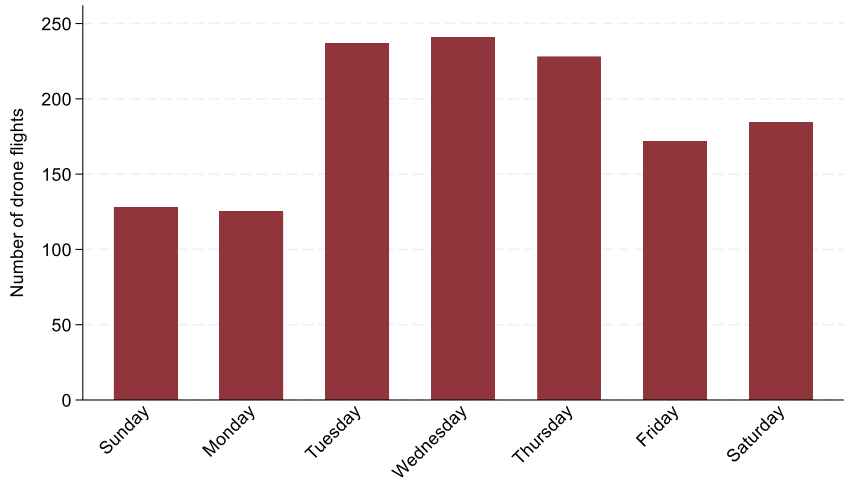
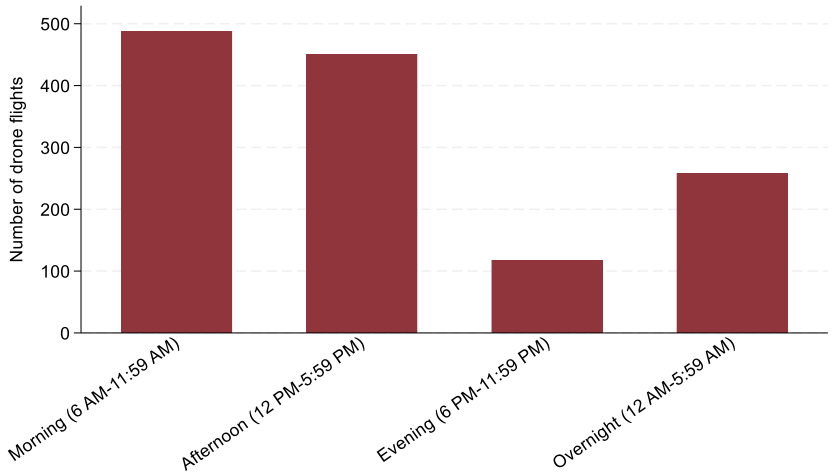



**Figure 2. RAVEN Flights by Time of Day**



Flight activity occurred throughout the week (see Figure 1), although it was somewhat more concentrated during the middle and end of each week. Tuesday and Wednesday each accounted for approximately 18% of recorded flights, followed by Thursday at 17%. Saturday also accounted for a relatively large share of activity at 14%. Flight activity was lowest on Sunday and Monday, each accounting for approximately 10% of flights. As indicated in Figure 2, flight activity was concentrated during daytime hours when pilots were more available. Approximately 37% of flights occurred during the morning between 6:00 a.m. and 11:59 a.m., while 34% occurred during between noon and 5:59 p.m. Together, approximately 71% of all recorded flights occurred between 6:00 a.m. and 5:59 p.m. Overnight flights accounted for 20% of activity, while the fewest flights occurred during the evening period between 6:00 p.m. and 11:59 p.m. (9%).

# CAD-Linked Drone Deployments

**Table 2. RAVEN Flights and CAD-Linked Incidents**

| Measure | Count |
|---|---|
| All recorded drone flights | 1,315 |
| CAD-linked drone flights | 637 |
| Unique CAD incidents receiving drone support | 308 |

Of the 1,315 drone flights recorded during the study period, 637 were associated with a valid CAD incident, while the remaining 678 flights did not contain a CAD incident number. Interviews with program personnel indicated that many of these non-CAD-linked flights involved training, equipment checks, test flights, or other activities for which a CAD incident number was not applicable. However, the flight records do not contain sufficient information to systematically classify non-CAD-linked flights by purpose. Consequently, we could not determine how many of the 678 non-CAD-linked flights were attributable to training, testing, equipment checks, or other operational activities. As indicated in Table 2 above, the 637 CAD-linked physical flights were associated with 308 unique CAD incidents.

# Characteristics of Drone-Supported CAD Incidents

We next examined the characteristics of the 308 unique CAD incidents that received drone support. Drone-supported incidents were distributed across both officer-initiated activities and citizen-generated calls for service. Of the 308 incidents, 115 (37%) were officer initiated and 113 (37%) originated through 911. An additional 76 incidents (25%) came through the city's 4545 non-emergency call system, while four incidents (1%) were classified as other call sources. Taken together, nearly two-thirds (62%) of drone-supported incidents originated from citizen requests for police service through either the 911 or 4545 systems.

