

Persistent Surveillance



Systems

# Wide Area Surveillance in Support of Law Enforcement

Ross T. McNutt

Persistent Surveillance Systems

Jan 2014

# Persistent Surveillance Systems, LLC



**Ross McNutt**  
*President &  
 Chief Executive Officer*

Advisory board

**Stacy McNutt**  
*Vice President  
 Business Operations*

Lawyer  
**Wayne Waite Esq**

Software  
 Development  
  
**Josh Wert**

Accounting  
 Laura Bragg, CPA

HR/Security  
 Facilities/Admin

Communications

Contracts

**MacAir Aero Club**  
  
 Joe Callawear  
 Club Manager  
  
 Mission Statement:  
 Provide fun, safe and cost effective Flying for members  
  
 Flight Training

**MacAir Aviation Services** P&L  
 Director of Ops  
  
 Mission Statement:  
 To be recognized by our customers, our teammates and our vendors as the premier FBO of choice.  
  
 To provide exceptional aviation services to our customers through dedication to quality, safety, and efficiency while maintaining a commitment to growth and the development of our team.  
 Current Customers:  
 1. PSS Support  
 2. AAL AFSAM  
 3. General Public

## Persistent Surveillance Systems (Core)

**Surveillance Operations**  
  
 Alex Blasingame  
 Peter Hairston  
 Directors of Operations  
  
 Deployed Operations  
 Integrated Surveillance Center  
 -Tech Town w Dayton PD / IDCAST  
 Integrated Analysis Center – ATIC  
 ATEP Ball/NASIC  
 Mission Statement:  
 Committed to providing service for our customers across digital channels. That means focusing on Analyzing sensitive data. The PSS Digital team focuses on delivering cutting edge technology solutions to our customer needs.  
 Current Customers:  
 1. DPD, DHS, DEA  
 2. ATEP  
 3. PSS

**Business Development**  
  
 Rob Casebere  
 Director Business Development  
  
 Northrop Grumman  
 United Technologies  
 Cirrus Aircraft  
  
 International  
 DeGuarde  
 MPX  
 ALBA

**Product Engineering/ Production**  
  
 Ross McNutt  
  
 Director Airborne Systems  
  
 Director Ground Systems  
  
 Director of Software

**MacNaughtan Development**  
  
 Rapid Research and Development  
  
 Ross McNutt  
  
 Mission Statement:  
 Develop new profitable products, services, and businesses and teach others to do the same  
  
 R&D Partners  
 Ohio University  
 IDCAST  
 Central State CHPSA  
 361 Interactive



# We request your help

- PSS is concerned about privacy and the impact of these systems and has draft policies for use of its and similar systems.
- PSS has been working with various police and local communities to develop appropriate policies for use in support of local law enforcement.
- Current PSS systems are currently legal and covered by existing airborne surveillance law and supreme court decisions
- These and similar technologies are coming whether PSS does it or not.
- We (PSS) request your assistance to develop appropriate policies and practices that could be adopted as the standard for us and for others.
  - Resolution Restrictions
  - Investigation Policies
  - Data Retention Policies
  - Data Access Policies
  - Oversight Procedures
  - Data Protection Policies
  - Defense Attorney Access
  - Analyst Training and Agreements
- We are asking for and would very much like your help



# Persistent Surveillance Systems

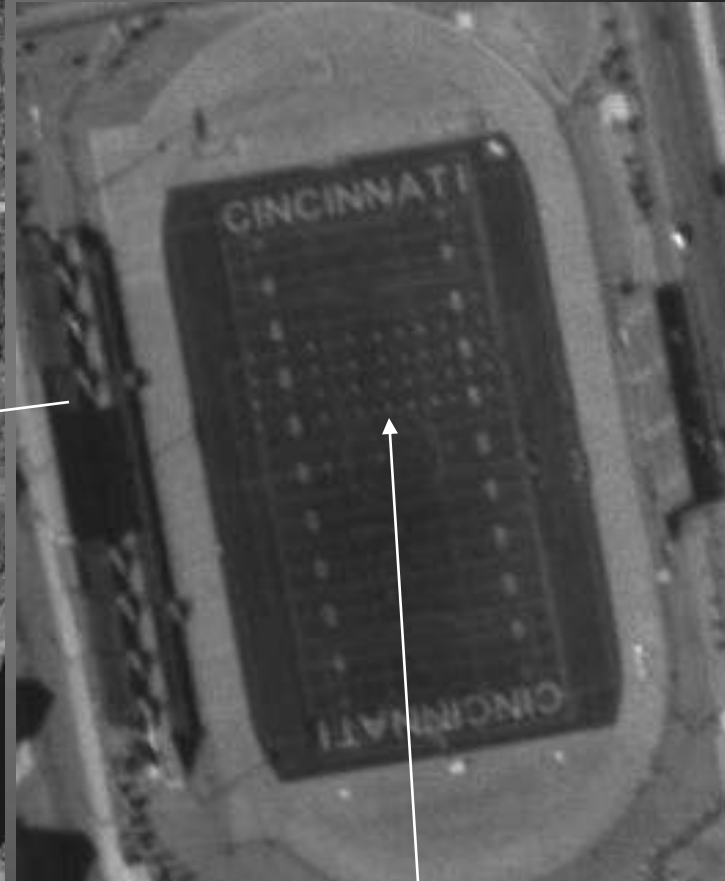
- Wide Area Airborne Surveillance Introduction
- Sample Coverage Areas
- Example Murder Investigation
- Analysis and Law Enforcement Use
- PSS and Customer Privacy Policies
- Sample City Unmet Needs
- Request to work to develop appropriate privacy policies



# Wide Area Surveillance

88 megapixels 1Hz downlinked

Cincinnati 12 Sept 07



Football players practicing



# Persistent Surveillance Systems

## Samples of Pixels

### Typical Security Camera

Standard TV	640 x 480	0.31 MP
HD TV 720P	1280 x 720	0.92 MP
HD 1080	1920 x 1080	2.07 MP
Digital Cinema 2K	2048 x 1080	2.21 MP
Imax Digital Cinema 4k	4096 x 2160	8.84 MP

### Wide Area Surveillance Systems

PSS Hawkeye		99 MP
PSS Hawkeye II Color		192 MP



13:19:05

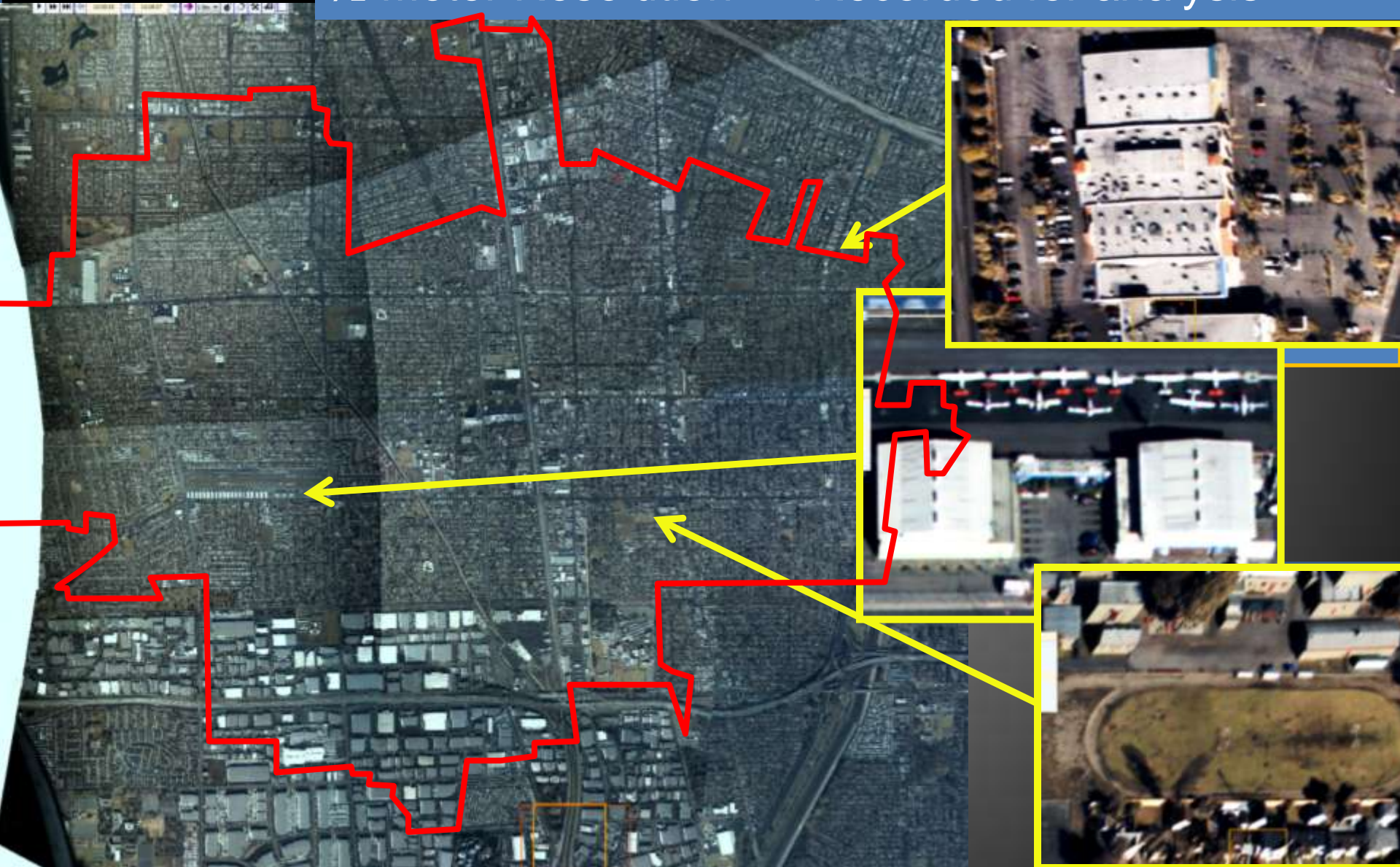
- ▼ Main Layer
- ▼ 3D Image
- ▼ Tracking
- ▼ Motion Screen
- ▼ Motion Area
- ▼ Color of Screen
- ▼ Effect





