

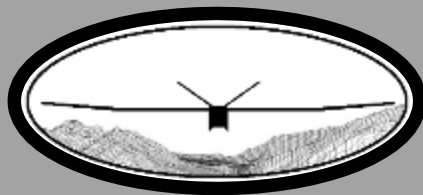
ENVIRONMENTAL STEWARDSHIP UAS APPLICATION CONSIDERATIONS

Victor Wilhelm, P.E.

21 June 2017

On behalf of:

Jacksonville District UAS team



UNMANNED. UNMATCHED

INFORMATION BRIEF



"The views, opinions and findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."



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PURPOSE/TOPICS

ASK YOURSELF:

- 1.** Is it good for my customer?
- 2.** Is it legal and ethical?
- 3.** Is it something I am willing to be accountable for?

If so, don't ask permission, you already have it.



LTG Flowers
Chief of Engineers 2000-2004



Purpose:
Briefing on Jacksonville District
UAS capabilities

Topics:

- Prologue
- What are UAS
- Assessments
- Cultural Resources
- Invasive Species Management
- FAQs
- Conclusion

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THANKS...



THANKS to the “Team of Teams”

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WHY SHOULD YOU CARE?

- Some Identified Problems Where UAS May Help
 - Site monitoring (condition assessment, encroachments, land grants/leases)
 - Looting/ trespassing
 - Difficult to access or unsafe areas
 - Archeological assessment
 - Surveys of excavations
- Possible solutions
 - Site conditions
 - Change detection, site erosion, disturbance, invasive species
 - Unauthorized activities
 - Identify human disturbances/activity, violation of agreements, site remediation
 - Habitat mapping of difficult to access areas (high/steep terrain).
 - Detect, quantify, and assess archeological resources

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BOTTOM LINE UP FRONT

Small UAS brings additional situational awareness capability to decision makers

High fidelity data with rapid delivery from acquisition to data products.

Not a replacement for broader collection tools such as satellites for traditional aerial collection. Logistics much easier for small sites and priority areas.. (less than 20,000 acres)



UAV - HISTORY

- 2005: Starts with ERDC, USGS, University of Florida (UF) and Jacksonville District (SAJ)
- 2006-2010: Airframe/Payload Development
- 2010: Transition to operations
- 2011: SAJ designated UAV Southeast Division (SAD) Regional Center of Expertise.
- 2012: New Payload. Mosaic Solution
- 2012-2013: Production Environment
- 2014: “Metric” Payload. Gimbaled EO/TIR Video
- 2015: System diversification
- 2016: USACE Enterprise Solution



WHAT ARE UAS?

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UAS COMPONENTS



- AV: Air Vehicle, autopilot, payload, etc.




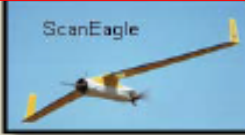



- GCS: Ground Control Station, Flight Planning, etc.



- Personnel: People, training, procedures, etc.



UAS GROUPS

UAS Groups	Maximum Weight (lbs) (MGTOW)	Normal Operating Altitude (ft)	Speed (kts)	Representative UAS	
Group 1	0 – 20	<1200 AGL	100	Raven (RQ-11), WASP	
Group 2	21 – 55	<3500 AGL	< 250	ScanEagle	
Group 3	< 1320	< FL 180		Shadow (RQ-7B), Tier II / STUAS	
Group 4	>1320	< FL 180	Any Airspeed	Fire Scout (MQ-8B, RQ-8B), Predator (MQ-1A/B), Sky Warrior ERMP (MQ-1C)	
Group 5		> FL 180		Reaper (MQ-9A), Global Hawk (RQ-4), BAMS (RQ-4N)	