**Table 3. Call Source of Drone-Supported CAD Incidents**

| Call Source | # | % |
|---|---|---|
| **4545** | 76 | 25% |
| **911** | 113 | 37% |
| **Officer Initiated** | 115 | 37% |
| **Other** | 4 | 1% |
| Total | 308 | 100% |

Drone support was used across incidents with varying levels of event priority (see Table 4). Under CDP's CAD system, Priority 1 represents the highest-priority incidents, while Priority 5 represents the lowest. Priority 2 incidents were the most common, accounting for 125 of the 308 incidents (41%). An additional 21 incidents (7%) were classified as Priority 1. Hence, nearly one-half (48%) of all drone-supported incidents were high priority events. Priority 3 incidents accounted for 53 incidents (17%), while Priority 4 incidents accounted for 101 incidents (33%). These findings suggest that drone support was used across a broad range of incident types and priority levels but was concentrated among relatively high-priority events. At the same time, the presence of drone deployments across all priority categories indicates that the technology was used to support a diverse set of operational needs rather than a single class of incidents.

**Table 4. CAD Priority of Drone-Supported Incidents**

| Event Priority | # | % |
|---|---|---|
| 1 | 21 | 7% |
| 2 | 125 | 41% |
| 3 | 53 | 17% |
| 4 | 101 | 33% |
| 5 | 4 | 1% |
| Missing | 4 | 1% |
| Total | 308 | 100% |

Analysis of CAD data also showed that drones were deployed in support of a wide range of police incidents. As shown in Table 5, the most common CAD classification was Information/Assistance, accounting for 92 incidents (30%). Among more specific incident classifications, drones were deployed in connection with persons with a gun, disturbances, suspicious persons, ShotSpotter alerts, wanted felons, missing persons, shots fired, domestic violence incidents, burglaries, and other calls. Overall, the descriptive analysis of drone flights and linked CAD data suggest that drones were not used for a single type of activity. Drone support extended across calls involving weapons, disturbances, searches for wanted or missing persons, suspected criminal activity, public-safety concerns, and requests for assistance.

**Table 5. Most Common CAD Call Types Receiving Drone Support**

| Call Description | # | % |
|---|---|---|
| Information / Assistance | 92 | 30% |
| Person with a Gun | 21 | 7% |
| Disturbance | 20 | 6% |
| Suspicious Person | 13 | 4% |
| ShotSpotter Alert | 10 | 3% |
| Wanted Felon | 10 | 3% |
| Missing Person | 9 | 3% |
| Shots Fired | 9 | 3% |
| Unknown Complaint | 8 | 3% |
| Domestic Violence | 7 | 2% |
| Theft Report | 7 | 2% |
| Disturbance / Mental | 7 | 2% |
| Other call types | 95 | 31% |
| Total | 308 | 100% |

# Geographic Distribution of Drone Deployment

The geographic distribution of RAVEN Program activity was examined in several ways. First, we examined the distribution of drone-supported CAD incidents across CDP's six police zones and individual cruiser districts or beats to identify where drone support was most frequently used. Second, we examined the locations from which drones were launched to better understand deployment patterns and operational coverage across the city.

Figure 3 presents the number of unique CAD incidents receiving drone support across CDP's six police zones. Drone-supported incidents were unevenly distributed across the city, which is expected given that not all zones had a dedicated drone assignment during the study period. Zone 3 accounted for substantially more incidents than any other police zone, with approximately 143 incidents during the study period. Zones 4 and 5 experienced the next highest levels of activity, while drone-supported incidents less frequent in Zones 1, 2, and 6.

**Figure 3. Drone-Supported CAD Incidents by Police Zone**

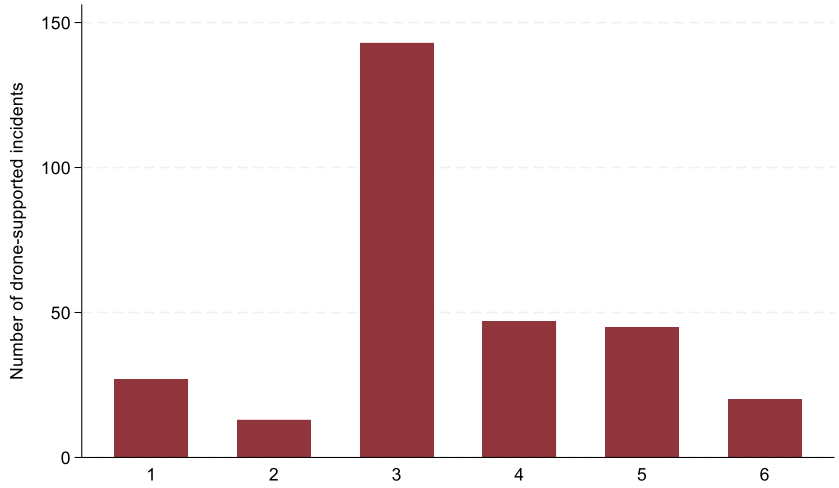



Figure 4 below provides a more detailed understanding of drone deployment by mapping unique drone-supported CAD incidents across cruiser districts. Although drone-supported incidents occurred throughout much of the city, their distribution varied considerably. Several cruiser districts experienced relatively high concentrations of drone-supported incidents, while many districts had few or no such incidents during the study period. These findings demonstrate substantial geographic variation in drone deployment both across and within police zones.