# Wide Area Surveillance

64 Square Kilometers    192 Megapixel Color Image  
1/2 Meter Resolution    Recorded for analysis

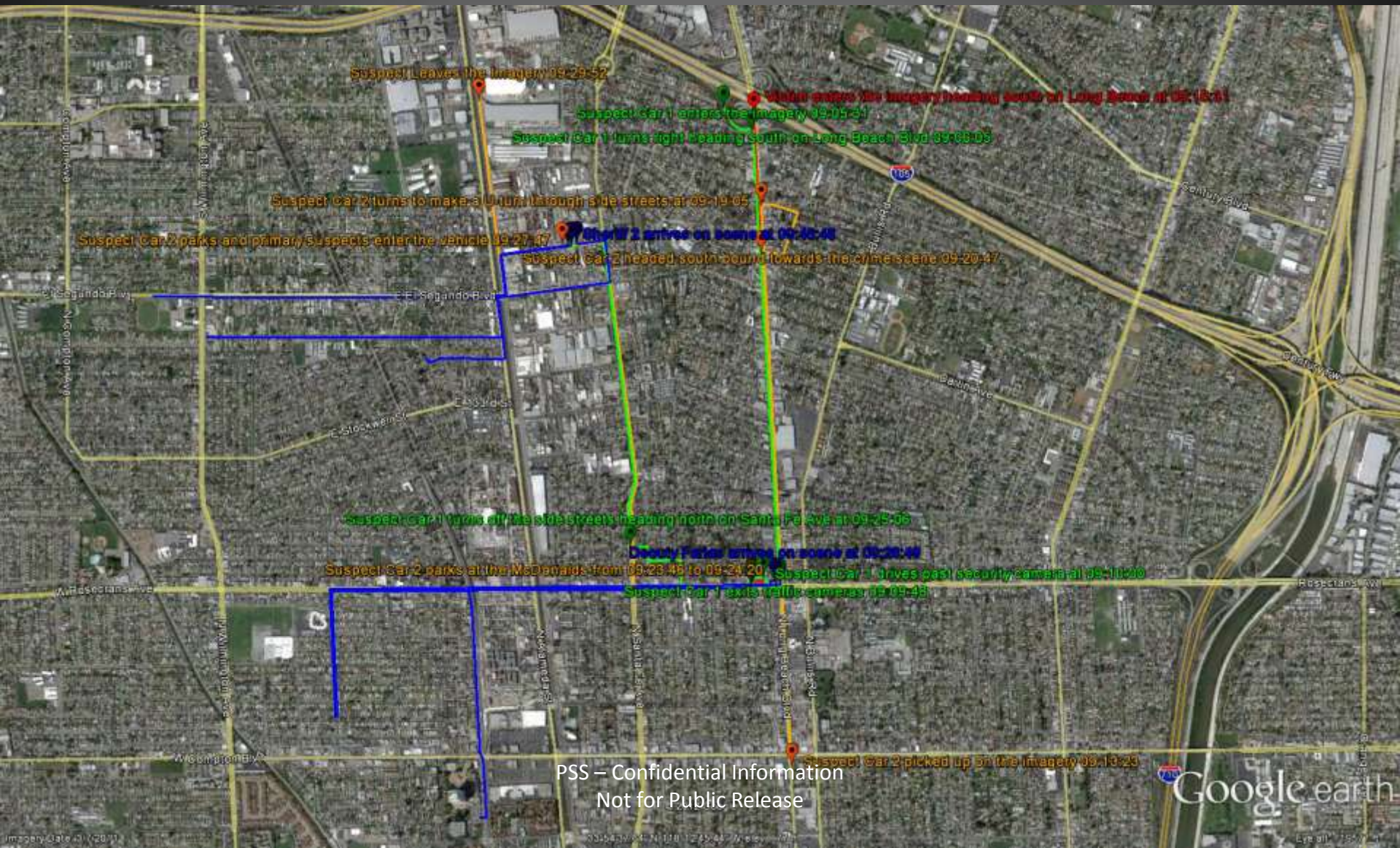






# Armed Robbery – Check Cashing Store

Rosecrans Ave and Long Beach Blvd Compton California



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Not for Public Release





# Example Investigation

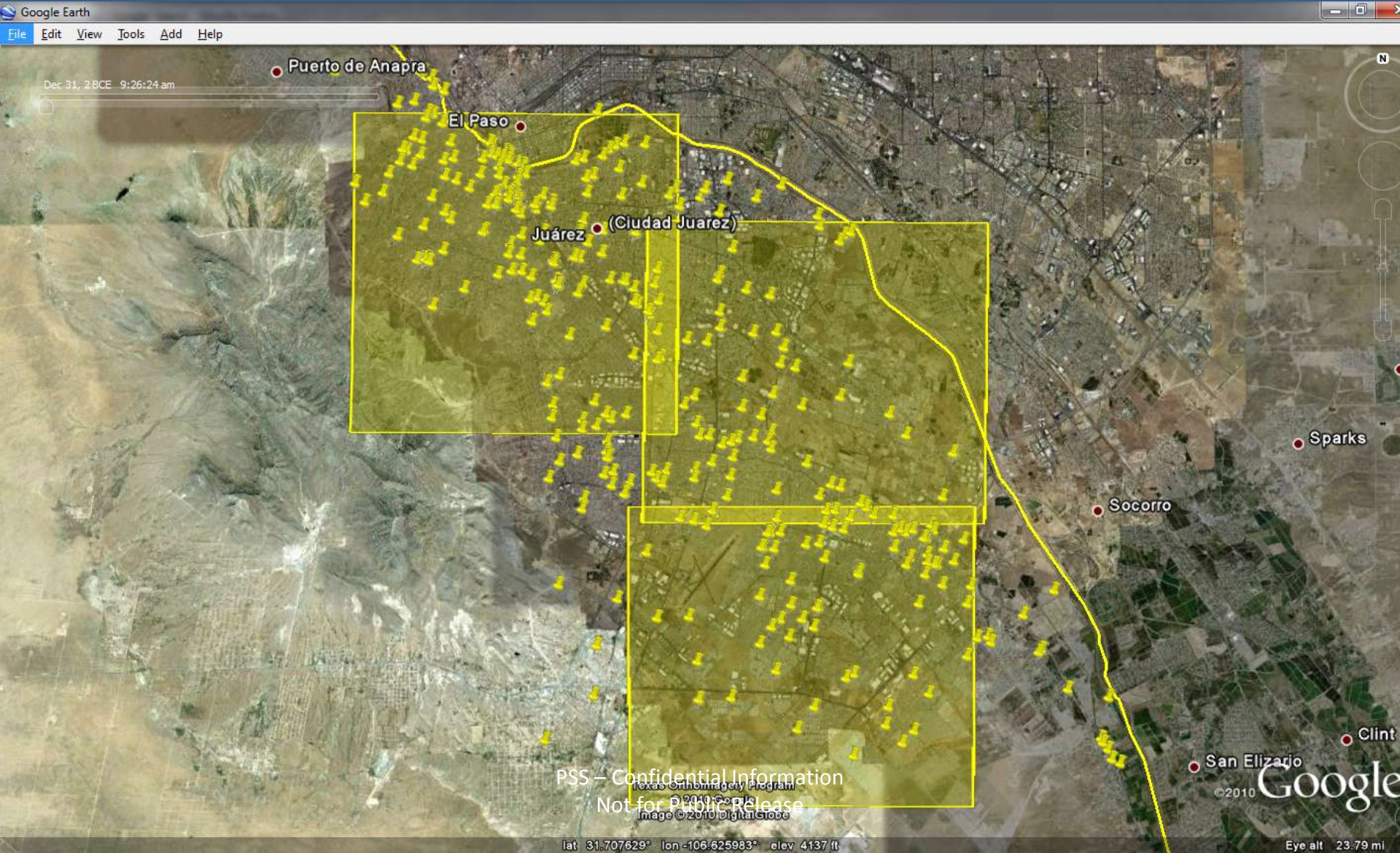
Murder #2 on  
26 Aug 09 at 13:42

Report Number 1126146  
Case Number 43132N





# Persistent Surveillance Systems Area Coverage (With 3 month murder overlay) Coverage Area 4 x 4 miles - 600,000 people within covered area





# Murders Observed and Investigated in a 2 month Period

**26 Aug 13:10 - Execution of Police Woman**

**26 Aug 13:45 - Cartel on Cartel Murder**

**31 Aug 1515 - Armed Robbery**

**1 Sept 15:20 - Body Dumping by Liberty Bridge**

**9 Sept 14:09 - Attempted Execution**

**9 Sept 14:55 - Execution of City Official**

**20 Sept 13:05 - Murder**

**24 Sept 16:15 - Execution on Street**

**25 Sept 14:22 - Execution on Street**

**29 Sept 14:47 - Murder**

**1 Oct 13:47 - Execution on Street**

**2 Oct 17:15 – Murder**

**10 Oct 1407 - Murder**

**15 Oct 14:22 - Murder**

**16 Oct 14:48 - Murder**

**21 Oct 11:56 - Double Murder**

**22 Oct 15:22 - Murder in Mall Parking Lot**

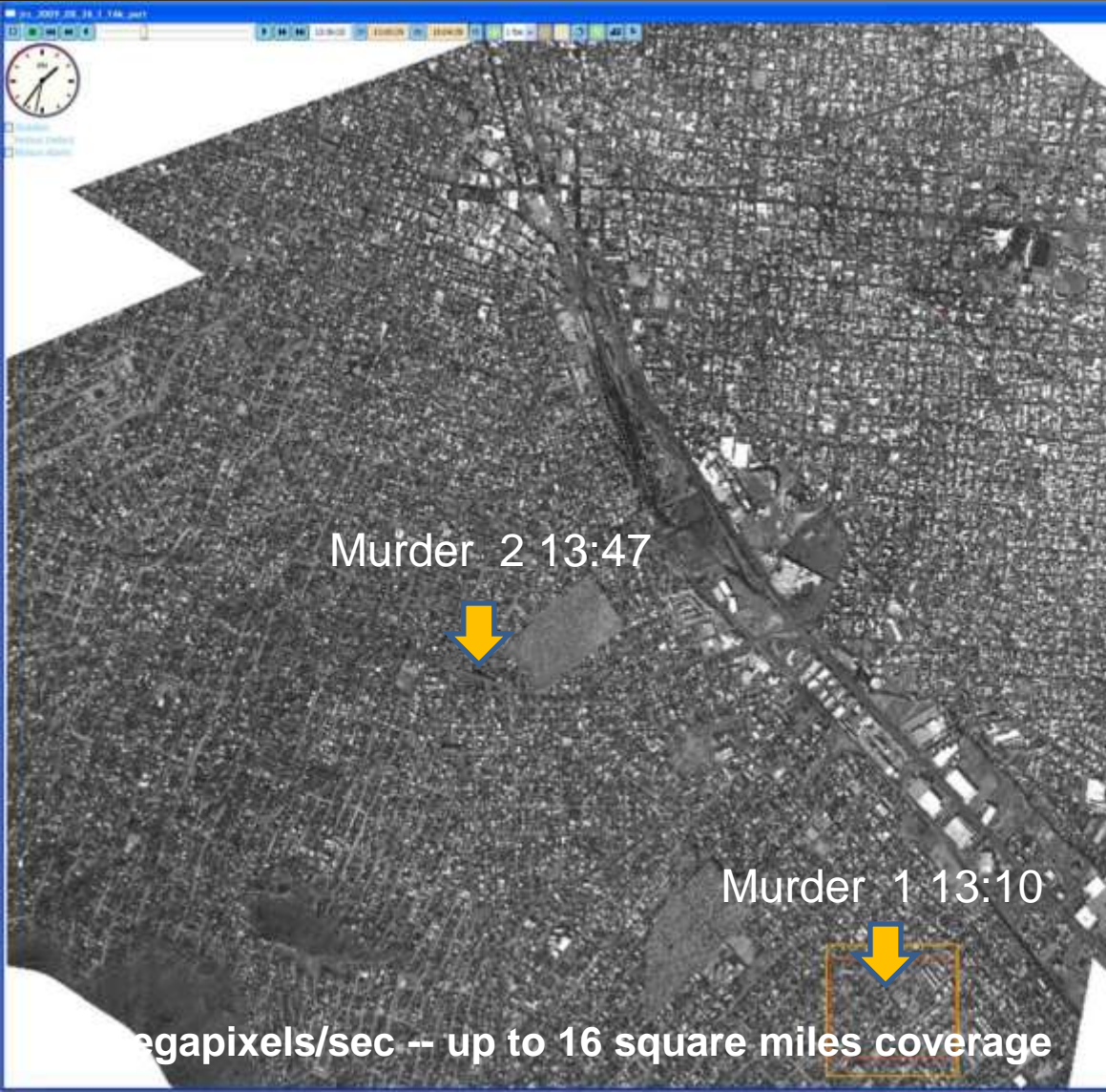
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Many more events in data collected but we have not analyzed