From DOD 2011 UAS Airspace Integration Plan D-3







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ACCESS PROFILE

	ACCESS PROFILES	OPERATIONAL MISSIONS	TRAINING MISSIONS	SUPPORT MISSIONS
Visual Line of Sight		<ul style="list-style-type: none"> Tactical surveillance & reconnaissance Disaster relief-DSCA 	<ul style="list-style-type: none"> Pilot/Operator qualification proficiency Combat readiness 	<ul style="list-style-type: none"> Development & test Maintenance & checkout
Terminal Area		<ul style="list-style-type: none"> Local security (e.g. event & emergency) 	<ul style="list-style-type: none"> Take-off / landing proficiency Orbit proficiency Check-flights 	<ul style="list-style-type: none"> Development & test Maintenance & checkout
Operating Areas		<ul style="list-style-type: none"> Local security (e.g. event & emergency) 	<ul style="list-style-type: none"> Orbit proficiency IFR Qualification & proficiency Combat readiness Check-flights 	<ul style="list-style-type: none"> Development & test Maintenance & checkout
Lateral Transit		<ul style="list-style-type: none"> Convoy & roadway security Border patrol Deployment 	<ul style="list-style-type: none"> Transit to training airspace Training for convoy/roadway 	<ul style="list-style-type: none"> Development & test Ferry (e.g. contractor to test facility)
Vertical Transit		<ul style="list-style-type: none"> Transit to Class A controlled airspace for all operational missions 	<ul style="list-style-type: none"> IFR Qualification & proficiency Combat readiness Orbit operations 	<ul style="list-style-type: none"> Development & test Ferry
Dynamic		<ul style="list-style-type: none"> All operational missions 	<ul style="list-style-type: none"> All training missions 	<ul style="list-style-type: none"> All support missions

From DOD 2011 UAS Airspace Integration, table 1.

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COE UAS SYSTEMS



APPLICATIONS

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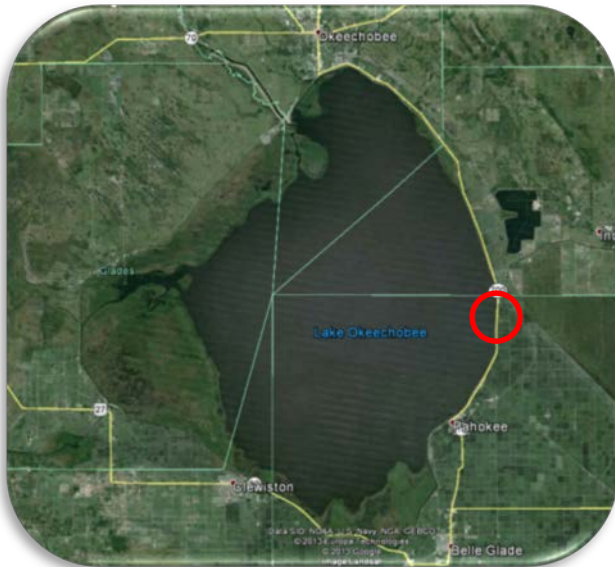


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QUICK: HOURS FOR A DATA PRODUCT