**Figure 4. Drone-Supported CAD Incidents by Cruiser District**

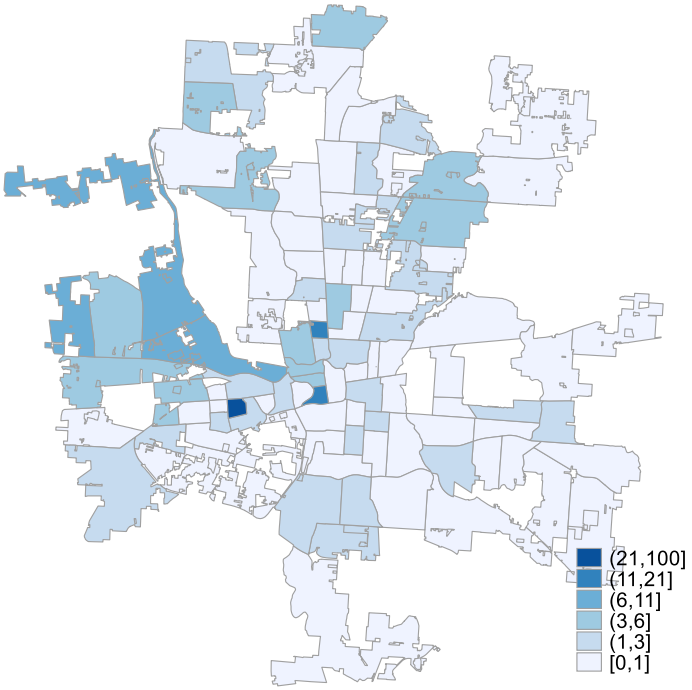
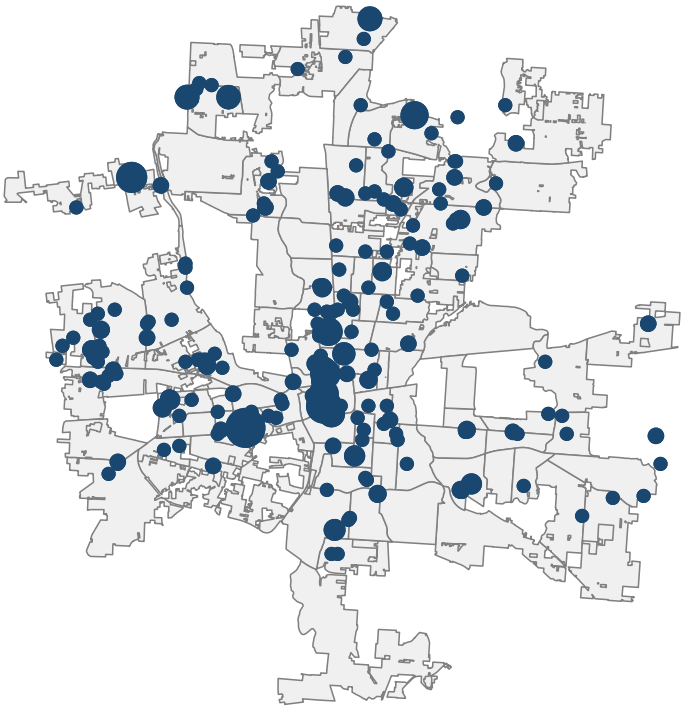


**Figure 5. Frequency of Drone Launches by Location**



*Note: Point size reflects the number of CAD-linked flights launched from each location. Cruiser-district boundaries are shown for geographic reference.*

Figure 5 examines a different aspect of the RAVEN program's geographic distribution by mapping the locations from which drones were physically launched. The map displays launch locations for CAD-linked flights, with larger symbols indicating locations used more frequently for drone deployments. Launch activity was geographically dispersed across the city, although several locations were used repeatedly, particularly in the Hilltop neighborhood on the city's west side and near CDP Headquarters in downtown Columbus, where many large public events and demonstrations occur. These findings are consistent with the RAVEN program's patrol-based deployment model, in which pilots select launch locations based on operational needs and incident circumstances rather than relying on a small number of fixed launch sites.