We witnessed many more crimes than could be analyzed with available staff



# Wide Area Surveillance Murder Examples



# Images of the Murder



# Images of the Murder





# Images of the Murder





# 3 Cars Directly Involved in Murder



Murder Car 3

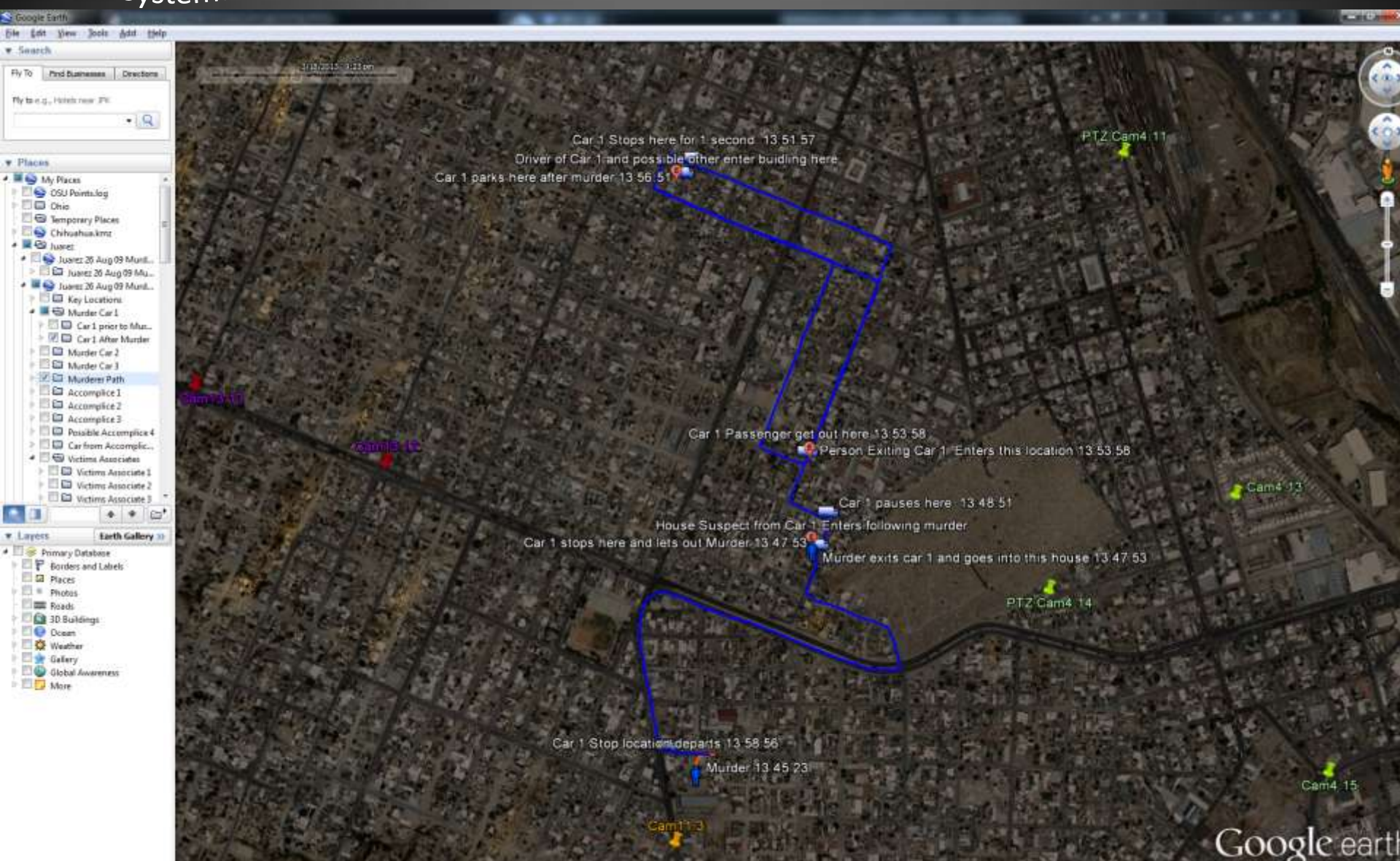
Murder Car 2

Murder Car 1  
Murder Get into  
this car after murder

Murder Location  
and Murderer

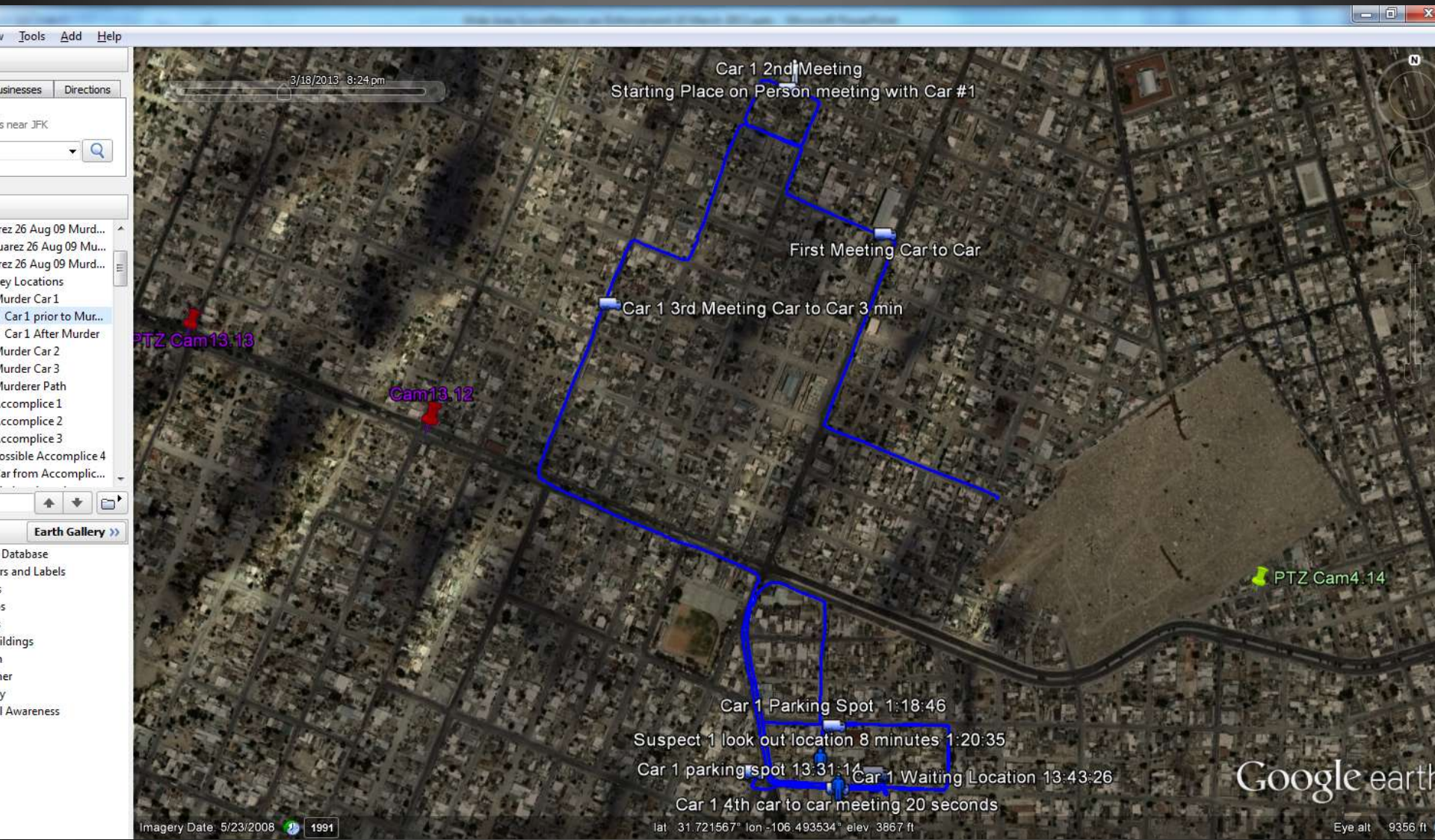


# Suspect Car 1 Path after Murder





# Suspect Car 1 Path Prior to Murder





# Suspect Murder Car #1 Timeline

- 13:01:14 Murder Car #1 Start
- 13:02:51 Car to Car Meeting With Car 3
- 13:04:20 Car to Multi People Meeting
- 13:07:32 Car to Car Meeting with Car 3
- 13:12:40 Car to Car Meeting by Where murder will happen
- 13:18:48 Person exits Car to observe area where the murder will take place
- 13:42:11 Car to Car meeting just down the block where the murder will happen
- 13:44:25 Murder Occurs
- 13:45:46 Suspect enters Car on passenger side and Suspect Car drives away
- 13:47:58 1<sup>st</sup> Person exits Car enters house
- 13:48:33 Car to Person Meeting
- 13:53:41 2<sup>nd</sup> Person exits Car and enters house
- 13:56:05 Suspect Car Parks - Driver exits Car
- 14:35:20 Suspect Car stops (37 25.818'N 122 05.36'W) 35 minutes long
- 14:39:46 Suspect Car parks and Driver exits

.....

# Post Murder Locations



Suspects from Car 1  
Enter this House after  
Murder

Suspects from Car 2  
Enter this House after  
Murder

Suspect Car #2  
Returns here after  
Murder

Suspect Car #1  
Returns here  
after Murder  
– Drops off  
person



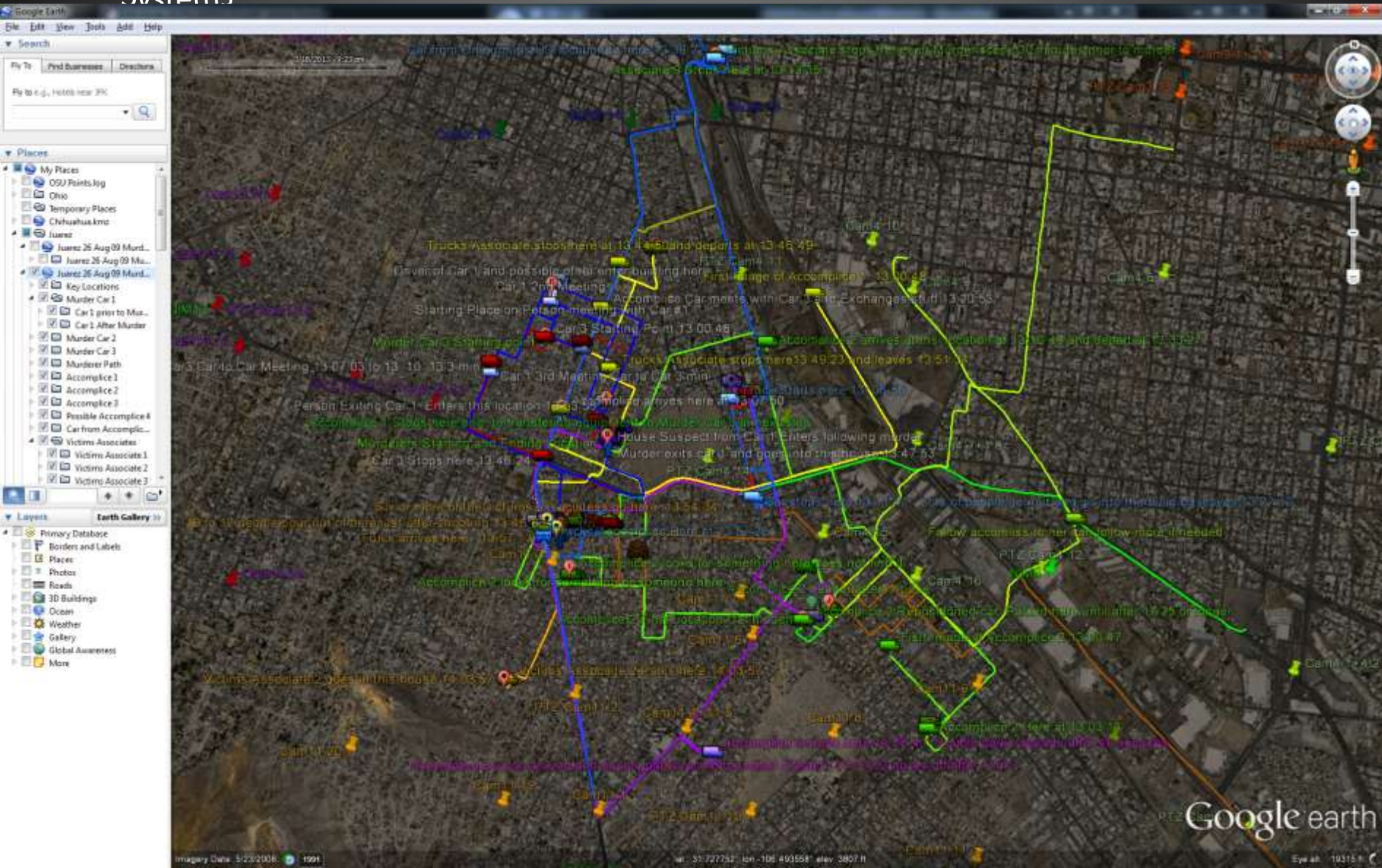
# Street View

SUSPECT #1 STARTING AND ENDING LOCATION "B"