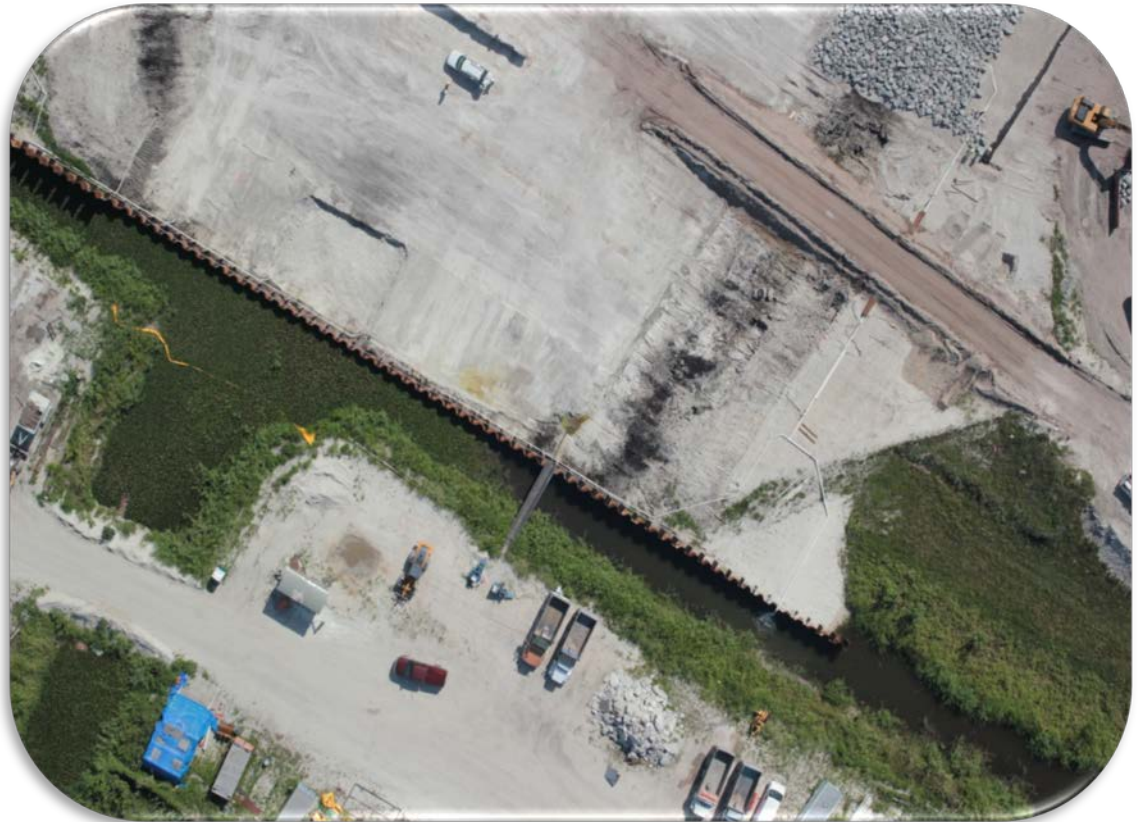
HHD CULVERT REPLACEMENTS: C-16 E SIDE OF LAKE OKEECHOBEE



Culvert C-16

Flown 21 May 2014

Mosaic 23 May 2014



APPLICATION: quick assessment of existing site conditions
(cultural resources, human remains, artifacts, etcA.



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HIGH FIDELITY: UNMATCHED DETAIL



APPLICATION: detailed monitoring of land grant/leases, possible encroachments, environmental violations

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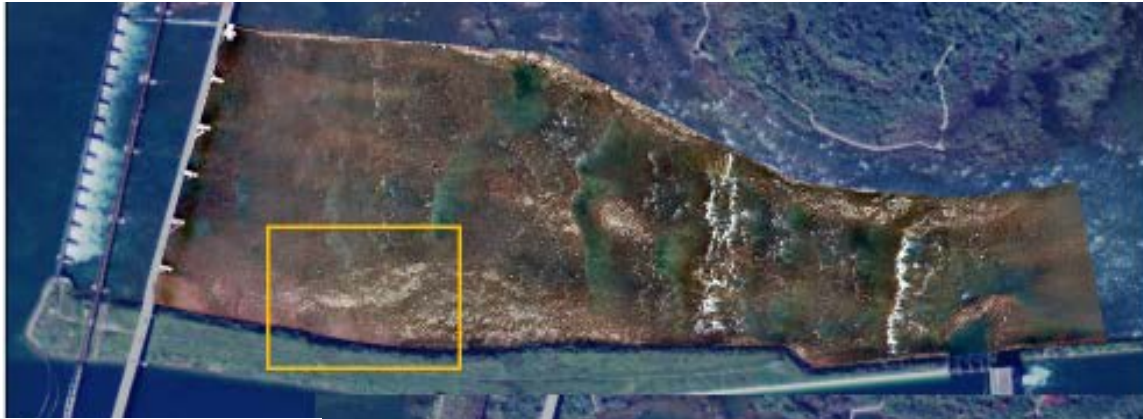
INFRASTRUCTURE/ASSET MANAGEMENT