# 4. MISSION OBJECTIVES AND OPERATIONAL PERFORMANCE

## Reporting and Measurement Considerations

To assess the operational purposes and performance of drone deployments, we used information recorded in the flight reports. The records contain measures of mission objectives, whether the drone was first on scene, perceived deployment effectiveness, equipment performance, operational problems, and other mission outcomes. These measures provide

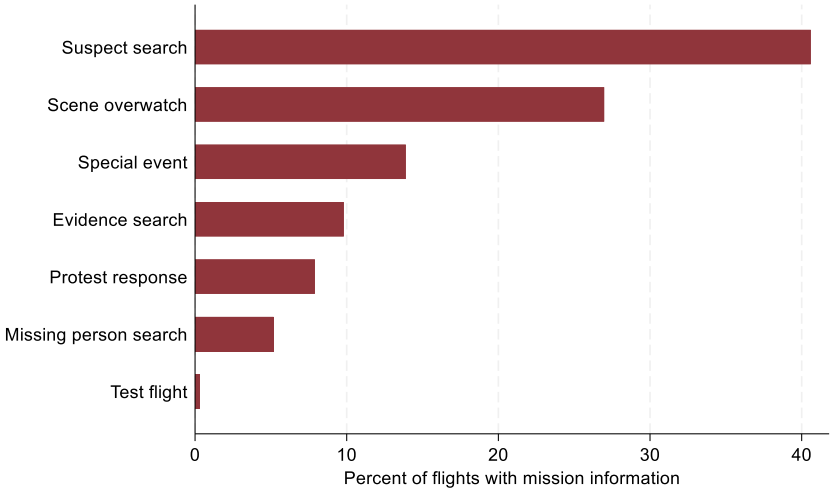
useful descriptive indicators of RAVEN Program's operational effectiveness. Importantly, however, the relevant fields in the flight reports were not populated for every CAD-linked physical flight. Interviews with RAVEN program personnel provided important context for understanding this reporting pattern. When multiple drone flights were associated with a single CAD incident, deployment information was not necessarily entered separately for each flight. Instead, information about the mission and its outcomes was generally documented once for each incident. Consequently, missing information on an individual flight record does not necessarily indicate that the deployment was undocumented or that the relevant activity did not occur. The analyses below report results among CAD-linked flights for which information was available for relevant measures. The findings should be interpreted as descriptive indicators of operational effectiveness as opposed to impact of the program on police operational outcomes.

# Mission Objectives

Figure 6 presents the reported mission objectives of CAD-linked drone flights. Suspect searches were the most frequently reported objective, accounting for approximately 41% of flights. Scene overwatch was the second most common objective, accounting for approximately 27%. Special events accounted for approximately 14%, followed by evidence searches (10%), protest response (8%), and missing-person searches (5%). Because a flight could have more than one mission objective, these categories are not mutually exclusive and the percentages do not sum to 100%.

The distribution of mission objectives demonstrates that RAVEN serves a range of operational purposes beyond locating suspects. Scene overwatch, special-event operations, and protest response represent uses in which the primary value of the drone is providing ground personnel with an aerial view of an evolving situation. This function was particularly evident during the research team's observations of drone operations at the Columbus Pride Parade and the Sonic Temple Art & Music Festival. Interviews with pilots similarly indicated that drones can provide commanders responsible for managing large events and protests with real-time situational awareness that is difficult to obtain from personnel positioned at ground level. The aerial views can allow commanders to monitor crowd movements, identify emerging issues, and make more informed decisions about the positioning and deployment of personnel and other resources.

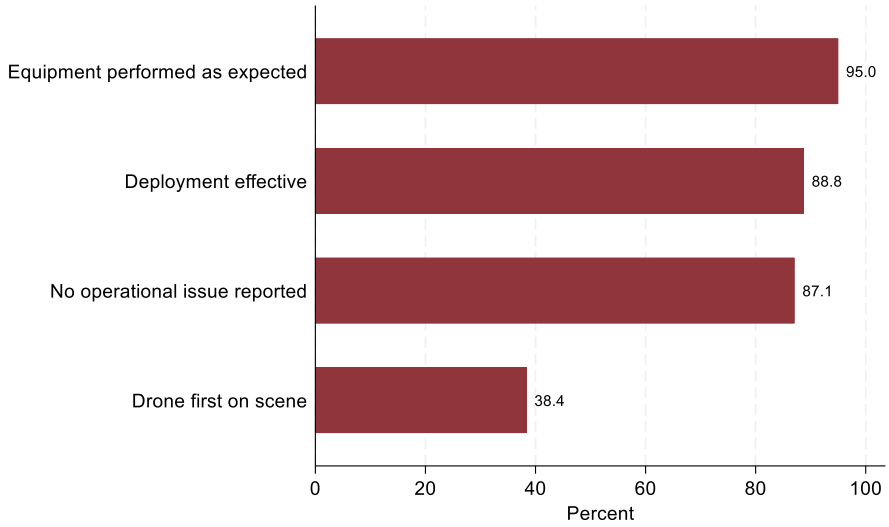
**Figure 6. Drone Mission Objectives**




# Operational Performance Indicators

Figure 7 presents four available indicators of operational performance among CAD-linked flights with reported information. Overall, the available flight reports indicate favorable assessments of RAVEN Program operational performance. Equipment was reported to have performed as expected in 95.0% of flights with available information, 88.8% of deployments were perceived by drone pilots as effective, and 87.1% had no reported operational problem/issue.

