The Role of Geospatial in Urban Search and Rescue MGISAC December 2017

Scott Olsen Fire Chief, Boone County Fire Protection District Program Manager, Missouri Task Force 1



# **Missouri Task Force 1**



### National US&R Response System Task Forces



Divided into Eastern 

, Central
and Western
Divisions

#### FEMA Type I US&R Task Force



### Transportation Ground





### Transportation Air

U.S. AIR FORCE

#### 2017 FEMA US&R Rotation Model

#### NATIONAL URBAN SEARCH & RESCUE RESPONSE SYSTEM

2017 ROTATION MODEL

Rotation	REGION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
	W	CA-TF1	CA-TF8	CA-TF3	WA-TF1	CA-TF6	CA-TF2	CA-TF7	CA-TF5	CA-TF4	CA-TF1	CA-TF8	CA-TF3	WA-TF1
1st	С	TN-TF1	CO-TF1	NM-TF1	NE-TF1	NV-TF1	IN-TF1	MO-TF1	TX-TF1	UT-TF1	AZ-TF1	TN-TF1	CO-TF1	NM-TF1
	E	PA-TF1	VA-TF2	MA-TF1	VA-TF1	MD-TF1	FL-TF2	OH-TF1	NY-TF1	FL-TF1	PA-TF1	VA-TF2	MA-TF1	VA-TF1
	W	CA-TF8	CA-TF3	WA-TF1	CA-TF6	CA-TF2	CA-TF7	CA-TF5	CA-TF4	CA-TF1	CA-TF8	CA-TF3	WA-TF1	CA-TF6
2nd	С	CO-TF1	NM-TF1	NE-TF1	NV-TF1	IN-TF1	MO-TF1	TX-TF1	UT-TF1	AZ-TF1	TN-TF1	CO-TF1	NM-TF1	NE-TF1
	E	VA-TF2	MA-TF1	VA-TF1	MD-TF1	FL-TF2	OH-TF1	NY-TF1	FL-TF1	PA-TF1	VA-TF2	MA-TF1	VA-TF1	MD-TF1
	W	CA-TF3	WA-TF1	CA-TF6	CA-TF2	CA-TF7	CA-TF5	CA-TF4	CA-TF1	CA-TF8	CA-TF3	WA-TF1	CA-TF6	CA-TF2
3rd	С	NM-TF1	NE-TF1	NV-TF1	IN-TF1	MO-TF1	TX-TF1	UT-TF1	AZ-TF1	TN-TF1	CO-TF1	NM-TF1	NE-TF1	NV-TF1
	E	MA-TF1	VA-TF1	MD-TF1	FL-TF2	OH-TF1	NY-TF1	FL-TF1	PA-TF1	VA-TF2	MA-TF1	VA-TF1	MD-TF1	FL-TF2
	W	WA-TF1	CA-TF6	CA-TF2	CA-TF7	CA-TF5	CA-TF4	CA-TF1	CA-TF8	CA-TF3	WA-TF1	CA-TF6	CA-TF2	CA-TF7
4th	С	NE-TF1	NV-TF1	IN-TF1	MO-TF1	TX-TF1	UT-TF1	AZ-TF1	TN-TF1	CO-TF1	NM-TF1	NE-TF1	NV-TF1	IN-TF1
	E	VA-TF1	MD-TF1	FL-TF2	OH-TF1	NY-TF1	FL-TF1	PA-TF1	VA-TF2	MA-TF1	VA-TF1	MD-TF1	FL-TF2	OH-TF1
	W	CA-TF6	CA-TF2	CA-TF7	CA-TF5	CA-TF4	CA-TF1	CA-TF8	CA-TF3	WA-TF1	CA-TF6	CA-TF2	CA-TF7	CA-TF5
5th	С	NV-TF1	IN-TF1	MO-TF1	TX-TF1	UT-TF1	AZ-TF1	TN-TF1	CO-TF1	NM-TF1	NE-TF1	NV-TF1	IN-TF1	MO-TF1
	E	MD-TF1	FL-TF2	OH-TF1	NY-TF1	FL-TF1	PA-TF1	VA-TF2	MA-TF1	VA-TF1	MD-TF1	FL-TF2	OH-TF1	NY-TF1
	W	CA-TF2	CA-TF7	CA-TF5	CA-TF4	CA-TF1	CA-TF8	CA-TF3	WA-TF1	CA-TF6	CA-TF2	CA-TF7	CA-TF5	CA-TF4
6th	С	IN-TF1	MO-TF1	TX-TF1	UT-TF1	AZ-TF1	TN-TF1	CO-TF1	NM-TF1	NE-TF1	NV-TF1	IN-TF1	MO-TF1	TX-TF1
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	W	CA-TF7	CA-TF5	CA-TF4	CA-TF1	CA-TF8	CA-TF3	WA-TF1	CA-TF6	CA-TF2	CA-TF7	CA-TF5	CA-TF4	CA-TF1
7th	С	MO-TF1	TX-TF1	UT-TF1	AZ-TF1	TN-TF1	CO-TF1	NM-TF1	NE-TF1	NV-TF1	IN-TF1	MO-TF1	TX-TF1	UT-TF1
	E	OH-TF1	NY-TF1	FL-TF1	PA-TF1	VA-TF2	MA-TF1	VA-TF1	MD-TF1	FL-TF2	OH-TF1	NY-TF1	FL-TF1	PA-TF1
	W	CA-TF5	CA-TF4	CA-TF1	CA-TF8	CA-TF3	WA-TF1	CA-TF6	CA-TF2	CA-TF7	CA-TF5	CA-TF4	CA-TF1	CA-TF8
8th	С	TX-TF1	UT-TF1	AZ-TF1	TN-TF1	CO-TF1	NM-TF1	NE-TF1	NV-TF1	IN-TF1	MO-TF1	TX-TF1	UT-TF1	AZ-TF1
	E	NY-TF1	FL-TF1	PA-TF1	VA-TF2	MA-TF1	VA-TF1	MD-TF1	FL-TF2	OH-TF1	NY-TF1	FL-TF1	PA-TF1	VA-TF2
	W	CA-TF4	CA-TF1	CA-TF8	CA-TF3	WA-TF1	CA-TF6	CA-TF2	CA-TF7	CA-TF5	CA-TF4	CA-TF1	CA-TF8	CA-TF3
9th	С	UT-TF1	AZ-TF1	TN-TF1	CO-TF1	NM-TF1	NE-TF1	NV-TF1	IN-TF1	MO-TF1	TX-TF1	UT-TF1	AZ-TF1	TN-TF1
	E	FL-TF1	PA-TF1	VA-TF2	MA-TF1	VA-TF1	MD-TF1	FL-TF2	OH-TF1	NY-TF1	FL-TF1	PA-TF1	VA-TF2	MA-TF1
10th	С	AZ-TF1	TN-TF1	CO-TF1	NM-TF1	NE-TF1	NV-TF1	IN-TF1	MO-TF1	TX-TF1	UT-TF1	AZ-TF1	TN-TF1	CO-TF1
IST Ro	tation	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN