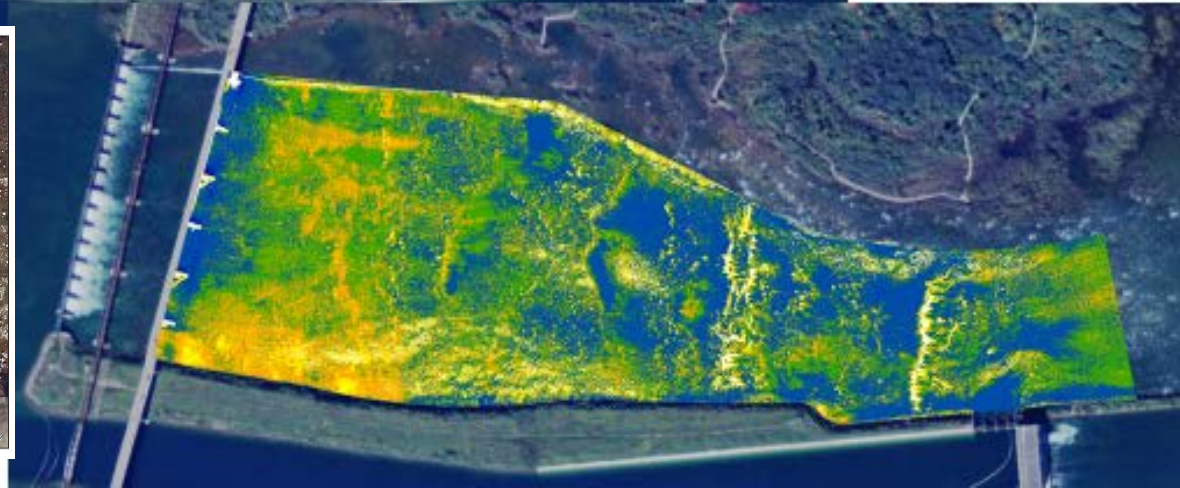
- UAS identified embankment erosion on Herbert Hoover Dike
- Erosion and degradation of levee was not detected by Routine Inspection
- Near real-time monitoring of critical assets.
- Emergencies: pre and post damage assessment



SAFER HABITAT MAPPING



Preliminary
Analysis of
Rapids
Habitat



Soo Locks, Sault St. Marie, Michigan, December 2016

APPLICATION: Remote habitat mapping reduces risk exposure for personnel

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EMERGENCY RESPONSE-SOUTH CAROLINA FLOODING (2015)