**Figure 7. Drone Operational Performance Indicators**




However, the final indicator of operational performance, whether the drone was first on scene, presented a different picture. Drones were reported to be first on scene in 38.4% of deployments with available information. This lower rate highlighted an important operational

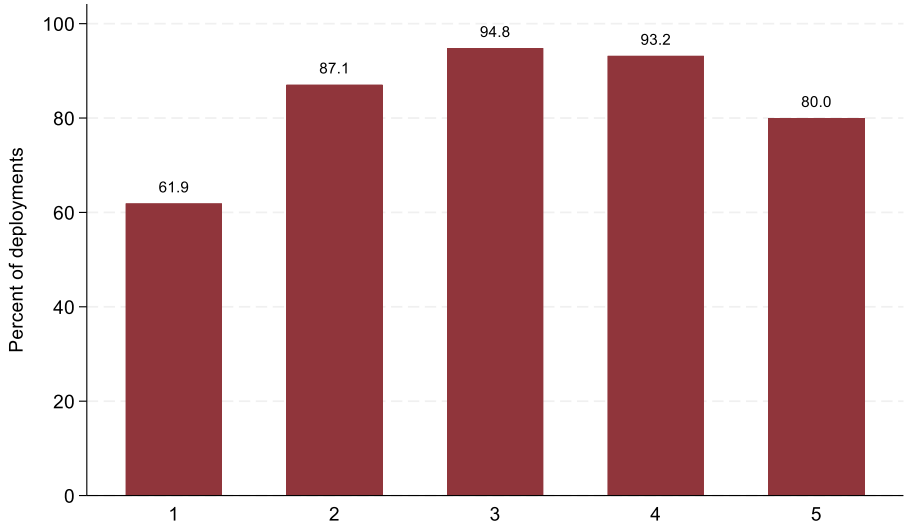
constraint associated with the patrol-based deployment model. Unlike a Drone as First Responder (DFR) model, in which drones can be launched immediately from fixed locations, RAVEN Program pilots deployed drones from patrol vehicles. Interviews indicated that when pilots received requests for drone support, they first had to travel to an appropriate launch location near the incident before deploying the aircraft. As a result, responding patrol officers often arrived at the scene before the pilot reached a suitable launch location and launched the drone.

This finding highlights an important tradeoff associated with the patrol-based drone deployment model. Although this approach provides flexibility in where aircraft can be launched, the time it requires for pilots to travel to an incident can delay the availability of aerial support and limit the drone's ability to contribute during the earliest stages of an incident. This constraint, however, does not necessarily eliminate the operational value of a drone support. Interviews and field observations indicated that drones provided substantial value during incidents that extend over time, particularly for suspect and missing person searches, special events, and protest responses. In these circumstances, drones can provide commanders and officers with real-time aerial views that may assist with searches, monitoring changing conditions, and making operational decisions.

# Effectiveness by Event Priority Levels

Figure 8 examines deployment effectiveness by CAD event priority level for incidents with available information. Because Priority 1 represents CDP's highest-priority calls, this comparison provides an initial indication of whether the perceived effectiveness of drone deployments varied according to the urgency of the incident. Reported effectiveness was generally high for Priority 2 through Priority 4 deployments. Approximately 87.1% of Priority 2 deployments were rated as effective, increasing to 94.7% for Priority 3 incidents and 93.2% for Priority 4 incidents. By comparison, the effectiveness rate for Priority 1 incidents was considerably lower, at 61.9%. Effectiveness was reported for 80.0% of Priority 5 incidents, although the small number of Priority 5 cases warrants caution in interpreting that estimate.

**Figure 8. Drone Deployment Effectiveness by CAD Priority**




The lower reported effectiveness for Priority 1 incidents was consistent with the operational constraints identified in the pilot interviews. Because these calls involved the most urgent incidents, the time required for a pilot to travel to an appropriate launch location and deploy the aircraft may have reduced the opportunity for the drone to contribute during the most time-sensitive stages of the response. By contrast, incidents that unfolded over longer periods provided greater opportunities for drones to contribute through searches, scene overwatch, and ongoing situational awareness, even when the aircraft was not first on scene. As a result, drones may have been perceived as more effective during incidents that allowed sufficient time for aerial support to be deployed and integrated into ongoing operations.