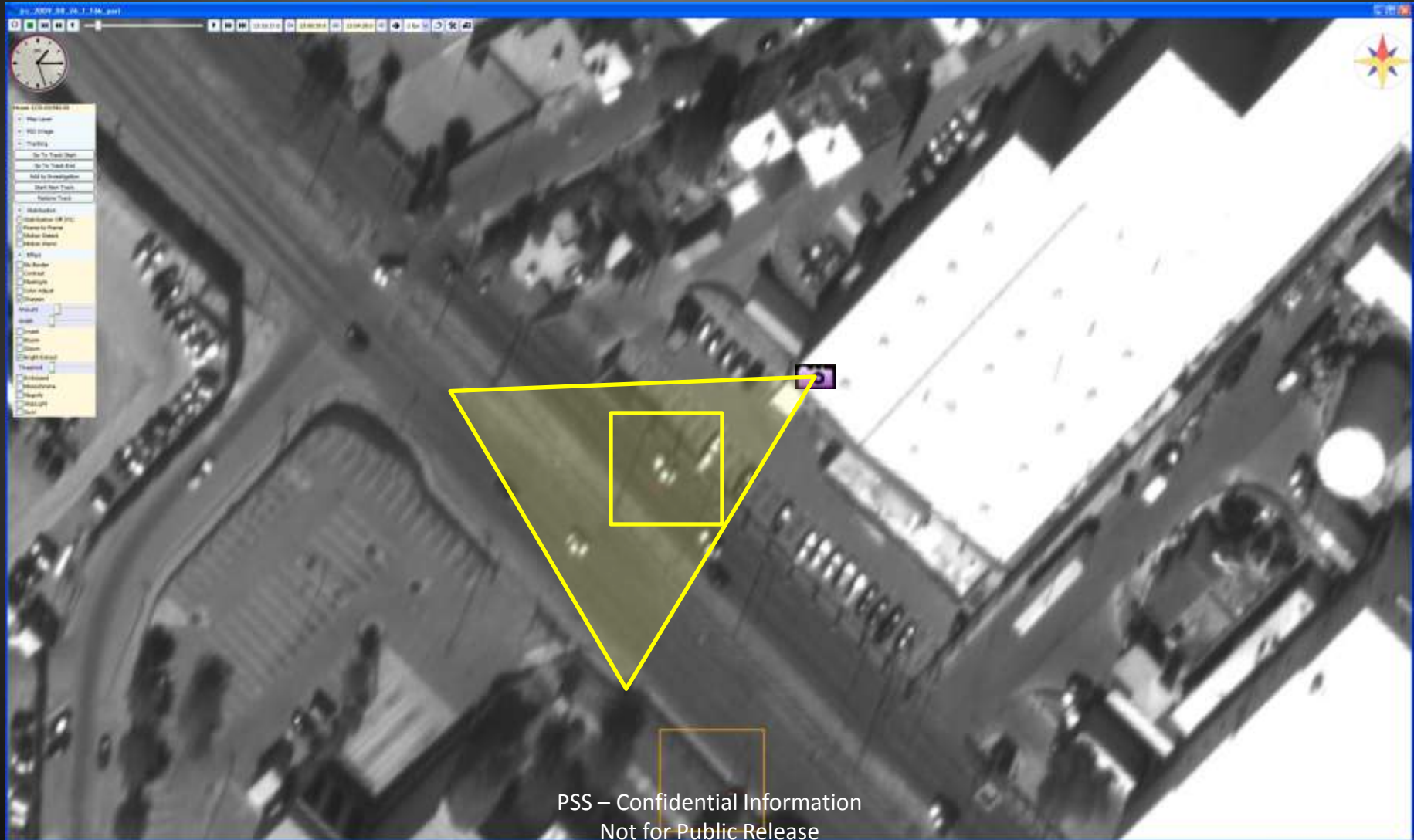


# Murderer, Accomplices, and Associates Tracked Activities 45 minutes prior and 3 hours after murder





# Suspect Car 1 in Camera 4.12 at 13:15:27



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# Annotated Reports Integrate Ground and Arial Imagery

## Car 1 and Car 2 Post-Murder Activities



Corner D.M. Ruiz & Heroes del Carrizal

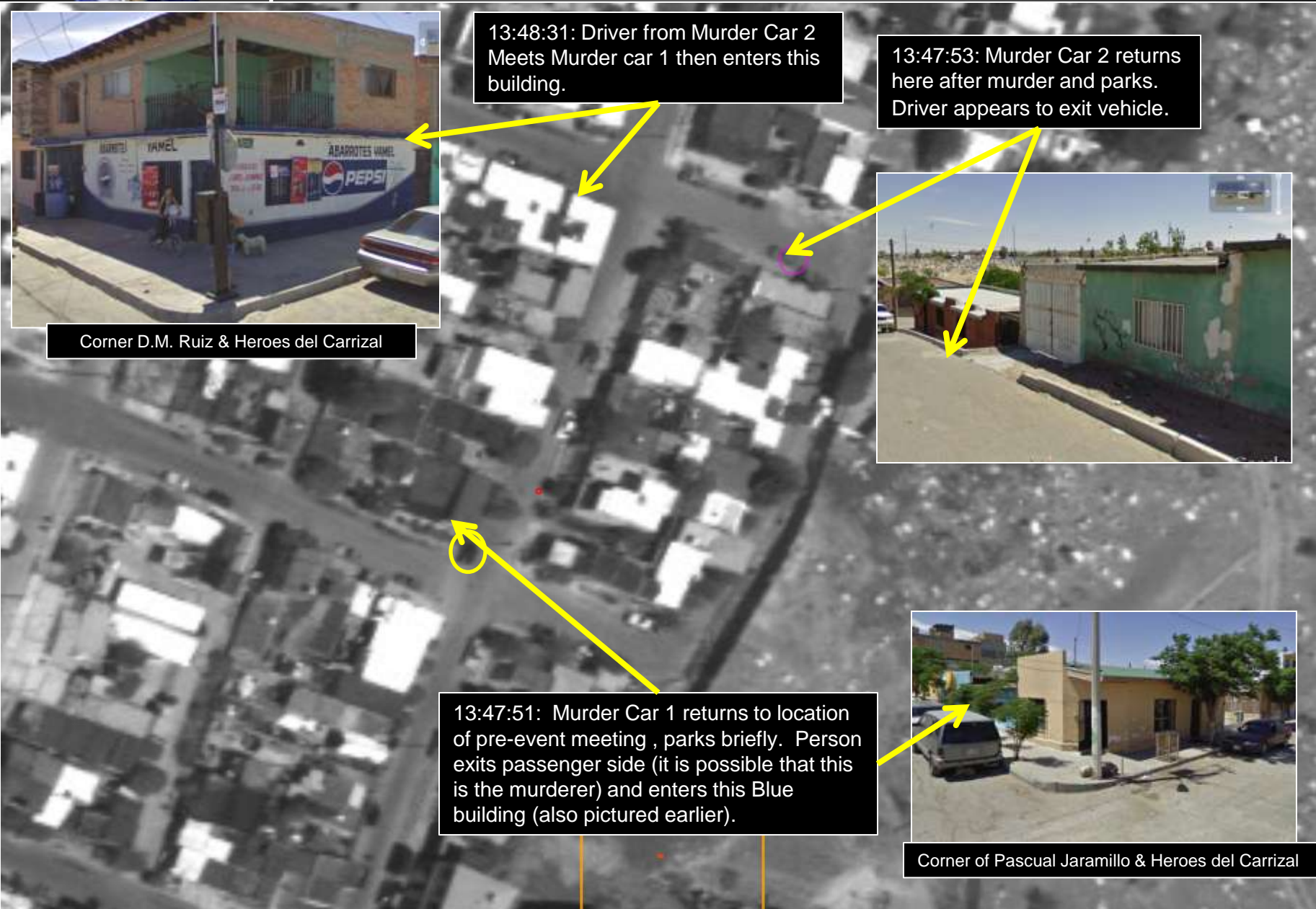
13:48:31: Driver from Murder Car 2 Meets Murder car 1 then enters this building.

13:47:53: Murder Car 2 returns here after murder and parks. Driver appears to exit vehicle.