Columbia Canal 201504
Google Earth



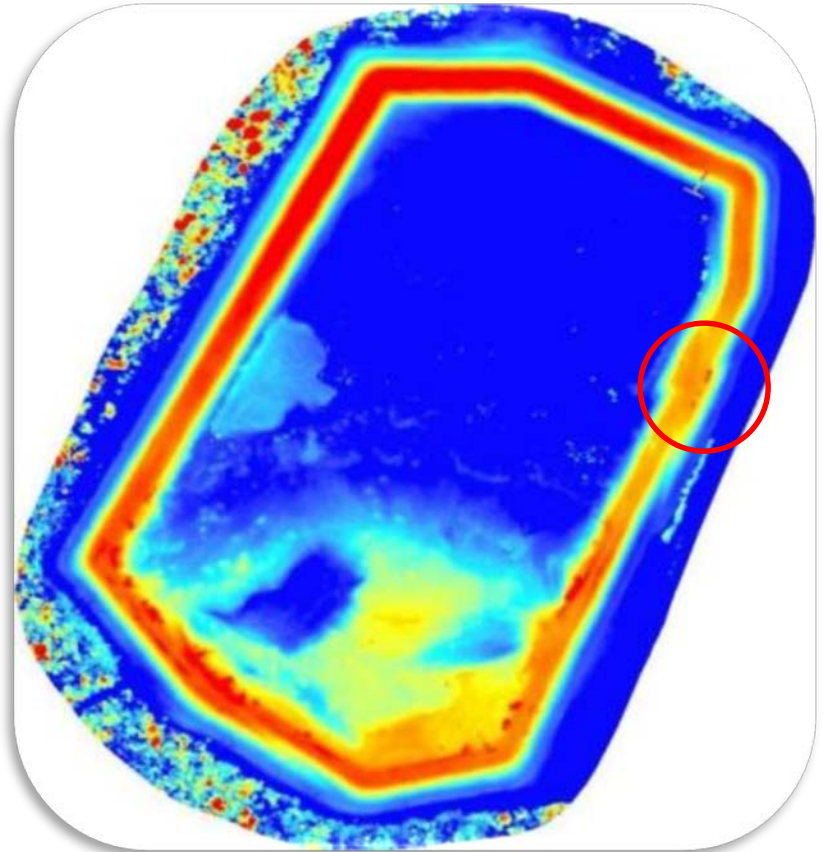
Columbia Canal
20151011-SAJ Mosaic

APPLICATION: Quickly map the severity and extent of damage
at critical infrastructure



GOT DSMS?

SJ1 Upland Disposal Area, St. Augustine, Florida

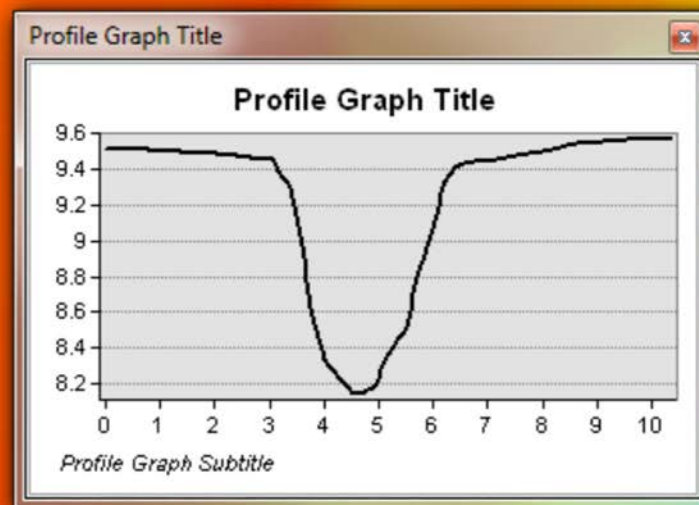
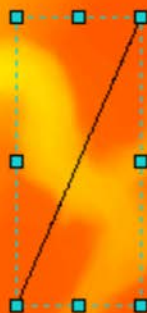


Sometimes the vertical relief is not readily apparent in imagery



WATCH YOUR STEP...

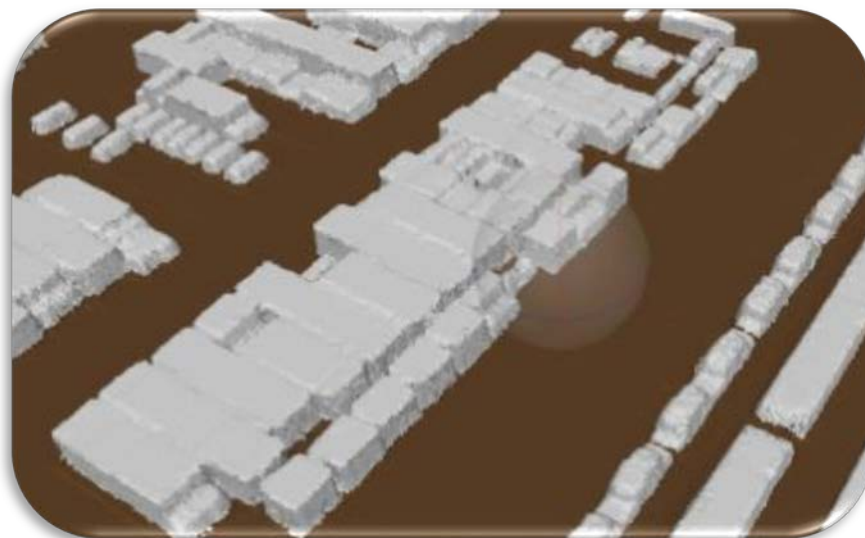
SJ1 Upland Disposal Area, St. Augustine, Florida