# 5. OPERATIONAL PROCEDURES, TRAINING, AND STAFFING

## Operational Procedures

The successful integration of drones into patrol operations depends not only on the capabilities of the technology but also on the policies, procedures, training, and staffing necessary to support their effective use. CDP's operational framework for the RAVEN Program is outlined in its SOP, which establish authorized uses, legal and regulatory requirements, pilot and visual-observer responsibilities, flight-safety protocols, reporting process, and deployment procedures.

Interviews with drone pilots indicated that day-to-day operations were generally consistent with these procedures. Pilots reported having sufficient discretion to determine when drone deployment was appropriate and how aerial support could best assist an incident. This

flexibility was viewed as important given the wide range of operational contexts in which drones were deployed, including suspect and missing-person searches, scene overwatch, crowd management, and special events. Overall, pilots viewed the SOP as providing a clear operational framework while preserving the flexibility needed to respond to evolving field conditions.

Interviews also identified challenges related to airspace awareness and regulatory compliance. Because pilots were responsible for determining whether flight restrictions or other airspace limitations affected proposed deployments, access to accurate and timely information was critical. Several pilots reported that obtaining current information on airspace restrictions was not always straightforward, particularly when conditions changed rapidly. Improving access to real-time information on airspace restrictions and flight authorizations could therefore strengthen deployment decision-making and support continued compliance with FAA requirements.

Overall, the findings suggest that the RAVEN program's operational procedures have been successfully integrated into routine practice. At the same time, improvements in pilots' access to airspace information could further support safe and effective drone deployments.

# Training and Preparation

Interviews with pilots indicated that the initial training they received provided a strong foundation for drone operations and policies. As training occurred during the program's initial implementation, respondents noted a need for periodic refresher and advanced training as the program matures. Ongoing training would provide opportunities to reinforce operational procedures, incorporate lessons learned from deployments, address changes in technology and regulatory requirements, and disseminate emerging practices across the pilot group.

The interviews also identified a gap in the training of visual observers. Although visual observers play an important role in supporting safe and effective flight operations, they currently do not receive formal training comparable to that provided to pilots on a division-wide basis. CDP has provided initial visual observer training in precincts where drone operations are assigned and has developed a formal training curriculum for visual observers; however, the program has not yet been fully implemented across patrol operations. Implementing this training would help ensure that personnel have a common understanding of their responsibilities, operational procedures, federal regulations, and best practices for supporting patrol-based drone operations.

Overall, CDP has established a solid training foundation for pilots. As the program continues to evolve, investments in refresher training for pilots and standardized training for visual observers could further strengthen operational consistency, safety, and deployment effectiveness.

# Staffing and Deployment Capacity

Staffing emerged as one of the most significant challenges identified through patrol officer and supervisor (sergeants) interviews. Drone pilots generally performed drone deployment duties in addition to their regular patrol assignments rather than serving as dedicated drone operators. Consequently, the presence of trained pilots within the division did not necessarily mean that those officers were always available to respond to requests for drone support.

This challenge was particularly pronounced during periods of patrol staffing shortages. Interview participants indicated that supervisors were often reluctant to release a drone pilot from regular patrol responsibilities when staffing levels were low. As a result, requests for drone support frequently competed with immediate patrol service demands. Pilot availability also varied seasonally because some pilots were assigned to other special duties during the summer months.

Staffing constraints also interacted with the patrol-based nature of the deployment model. Even when a pilot was available, they often had to travel to a suitable launch location near the incident before deploying the aircraft. Interviews with pilots indicated that travel to a launch location could take approximately 10 to 15 minutes in some cases, delaying the availability of aerial support. Limited pilot availability could further compound deployment delays. Additionally, pilots were sometimes called upon to support incidents in areas of the city or police zones in which they were less familiar, potentially making it more difficult to quickly identify appropriate launch locations and navigate local operational considerations. Increasing the number of trained pilots would improve the likelihood that a pilot was available closer to an incident, enhance geographic coverage across the city, and reduce deployment times.

Expanding the number of trained pilots alone, however, may not fully address these challenges. Because supervisors play a key role in determining whether officers can be released from their regular assignments to support drone deployment, they need a clear understanding of drone capabilities and how drone support can provide operational value. Providing supervisors with additional information and guidance regarding the capabilities, limitations, and appropriate uses of drones could help them make more informed decisions when balancing requests for drone support against competing staffing demands. The information and guidance could also strengthen visual observer participation by supporting expanded training and highlighting the critical role of observers, resulting in increased and improved operational support during deployments.

More broadly, the findings highlight the importance of aligning a drone program's deployment model with available resources. While patrol-based models can leverage existing patrol personnel and allow drones to be repositioned as operational needs change, they may also be associated with deployment delays because pilots must travel to an incident before launching a drone. Understanding these tradeoffs is important when assessing program performance and considering future program expansion.