#### **Deployments**

- World Trade Center 9/11 New York City, NY 2001
- Hurricane Katrina
   New Orleans, LA 2005
- Hurricane Ike Lafayette, LA 2008
- Elks Lodge Building Collapse
   Clinton, MO 2006
- EF5 Tornado Joplin, MO 2011
- Hurricane Sandy
   New York City, NY 2012
- Colorado Floods Larimer County, CO 2013
- Hurricane Matthew North Carolina, 2016
- Southern Missouri Floods Missouri 2017
- Hurricane Harvey Houston, TX 2017
- Hurricane Irma and Maria
   Puerto Rico and U.S.V.I. 2017



#### FEMA Urban Search and Rescue

- Multi-hazard incident response.
- Many of our missions involve a wide area search component.
- Recent search missions:
  - Hurricanes (Katrina, Ike, Sandy, Harvey, Irma, Maria, etc.)
  - Flooding (Colorado Floods)
  - Tornado's (Joplin EF5)
  - Landslides (Oso, WA Landslide)
- To effectively and efficiently search, requires that we effectively and efficiently document our search.

### **Historical Context**

#### Hurricane Katrina New Orleans, LA - August 2005





# Hurricane Katrina New Orleans, LA - August 2005

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#### **Hurricane Katrina**

FEMA Search and Rescue Divisions











#### Issues

Little Intelligence/Data for Region

- Commercial Paper Maps
- Search Region and Segment Creation
- Wide Area Search Procedures (in a flooded environment)
- GPS Utilization (basic tracklogs and waypoint capture not universally used)
- Search Data We didn't have a standardize way to collect search data

# Hurricane Katrina Lessons Learned

- Utilization of GIS (USGS and NGA)
- Data, data and more data. Need to figure out how to more efficiently collect it, process it and manage it.
- GPS/GIS integration. This works, need to expand the process.
- Need to standardized the search data collection process and workflow procedures



### Hurricane Ike September 2008



### Hurricane Ike

First test of the system since Katrina

- Wide Area Search as a concept
- Documentation was expected, scrutinized, and delivered
- GPS use was the standard
- Insatiable hunger for information by all
- Search data collection and distribution process created and pushed by internal players – task forces and IST.