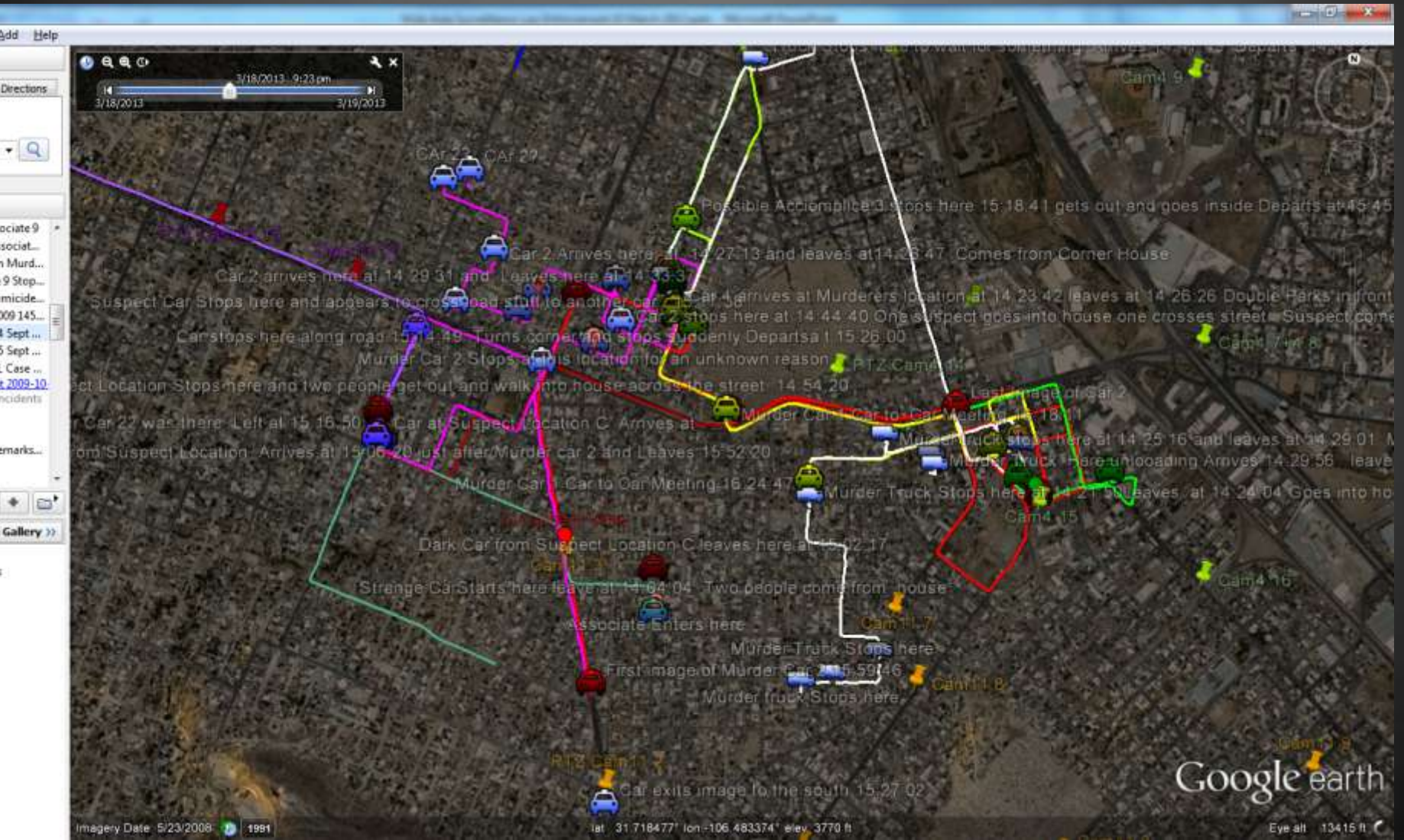
Corner of Pascual Jaramillo & Heroes del Carrizal

13:47:51: Murder Car 1 returns to location of pre-event meeting, parks briefly. Person exits passenger side (it is possible that this is the murderer) and enters this Blue building (also pictured earlier).





# 24 Sept Murder Same Group



# Analysts at Work





# Persistent Surveillance Systems

## Levels of Analysis

- **Real -Time Operational Support**
  - Event response and information forwarding
  - Multiple simultaneous location surveillance
  - Cued or tasked support - Dispatch or 911, locations of interest, BOLO
- **Level 1 Analysis - Overnight**
  - Who is directly involved with the crime
  - Where did they come from
  - Where did they go
- **Level 2 Analysis – 1-3 days**
  - Who did the criminals meet with
  - Where did they come from
  - Where did they go
- **Level 3 Network Analysis - 1 week**
  - Over the last week or two who did all of the above meet with
  - Where did they come from and where did they go



# Wide Area Surveillance Other Applications

- **Officer Support**
  - Support for local law enforcement in crime investigations
  - Philadelphia, Baltimore, Dayton, Compton, Nogales, Juarez, Mexicali, Torreon, Indianapolis, Columbus, Cleveland
- **Major Event Security**
  - Security and traffic management support of large events
  - Brickyard 400, Coca Cola 600, Sarah Palin VP announcement, 4<sup>th</sup> July Fort Leonard Wood, Ohio State Football
- **Emergency Response**
  - Quick response to natural disasters and other events
  - Iowa Floods, Gulf Oil Spill, Hurricane Sandy
- **Border Surveillance**
  - Coverage of large swaths of remote borders
  - Yuma Proving Grounds, Nogales Sector, El Paso Sector
- **Environmental Management**
  - Pipeline surveillance, environmental impact, wild life studies, traffic Studies



# User Need Analysis

Dayton Ohio Example



# Unmet Need: Dayton Crime Example

In 2010, Dayton had **28,245 reported crimes**

- 1,509 were violent crimes
- 8,890 major property crimes

Dayton's case closure rate is **14% for property crimes**

2010 FBI UCR Crime Data Table 25 Case Clearance Rates

- Similar to U.S. case closure rates for U.S. cities.
- Most cases go unsolved for lack of evidence, leads, or witnesses

**Per capita - Dayton's crime ranks**

- 39th in violent crime
- 22<sup>nd</sup> in property crime
- Roughly **1 of 14 citizens** or **1 of 4 families** will be a victim of major crime each year.

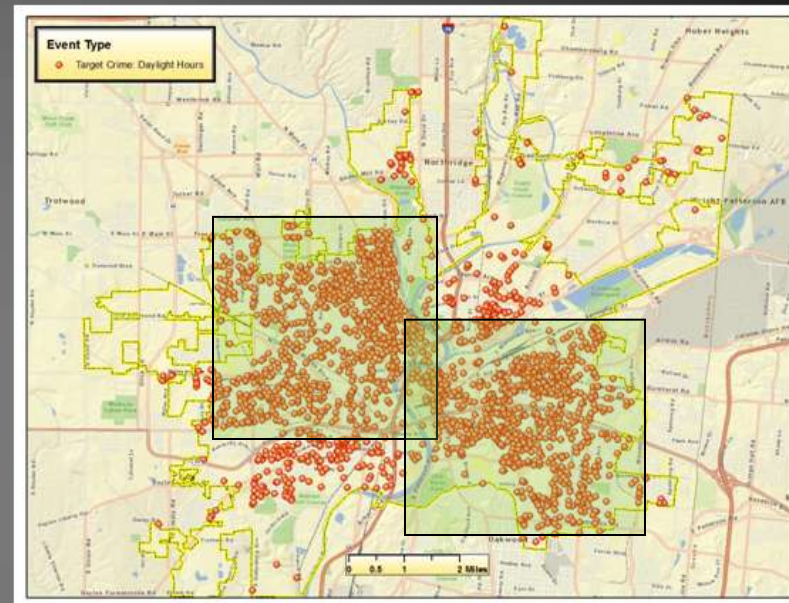
- Traditional policing strategies, community based policing, intelligence-driven policing, and community involvement while having some impact, has **not adequately addressed the problem.**

**The cost of crime to Dayton is significant**

- Dayton's total cost of crime is **over \$480M per year** or **over \$3300 per person per year.**  
Based on the cost of crime from a recent National Institute of Justice - Urban Institute study and the number of FBI reported Dayton crimes
- Does not include the impact on quality of life, home prices, and economic development in our community.

**Avoiding even a fraction of this crime would provide significant value to the community.**

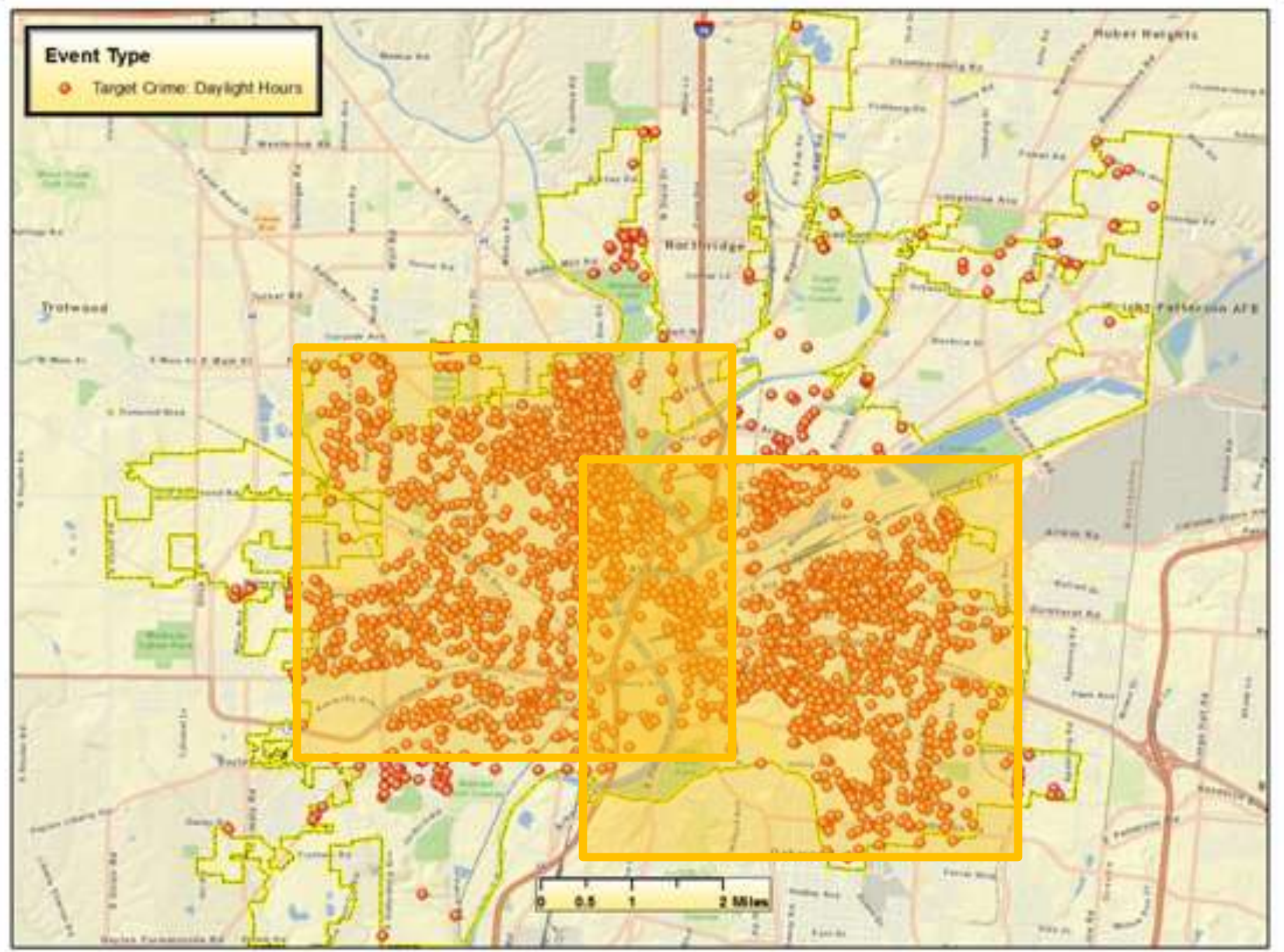
**Dayton represents just one of over 200 US cities of similar size and circumstance**







# Dayton Crime Daylight Hours





# Cost of Crime

<http://www.rand.org/jie/centers/quality-policing/cost-of-crime.html>

The cost of crime is significant. The national Institute of Justice has sponsored many studies on the cost of crime to a community. Using the results of one of these studies conducted by the Rand Center on Quality Policing the cost of crime in Dayton is calculated to be \$480M per year. This is calculated by multiplying the number of crimes in a given category by the cost of crime from the study.