Overall, the findings suggest that staffing capacity represented one of the primary constraints on the implementation of the RAVEN pilot program. While the program's operational framework appeared well aligned with field practices, the ability to provide timely and consistent drone support was influenced by pilot availability, supervisor release decisions, and the patrol-based deployment model itself. Expanding the number and geographic distribution of pilots could improve deployment capacity and reduce response times. Alternatively, CDP could consider establishing dedicated drone pilot positions or a specialized drone unit whose primary responsibility would be to provide aerial support to patrol officers and special operations and events, thereby reducing the competing demands associated with patrol-based assignments. At the same time, investments in recurrent pilot training, standardized visual-observer training, and supervisor education regarding the capabilities and appropriate uses of drones could further strengthen the program's operational effectiveness and long-term sustainability.

# 6. SUMMARY OF KEY ACCOMPLISHMENTS AND IMPLEMENTATION CHALLENGES

The findings suggest that the RAVEN pilot program has successfully demonstrated the operational utility of drones across a variety of policing contexts. Administratively, CDP has established the foundational infrastructure necessary to support drone operations, including a formal standard operating procedure (SOP), a cadre of FAA-certified pilots, and a deployment reporting system. These systems provide a framework for safe and accountable operations while also creating a foundation for future performance measurement and evaluation.

Operationally, drones were deployed in support of a diverse range of calls for service and police activities across the division. Drone deployments occurred in response to both citizen-generated calls and officer-initiated incidents and supported a wide variety of operational objectives, including suspect searches, missing-person searches, scene overwatch, crowd management, special events, and tactical operations. Deployments were distributed across all six patrol zones, demonstrating the program's flexibility and applicability to a broad range of policing contexts.

Drones provided real-time situational awareness during large public events and suspect and missing-person searches. Field observations indicated that aerial information enhanced commanders' awareness of changing conditions and supported more informed decision-making during incident response. Drones were also reported to improve scene overwatch, perimeter management, and officer coordination during evolving events.

The technology appeared particularly valuable for search-related operations. Personnel reported that thermal-imaging capabilities enhanced missing-person searches and suspect-

search operations, and drones were credited with assisting in suspect apprehensions in several incidents. Respondents also emphasized the safety benefits associated with drone deployment, noting that drones allowed officers to assess hazardous, uncertain, or difficult-to-access areas before committing personnel to those environments.

Despite these accomplishments, the study identified several major implementation challenges that affected the program's efficiency, coverage, and long-term sustainability. The most significant challenge was the patrol-based deployment model itself. Pilots were required to travel to an incident area before launching a drone. As a result, many incidents were resolved before a drone could arrive and become operational, limiting the program's ability to support rapidly evolving calls. The study found that drones were reported to be first on scene in fewer than four out of ten deployments, highlighting the operational constraints associated with patrol-based deployment. Staffing and deployment capacity also emerged as significant concerns.

Because pilots performed drone duties in addition to their regular patrol duties, their availability varied across shifts, patrol zones, and time periods. Supervisors were sometimes reluctant to release pilots from regular patrol responsibilities during staffing shortages, reducing deployment consistency. Limited availability and engagement of trained visual observers created additional constraints. Resource limitations further affected operational capacity. Limited numbers of available pilots and aircraft also constrained citywide coverage. Pilots also noted that the lack of parachute-equipped aircraft restricted some deployments over people, vehicles, and roadways.

The study also identified opportunities to strengthen performance measurement and program evaluation. Although deployment reports provide valuable operational information, flight records and CAD data are not yet fully integrated for routine performance assessment. Important measures, such as response times from deployment request to launch and from deployment request to arrival on scene, are not consistently tracked. As a result, current data systems provide only limited ability to evaluate program effectiveness or assess operational outcomes.

Finally, future expansion of the program will require continued attention to governance, accountability, and community trust. Key considerations include maintaining compliance with FAA requirements, addressing privacy and liability concerns, improving public transparency regarding drone deployment practices, and securing the resources necessary to expand capacity while maintaining training quality, supervision, safety, and accountability.

# 7. RECOMMENDATIONS

The implementation assessment identified several opportunities to strengthen the RAVEN program. The recommendations below are informed by findings from the administrative data, interviews, SOP review, and field observations and are intended to improve deployment capacity, operational effectiveness, performance measurement, and program sustainability.