# The Process

- Rules of engagement evolved
- Search definitions evolved
- GPS utilization
  - Waypoints with text
  - Tracklogs
- GIS utilization
  - Hasty GIS Mapsource and Google Earth
  - Technical GIS Arcview
    - NGA and USGS
    - Forward GIS Team (USGS vehicle)
    - Base Camp GIS Team (NGA)

### Hurricane Ike









### **Post-Hurricane Ike Objectives**

- Focus on utilization of Garmin GPS (already in the cache)
- Focus on waypoints and track logs
- Select/Develop core symbology (data elements)
- Develop an open source GPX to KML/KMZ converter that also tallied symbols
- Culminated in Basic WAS Data Collection (what is called the "Iron Sights" Solution)

# What is "Iron Sights"?

- It is a process develop by members of MO-TF1 that defines how wide area search data is gathered in the field.
- Uses Garmin GPS's to gather tracks and custom waypoint symbols.
- Tracks and symbols are downloaded into Garmin Basecamp to validate the data and convert the data to a GPX format.
- The GPX files are converted to useable data: master tally sheet of symbols in Excel and viewing the data in Google Earth

# Garmin 64st GPS Custom Symbol Set



•	<b>\</b>		•	À	È
1 - Structure No Damage	2 - Structure Damaged	3 - Structure Failed	4 - Structure Destroyed	5 – Assisted	6 - Evacuated
R 7 – Rescued	۶ - Follow-Up Form	9 - Victim Detected	10 - Confirmed Victim	11 - Human Remains	12 – Human Remains Removed
13 - Shelter in Place	(The second seco	(With the second	16 - Hazardous Material Incident	Targeted Search	18 - Flood/Water Level
19 - Helicopter Landing Site	20 – Route Blocked	21) 21 - Extra 23	22 22 - Extra 24	23 - Extra 23	24 24 - Extra 24

# No "Death by Rocker"

- Mark button on GPS
   Mark waypoint
- Navigate to symbol
- Select symbol
- Don't need to change waypoint name!



Garmin 62/64

#### Garmin 60





# Why Multiple Waypoints at One Location?

- Iron Sights is a data gathering method (tally)
- 24 custom symbols (story board)
- Track logs
- Importance of 'clean' data file from unit at tactical level

•		\$	•	À	È
1 - Structure No Damage	2 - Structure Damaged	3 - Structure Failed	4 - Structure Destroyed	5 – Assisted	6 - Evacuated
R 7 – Rescued	<del>ک</del> 8 - Follow-Up Form	9 - Victim Detected	10 - Confirmed Victim	11 - Human Remains	12 – Human Remains Removed
13 - Shelter in Place	(The second seco	15 – Fire Incident	16 - Hazardous Material Incident	Targeted Search	18 - Flood/Water Level
19 - Helicopter Landing Site	20 – Route Blocked	21) 21 - Extra 23	22 22 - Extra 24	23 - Extra 23	24 24 - Extra 24

# Tally Symbols Quickly in Excel

- Place converted GPS data files in folder
  - Can do with one drag and drop
- Execute macro in Excel tally sheet
  - Can do with the push of one button

Event: TF/Team: Period:	CO-Larimer All SAR Teams As of 9-22-13 at 1100 hrs	Click Button to Import All csv Files in the Same Folder as this Tally Sheet
Symbol	Description	Total Number of Symbols in all Sheets
•	Structure No Damage	1264
•	Structure Damaged	114
\$	Structure Failed	34
•	Structure Destroyed	38 1450 All Structures Searched
À	Assisted	59
Ē	Evacuated	155
۲	Targeted Search	281
۲	Flood/Water Level	14
$\overline{\bullet}$	Helicopter Landing Site	83
	Route Blocked	45
23	Extra 23	67
24	Extra 24	45

# What does the "Iron Sights" product look like?



#### 18-SEP-13 1:50:21PM 033 Structure Destroyed Filename: Secondary 9-18-13p4\_NE-TF1\_Clark\_Koranda USNG: 13T EE 27128 69578 Lat.Long: 40.376346493139863.-104.68042572028935 Elevation: 1420.703125

Directions: To here - From here



03" N 104 40'53 61" W elev 4651 f

Event: CO-Larimer TF/Team: All SAR Teams Period As of 9-22-13 at 1100 hrs

Tally Sheet

Symbol	Description	Total Number of Symbols in all Sheets		
•	Structure No Damage	1264		
Ø	Structure Damaged	114		
\$	Structure Failed	34		
	Structure Destroyed	38	1450	All Structures Searched
À	Assisted	59		
(E)	Evacuated	155		
٠	Targeted Search	281		
۲	Flood/Water Level	14		
$\odot$	Helicopter Landing Site	83		
	Route Blocked	45		
23	Extra 23	67		
24	Extra 24	45		