## Cost of Crime Dayton

### Cost of Dayton Violent Crime

Type	Number	Cost per crime	Total Cost
Murder	34	\$8,649,216	\$294,073,344
Rape	93	\$217,866	\$20,261,538
Robbery	782	\$67,277	\$52,610,614
Aggravated Assault	602	\$87,238	\$52,517,276
<b>Total Violent Crime</b>			<b>\$419,462,772</b>

### Cost of Dayton Property Crime

Burglary	3,390	\$13,096	\$44,395,440
Larceny	4,882	\$2,139	\$10,442,598
Auto Theft	673	\$9,079	\$6,110,167
<b>Total Property Crime</b>			<b>\$60,948,205</b>

**Total Cost of Part 1 Crimes \$480,410,977**

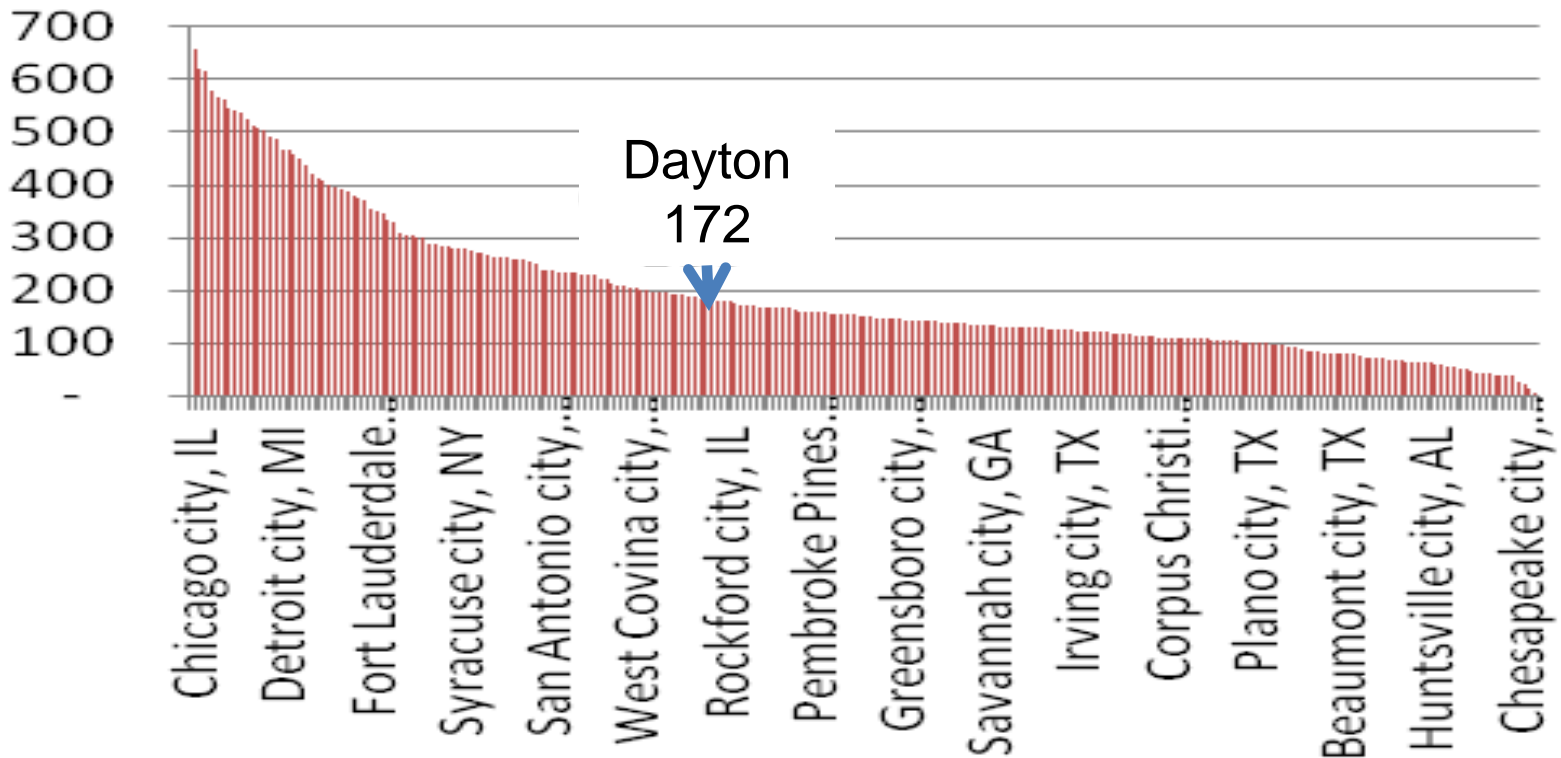
Dayton Population 142,000 Cost per Person **\$3383 per year per person**



# Crimes per Square Mile Per year

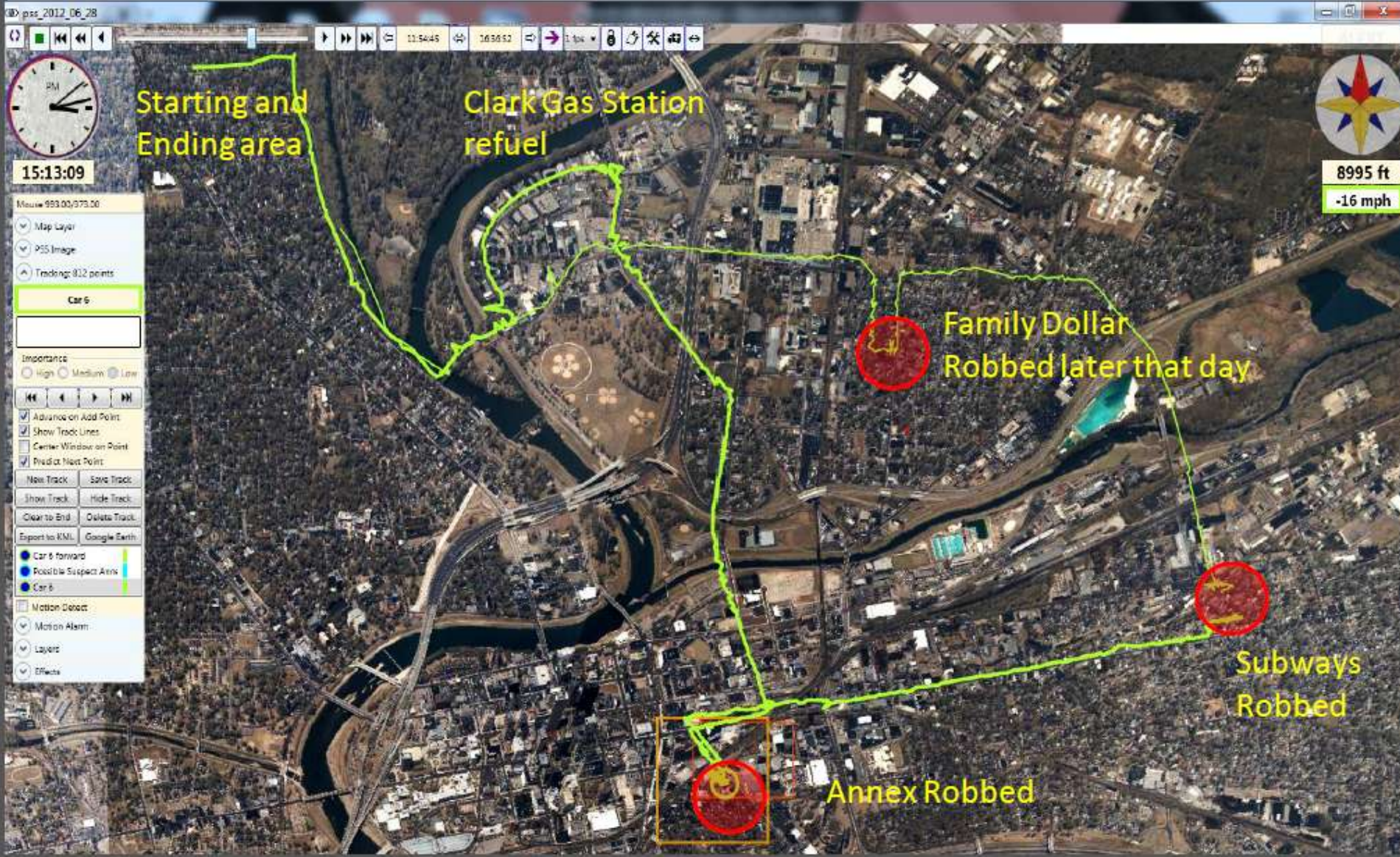
**Crimes Per Year Per Square Mile  
US Cities over 100,000 People**

(Even Distribution Assumption)





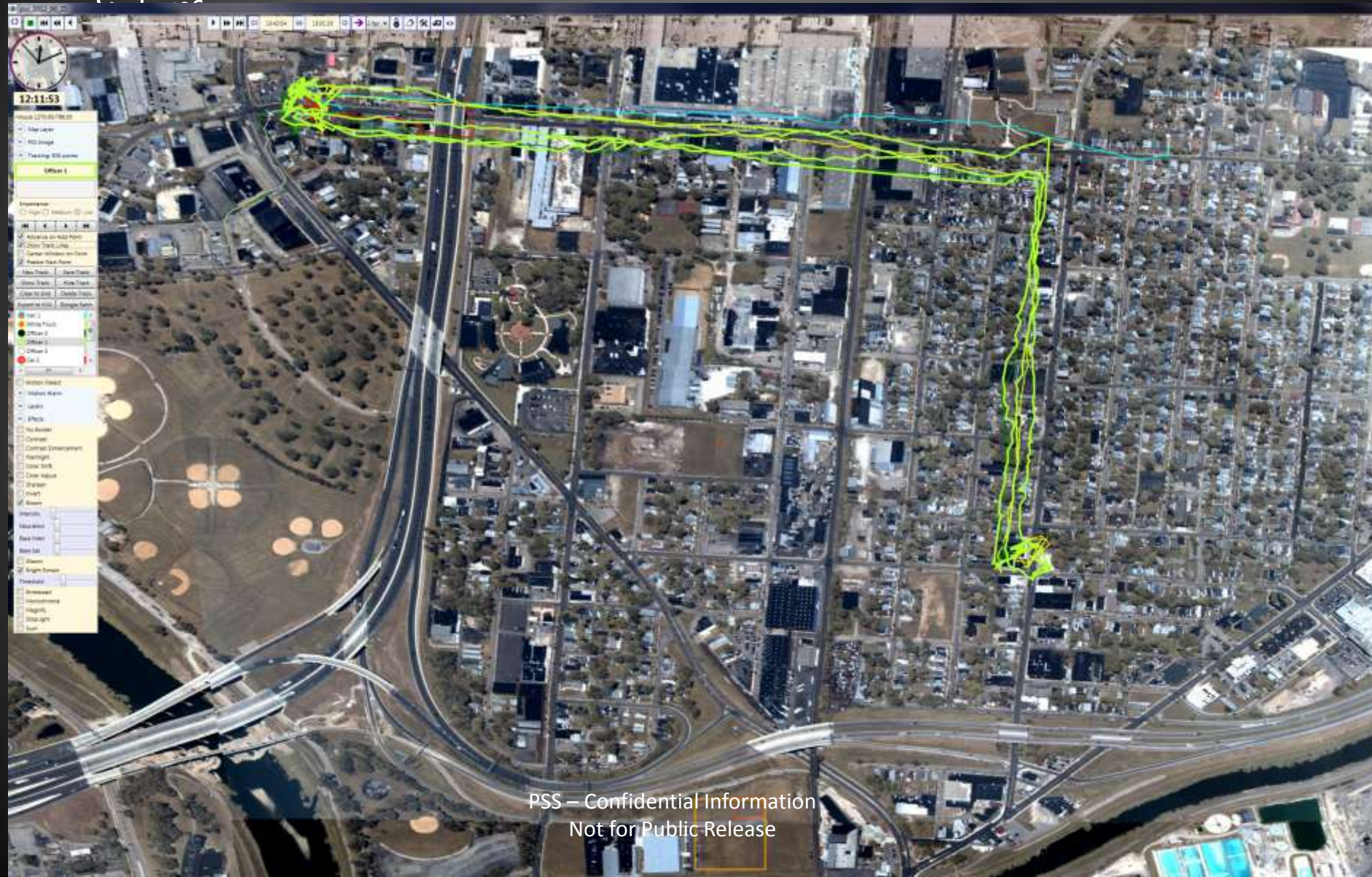
# Robbery Spree Captured Single Perpetrator - 3 locations





# Dayton House Burglary

Officers directed by PSS caught up to suspect before he got out of his car – With stolen goods in it



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Not for Public Release



# Review of Other Surveillance Technologies

- **Ground-based Cameras** – Widely Deployed by Police Departments
  - A recent Urban Institute report Baltimore invested over **\$8M** in cameras and operating costs to cover an area of **1.19 sq miles**. = **\$6.7M per square mile**
  - The net return cited in the report, while positive, is also lower than one would hope for.
- **Police Helicopters** - Traditional Airborne Surveillance
  - **Cost of procurement (\$4-7M) and operating (\$1.25M per year)** is beyond the available resources of the department for the perceived benefit.
  - Small coverage area of the camera systems does not allow it to be effective in investigating most of our targeted crimes.
- **Other Sensors Considered**
  - Departments are considering adding additional sensors such as automatic license plate readers, shot spotter gunshot detection system, red light cameras, and speed cameras



# SITUATIONAL AWARENESS AND SURVEILLANCE SYSTEMS

## Market Size

Ohio Third Frontier Targeted Growth Opportunities Battelle Nov 2011

### Global Market Surveillance Equipment



#### Surveillance Equipment:

The global market for surveillance equipment was **\$78 billion** in 2009 and is expected to grow at a CAGR of 11.7 percent to reach **\$139.2 billion** in 2015.