- **Enhance Staffing and Deployment Capacity.** Staffing limitations emerged as one of the primary constraints on the RAVEN Program. CDP should expand the number and geographic distribution of trained drone pilots to improve coverage across patrol zones and shifts. As the program matures, CDP should also consider alternative staffing models, including dedicated drone operators and a dedicated supervisor to oversee the program operations, training, deployment coordination, and quality assurance
- **Strengthen Training and Operational Readiness.** While pilots viewed the current training program positively, interviews identified a need for ongoing training and greater support for visual observers. CDP should implement periodic refresher training for pilots, establish a standardized visual-observer training program, and continue incorporating lessons learned from deployments into training and operational procedures.
- **Establish a General Order or Department Policy**. A formal policy establishes a consistent framework for officer decision-making, documentation, and supervisory oversight. It also reduces ambiguity for personnel, supports risk management practices, and promotes consistent implementation of the program across shifts, units, and operational environments.
- **Improve Coverage and Operational Resources.** Limited personnel and equipment constrained drone deployments. CDP should evaluate opportunities to improve coverage across shifts and consider purchasing parachutes to expand operational flexibility.
- **Enhance Data Collection and Performance Measurement.** Although the RAVEN Program has established a strong reporting foundation, additional performance measures are needed to support ongoing management and future evaluation. CDP should improve the integration of flight-report and CAD data, standardize reporting requirements, and routinely track key metrics, including deployment requests, response times, mission outcomes, and operational effectiveness. The objectives of all flights, including training, testing, equipment checks, and other activities, should be recorded in the Skydio flight data reporting platform. Particular attention should be given to documenting incidents in which drone support was requested but not deployed, including the reasons deployment did not occur.
- **Develop an Evaluation Framework for Measuring Outcomes.** Future assessment efforts should move beyond implementation measures to evaluate operational outcomes. CDP should continue developing the data infrastructure needed to assess how drone deployments affect searches, suspect apprehensions, event management, patrol operations, officer safety, and other operational outcomes. Establishing baseline measures and long-term performance benchmarks will support future impact evaluations and inform resource allocation decisions.
- **Enhance Transparency and Community Awareness.** As the program expands, CDP should continue to prioritize transparency and accountability. Public-facing information, such as deployment statistics, privacy and data-protection safeguards, program policies, and operational outcomes, can help build community awareness and confidence in the program. Regular reviews of policies and procedures should also be conducted to ensure

that drone operations remain consistent with legal requirements, FAA regulations, technological developments, and evolving community expectations.

- **Evaluate Alternative Deployment Models.** The current patrol-based deployment model imposes significant resource and response-time constraints. CDP should consider piloting alternative deployment models in targeted areas with high demand for police services. Based on observed deployment patterns and operational demand, potential pilot locations could include areas near CDP Headquarters in the downtown core, as well as in the city's East and West sides that experience high volumes of calls for service. Strategically positioning drone resources in these areas may improve response times and increase the likelihood that drones can provide effective aerial support during the earliest stages of an incident.

# 8. LESSONS LEARNED

The findings from CDP's RAVEN Program offer important lessons for Ohio law enforcement agencies considering similar drone initiatives. Its pilot program is notable because it relies on patrol-based, field-deployed drones rather than a traditional fixed-site DFR model. Although this approach was designed to meet the needs of a major urban agency, many of the program's observations and recommendations are applicable to agencies of varying sizes. In particular, the findings may benefit departments that use field-deployed drones as a primary operational model or to supplement DFR programs.

First, agencies should clearly define the operational objectives of drone deployment and prioritize mission types that provide the greatest value to patrol officers and commanders. In Columbus, drones proved particularly effective during large events, protests, searches, scene overwatch operations, and other incidents requiring enhanced situational awareness. Focusing drone deployments on clearly identified operational needs can help agencies maximize the effectiveness of the technology and ensure that resources are used efficiently.

Second, agencies should carefully evaluate staffing capacity and deployment models before program adoption. Patrol-based deployment models provide flexibility and broad geographic coverage, but they also introduce response-time constraints because pilots must travel to an incident before launching a drone. Agencies should not assume that patrol-based deployments will provide the same operational benefits as DFR models for rapidly evolving incidents. Adequate staffing is particularly important. Drone operations should be treated as an operational capability requiring dedicated personnel rather than simply an additional role for patrol officers.

Third, successful implementation requires investment in training and operational readiness. Agencies should establish formal training programs not only for pilots but also for visual observers and supervisors who play important roles in deployment decisions. Clear operational procedures, defined pilot authority regarding safety and compliance decisions, and routine equipment readiness checks can help ensure safe and effective deployments.

Fourth, agencies should invest early in data collection and performance measurement systems. Flight records, CAD data, incident characteristics, response times, deployment outcomes, and

operational performance measures should be designed for integration from the outset. Agencies should also document situations in which drone deployments were requested but did not occur because of staffing limitations, equipment constraints, weather conditions, regulatory restrictions, or incident resolution prior to deployment. Tracking these missed deployment opportunities can provide valuable information about program capacity and operational limitations.

Fifth, agencies should adopt a phased approach to program expansion. Pilot testing new deployment models, technologies, or operational concepts in targeted areas can help agencies identify implementation challenges before committing resources to large-scale expansion. Program design should remain responsive to local conditions and community expectations.

Finally, transparency and accountability should be incorporated into program development from the beginning. Public-facing information explaining authorized uses, safeguards, privacy protections, retention policies, and accountability mechanisms can help build community trust.