Greely, CO September, 2013

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Other Structure No Damage	Rescued 07
Structure Damaged	Follow-Up Form
Structure Failed	Victim 09
Structure 04	Confirmed Victim
A Assisted	Human Remains
Evacuated	Human Remains 12 Removed

(1) 13	Shelter in Place	19	Helicopter Landing Site
(F) 14	Animal Issue	<b>2</b> 0	Route Blocked
کی) 15	Fire Incident	21 21	Extra 21
16 16	Hazardous Material Incident	22 22	Extra 22
() 17	Targeted Search	23 23	Extra 23
18 18	Flood/ Water Level	24 24	Extra 24

**1 Recon** Preliminary survey (not search), assessing structures, safety, and HAZMAT

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#### 4 Secondary Search (Low) Systematic search of the interior and exterior of every structure



5 Secondary Search (High)

Exhaustive de-layering, complete search of every void space in an affected area

#### 6 Targeted



**Search** Priority search at a specific location requiring immediate attention and amplified effort



#### 2 Rapid/Hasty

**Search** Quick surface search of areas likely to contain victims, focusing on detection

#### 3 Primary Search Mir

**Search** Minimum 360 of every structure may include a quick interior search per the ROE US&R PD 2014-013 Search Operation Data Collection and Reporting Standards (9/30/2014)

- Outlined the use of basic data collection devices
- Outlined how we manage search data collection
- Outlined how we transmit search data
- Outlined situational assessment/ICS 209 reporting
- Outlined how we display search data

# MO-TF1 WAS Data Collection Continued Development

- Starting point was the MO-TF1 Basic WAS Data Collection Model (Iron Sights Solution)
- Development of the WAS data collection process
- Pre-Directive Utilization: Hurricane Irene, Hurricane Sandy, the Colorado Floods, Oso, WA Mudslide

#### **Colorado Floods – Storm Mountain**



### Colorado Floods – Big Thompson River



### Oso, WA Mudslide





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# ESRI Survey123 App

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This is a <u>temp</u> for rapid data	ate (not for real-world use at this time)	)

and symbology for Wide Area Search. It has been developed by the NAPSG Foundation Search and Rescue Working Group.

#### Linked Applications

- See Survey 123 Results in real-time.
- Link to Explorer for ArcGIS to track field observations (Coming Soon).
- Link to ArcGIS Earth for visualization in a familiar globe interface (Coming Soon).
- Link to Operations Dashboard for operational level decision making with high volumes of data (Coming Soon).
- See a Situational Awareness Viewer for an overview of the incident situation and mission planning.

Please test this app out and send feedback to pdoherty@publicsafetygis.org

#### Waypoint \*

Please select one of the following categories from the waypoint list. Based on your answer you may have a



#### **IronSights Plus**

#### Waypoint \*

X

Please select one of the following categories from the waypoint list. Based on your answer you may have a follow-up question.

#### Location \*

Please use the target icon to drop this waypoint at your location. You can drag the pin on the map for improved accuracy or enter an address / place in the search bar (USNG Coming Soon).



#### Photo

OPTIONAL: Please add a photo if you think it will help verify your field observations or if instructed to do so.



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### ESRI Survey123 App

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# **Operations** Dashboard



# **Operations** Dashboard



# **Operations** Dashboard

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# ESRI Workforce



### Hurricane Harvey – Houston, TX





### Hurricane Harvey – Houston, TX



### Hurricane Harvey – Houston, TX



# Hurricane Irma – U.S. Virgin Islands





# Hurricane Irma – U.S. Virgin Islands



# Hurricane Irma – U.S. Virgin Islands







### **Issues From Recent Deployments**

- Failure to collect data
- Failure to validate data
- The end user environment:
  - Collecting data "in initial attack mode"
  - Environmental issues user vs device
  - Communications loss of infrastructure
- Symbolizing search progression/Symbol location
- Uploading data to FEMA GeoPlatform
- Speed of data collection, validation and distribution

### **New Issues and Opportunities**

- Online/Connected vs Offline/Disconnected map caching and communication issues
- Collecting data outside of the map cache in offline mode
- Repetitive data entry
- Track logs vs breadcrumbs

### New Issues and Opportunities

- Blue force tracking in real-time
- Which device ruggedness, device protection, battery issues
- Workflow ESRI Workforce ?
- Bring GIS to the field
- Crowdsourced data