**Law enforcement** is the largest end-user market, worth nearly **\$50 billion** in 2009 and anticipated to reach **\$94 billion** in 2015.

The **military and government** segment of the market was valued at **\$10 billion** and should reach **\$16 billion** by 2015.

- Ohio has several industry participants working on cutting-edge technologies with situational awareness and surveillance applications.

#### SITUATIONAL AWARENESS AND SURVEILLANCE TECHNOLOGIES

**WHAT IS IT?** Technologies that allow users to perceive information about environment factors and anticipate their affect in the near future

**MARKET OUTLOOK** Growing market with fast growing niches in: surveillance equipment, sensors, and related software

#### Insights Into Markets That Ohio Can Serve From Industry Forum Discussions

Situational awareness and surveillance technologies are a key growth area in aerospace/defense.



# Market Segments







Privacy Policy and Concerns

Regulatory Requirements

PSS Privacy Policy

Draft Local Policy



# Regulatory Requirements

- **Use by Law Enforcement**

- Reviewed by multiple city attorneys
- Two Directly Related Supreme Court Decisions
  - Allowing Airborne Surveillance for law enforcement
  - Same rules as police helicopters when supporting law enforcement
- Strict PSS Privacy Policy eases some concerns
  - Used to support police directed crime investigations
  - Cued from police dispatch, crime report, or ongoing investigation.
- Strictly support local developed and approved privacy policies
  - To be included in support contracts
- Political concerns remain – Careful, Caution, and Full Open Communication
- Benefits are significant – Should be considered along with privacy issues
  - 34 murders witnessed -- confessions that account for 75
  - Multiple crimes witnessed per day



# PSS Privacy Policies

- Privacy and privacy policies are very important to PSS, our analysts, our customers, and our business
- Breaches in our privacy policies can and will be dealt with as a management priority
- PSS has privacy policy training and procedures for its analysts and teaches them to others
- PSS resolution is limited by technology and design
  - Objective is 1 pixel per person and to cover as large an area as possible
  - You cannot tell who a person is, what they are wearing, or most the time what they are doing
- Investigations are tied directly to a reported crime or ongoing investigation
  - PSS analysts find a reported crime in the imagery then track cars and people who are involved or are likely witnesses to the crime and can assist in the investigation.
  - Cars and people are only tracked over public roads and sidewalks in areas that have no expectation of privacy
  - Occasionally during investigations – Additional suspicious acting cars catch the eye of the analyst
    - Cars going at excessive speeds, making multiple u-turns, not stopping at red lights or stop signs. These cars are followed to determine if they are involved in a larger crime effort. If they are not they are to be deleted.



# PSS Privacy Policies (Cont)

- PSS analysts have had DHS suitability checks and/or DoD Security clearances to provide some assurance of personal integrity.
- PSS can provide an audit trail of every location and time when an analyst looked at imagery.
  - PSS through its server process can record this information and managers can review this data to ensure that the analyst is looking at appropriate locations and times for the crime they are investigating. This data can show every place and time the analyst looked. Management can pull this data when needed.
- PSS provides secure storage and management of the collected data. Sensitive data analyzed data can be secured in classified storage safes.
- All computers are password protected and firewalled keeping non-authorized users from the data.



# Sample Draft Police Department WIDE AREA AERIAL SURVEILLANCE POLICY STATEMENT

The XXX Police Department utilizes Wide-Area Aerial Surveillance for the purpose of creating a safer environment for all those who live, work and visit the city of XXX. This policy explains the purpose of the use of this technology and provides guidelines for the operation and for the storage of captured images.

## DEFINITIONS

**Wide-Area Aerial Surveillance-** Wide-Area Aerial Surveillance Sensors is an optical camera assembly that can provide continuous, second-by-second video monitoring of a city-sized area via a manned small fixed wing aircraft platform.

**Part 1 Crimes** - The Federal Bureau of Investigation (FBI) designates certain crimes as Part I or index offenses because it considers them to be the major crimes plaguing society in the United States: Murder, Rape, Robbery, Aggravated assault, Burglary, Larceny-theft, Motor vehicle theft, and Arson.

**Major Events** – For the purposes of this operating policy, major events will be interpreted as any event where a large gathering of individuals may congregate and there is illegal and/or dangerous activity.

**Weather Emergencies** – Large scale damage or power outages due to weather related events.

**Natural Disaster Response** – Coordination of emergency services to aid the populace in the event of a natural disaster.

**Large Scale Disturbances** – Rioting, civil unrest, violent strikes, etc.

**Tactical Operations** – Tactical operations include SWAT call outs, active shooter situations, Hostage Team call outs, maintenance of order, etc.

**Illegal Dumping** – Large scale disposal of waste in public right-of-way.



# Sample Draft Police Department WIDE AREA AERIAL SURVEILLANCE POLICY STATEMENT

## I. Purpose

Wide-Area Aerial Surveillance (WAAS) can be used for general deterrence of targeted crimes; disrupting identified crime patterns; safeguarding against potential threats to the public; management of emergency response situations during natural and man-made disasters; and for support of tactical operations.

## II. Wide-Area Aerial Surveillance

- The use of wide-area aerial surveillance (WAAS) will only be utilized to view areas of public right-of-way or public view.
- The current system has the ability to operate uninterrupted for five hours without having to make a stop for fuel.
- The sensor technology has the capability of viewing up to a 25 square mile area depending upon altitude
- The images captured by the sensor have the ability to be viewed nearly in real-time utilizing a down-link system.
- While images cannot identify specific persons, they can provide significant leads to investigators (See appendix A).
- Due to the cost to operate WAAS, this technology will only be deployed for the following reasons:
  - To disrupt identified Part I crime patterns.
  - To monitor major events,
  - To assist during weather emergencies or natural disaster response.
  - To monitor large scale disturbances.
  - To support tactical operations.
  - To monitor for illegal dumping
- During active WAAS operations dispatch information, to include citizen generated calls for service, will be monitored and evaluated to see if the use of this technology would assist in the apprehension or case solvability of an active incident.



# Sample Draft Police Department **WIDE AREA AERIAL SURVEILLANCE POLICY STATEMENT**

## **III. Training**

- Personnel involved directly with the use of WAAS technology shall be appropriately trained and supervised.
- Training shall include the review of this policy.

## **IV. Prohibited Activity**

- The use of WAAS will be conducted in a professional, ethical and legal manner.
- WAAS will not be used to invade the privacy of individuals, to look into private areas or areas where the reasonable expectation of privacy exists.
- All reasonable efforts will be taken to protect these rights.
- WAAS technology shall not be used to track individuals arbitrarily or based on race, gender, ethnicity, sexual orientation, disability or other classifications protected by law.
- Under no circumstances will aerial surveillance be used for the purpose of tracking persons lawfully exercising their rights to protest or assemble.



# Sample Draft Police Department WIDE AREA AERIAL SURVEILLANCE POLICY STATEMENT

## V . Media Storage

- All media will be stored in a secure area with access restricted to authorized persons.
- Recordings not otherwise needed for criminal evidence or for official reasons shall be retained for a period of 45 days.

## VI . Review and Release of Video Images and related Data

- The review or the release of video images and analytical data (to non-law enforcement personnel) shall be done only with the authorization of the Director and Chief of Police or their designee and only with a public records request.
- Any recordings or analytical data needed for a criminal investigation or other official reason shall be collected and stored as noted in General Order 3.02-7 and submitted into evidence as noted in General Order 1.06-1.
- An audit trail shall be maintained to record all access to the video images and analytical data and may be used to detect inappropriate or unauthorized use.

## VII . Policy Violations

- Unauthorized access to the WAAS recorded imagery, misuse of the imagery, unauthorized reproduction of the imagery, or unauthorized distribution of imagery will result in an Administrative Investigation.
- The Director and Chief of Police or his designee shall authorize access to the system.





# PSS Analysts

- 80 hours of hands on analysis training
- Training Formalized as Community College Courses
- System Introduction
- Privacy Policies and Procedures
- System Uses and Limitations
- Tracking
- Investigation Process
- Intel process
- Criminal TTPs (What they typically do)
- Integration of sources
- Reporting results
- Leading teams



# Summary

- New and Unique technology
- Demonstrated impact on various law enforcement operations
- Success in investigation support across a wide array of crimes
  - 34 murders witnessed and investigated – Confessions that account for 75
  - Kidnappings, Robberies, Assaults, burglaries, car theft, car jackings, ...
- Multiple other uses
  - Event Security, Emergency Response, Border Security
- Affordable system aimed at Large to mid-level police departments
  - Purchase, lease and service options available
- Want to develop appropriate policies to ensure protection of people and privacy



# Good People Doing Good Things





# Wide Area Surveillance Other Applications

- **Officer Support**
  - Support for local law enforcement in crime investigations
  - Philadelphia, Baltimore, Dayton, Compton, Nogales, Juarez, Mexicali, Torreon, Indianapolis, Columbus, Cleveland
- **Major Event Security**
  - Security and traffic management support of large events
  - Brickyard 400, Coca Cola 600, Sarah Palin VP announcement, 4<sup>th</sup> July Fort Leonard Wood, Ohio State Football
- **Emergency Response**
  - Quick response to natural disasters and other events
  - Iowa Floods, Gulf Oil Spill, Hurricane Sandy
- **Border Surveillance**
  - Coverage of large swaths of remote borders
  - Yuma Proving Grounds, Nogales Sector, El Paso Sector
- **Environmental Management**
  - Pipeline surveillance, environmental impact, wild life studies, traffic studies



# Persistent Surveillance Systems

- **Conducting Live Operations since 2008**
  - NASCAR BrickYard 400 Indianapolis Motor Speedway
  - North Philadelphia Philadelphia Police Department
  - Baltimore Police Department
  - NASCAR Race Cola Cola 600 Charlotte Motor Speedway
  - Iowa Floods
  - Dayton Police Department
  - Sarah Palin VP Candidate Announcement
  - Ft Leonard Wood
  - Juarez Mexico
  - Private Kidnapping
  - El Paso Border Surveillance DEA
  - Gulf Oil Spill
  - Mexicali Mexico
  - Torreon Mexico
  - Compton California – LA Sheriffs Office
  - Nogales Arizona Border Security Operations
  - Dayton Police Department
  - Hurricane Sandy Response NJ/NY Emergency Response



# Major Event Security

- Pre-Race Planning
- Minor Incident Response
- Major Incident Response
- Traffic Management
- Business Case



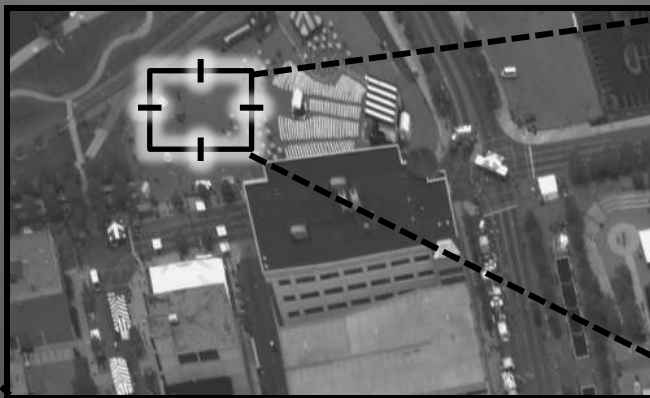
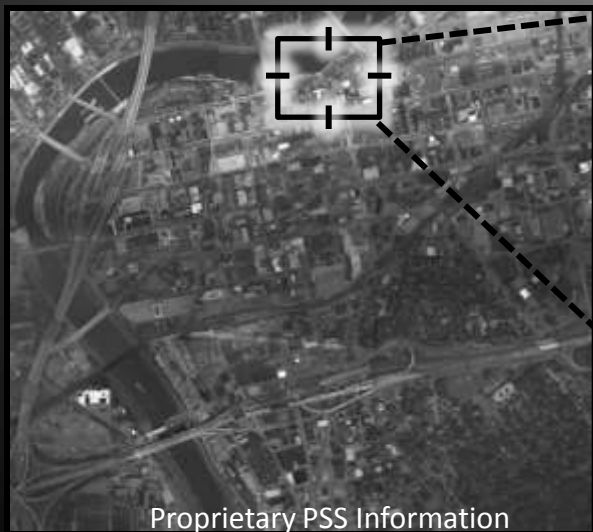
Brickyard 400 Indianapolis Motor Speedway



# Emergency Support and Disaster Response

## Real-Time Major Incident Response:

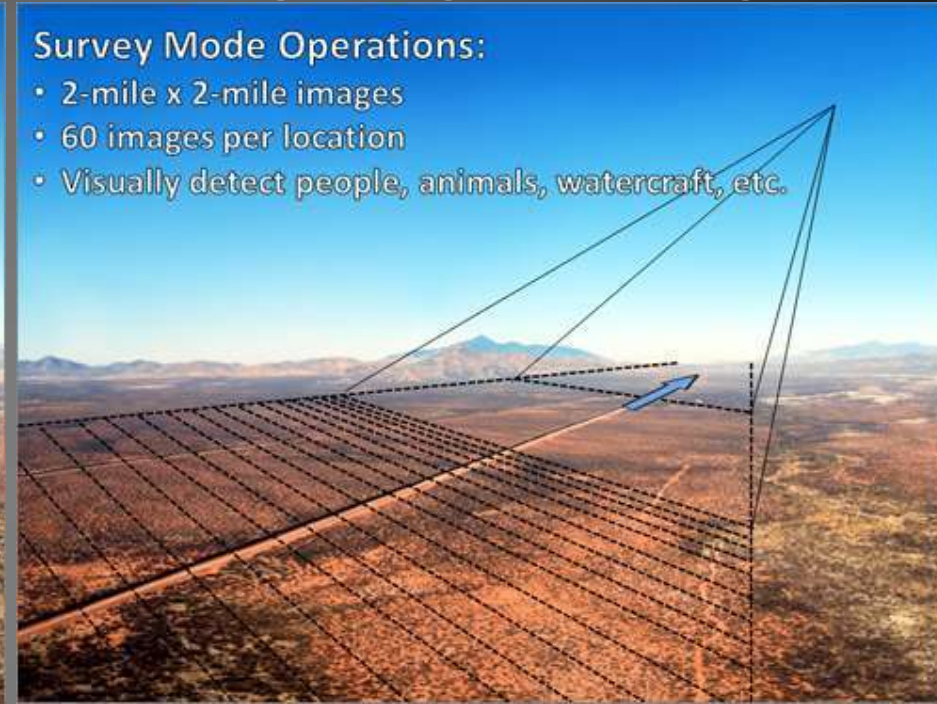
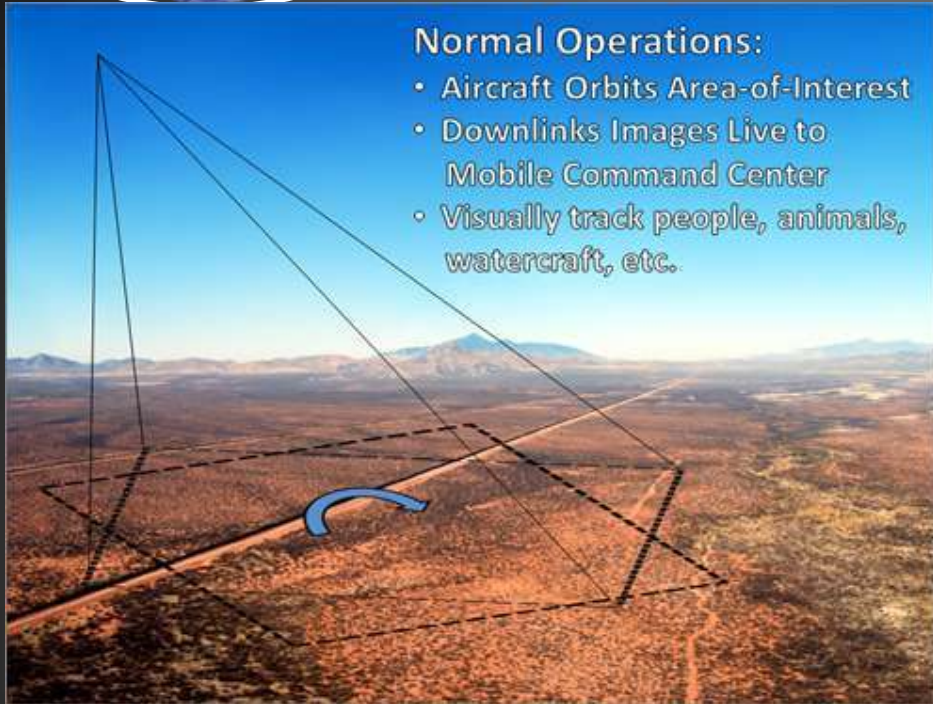
- Fast wide-area damage assessment
- Coordinate mass-evacuation, perimeter cordon
- Common Operating Picture for Police, FBI, emergency responders, and other event personnel
- Detect movement over broad areas for potential survivors



**Rewind imagery to track and backtrack potential suspects and witnesses**

# Staring and Survey Modes

## Persistent Stare and Long Range Coverage



### Persistent Coverage over an Area

- Used for high activity areas
- Constant Coverage over large area
- Detect and Track Movement Within Area
- Real Time Constant Download

### Long Range Periodic Coverage

- Used for Long areas of interest
- Multiple real time images allow for image to image change detection to auto detect movement within the area
- Pass by pass detection can highlight changes that occur between over flights
- Periodic Downlink when within range





# Iowa Floods

## Survey Mode Operations

Imaged entire 160 miles of flooded rivers in slightly over an hour (Route shown)

70 to 100 images per location

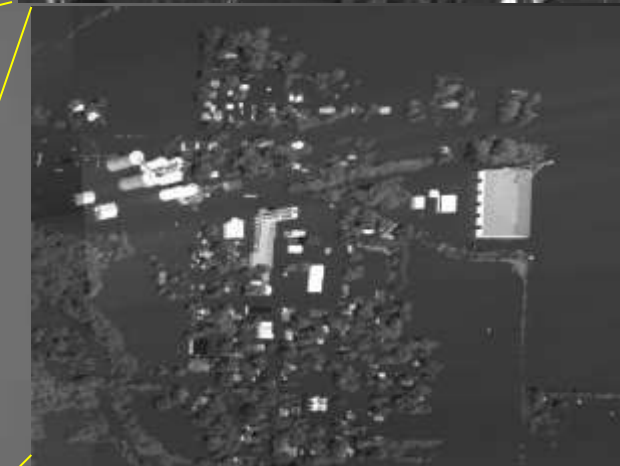
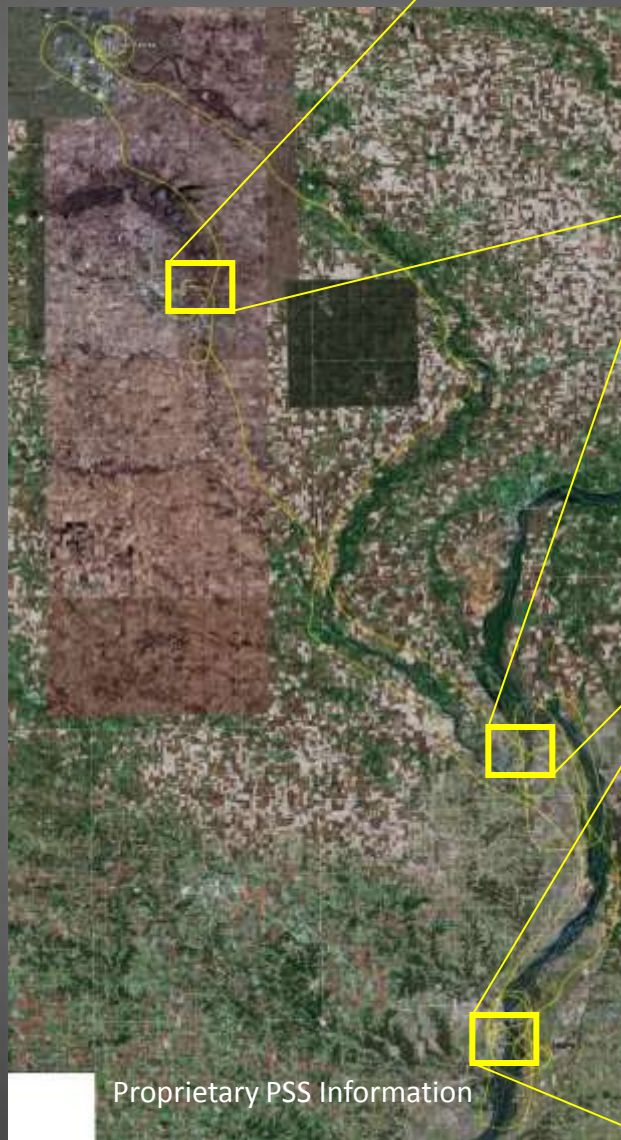
Circles over locations of particular interest

2 to 3 mile wide images

See individuals, vehicles, boats, and animals

Original images are 88 megapixels each

Images to right are highly subsampled.





# Persistent Surveillance Systems

## Emergency Response

### Iowa Floods

**>1,000 sq miles surveyed in one flight**





# Hurricane Sandy Rapid Response

Imaged entire impacted areas in less than 2 hours

Imagery available to emergency support Personnel

60 images per location provides moving look at any location



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