- ~1.2 meter washout
- Rapid assessment of road/levee conditions
- Repair volume and debris removal estimation



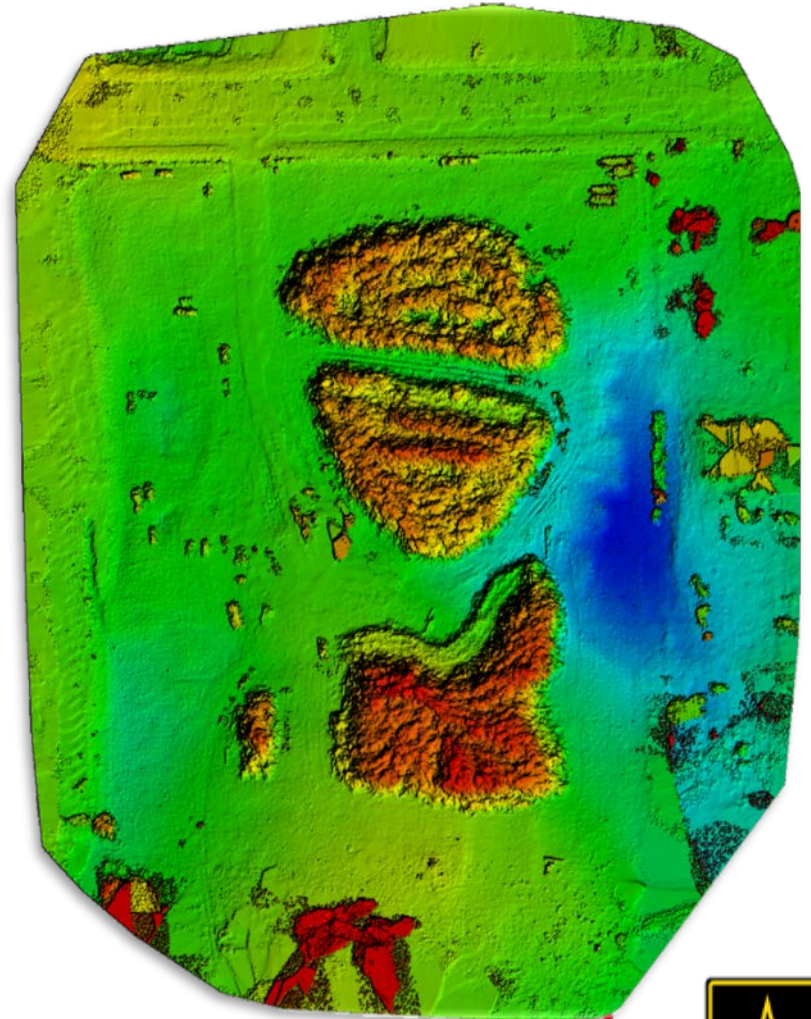
POINT CLOUDS WITH RGB VALUES



- RGB point clouds can be used to create three dimensional visualizations
- Bare Earth model can segregate storm debris for volume estimates



3100 GILLIONVILLE DEBRIS STOCKPILES



1) 14962 yds 2) 17818 yds 3) 22830 yds



THERMAL IMAGERY APPLICATIONS



- Thermal Infrared spectrum reveal temperature variations
- Locate and track unauthorized access: looters, trespassers, vandals, etc.
- Find ancient archeological features?
 - <http://www.livescience.com/44679-drone-images-reveal-buried-archaeological-ruins.html>



APPLICATIONS

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CULTURAL RESOURCE DOCUMENTATION



ISIS Media Organization Screen Shot. Source: Newsweek



ISIS destruction of artifact on a wall in Hatra, a UNESCO World Heritage site. Source: AP File Photo

- Can we document artifacts before they are destroyed, looted, mistakenly damaged?

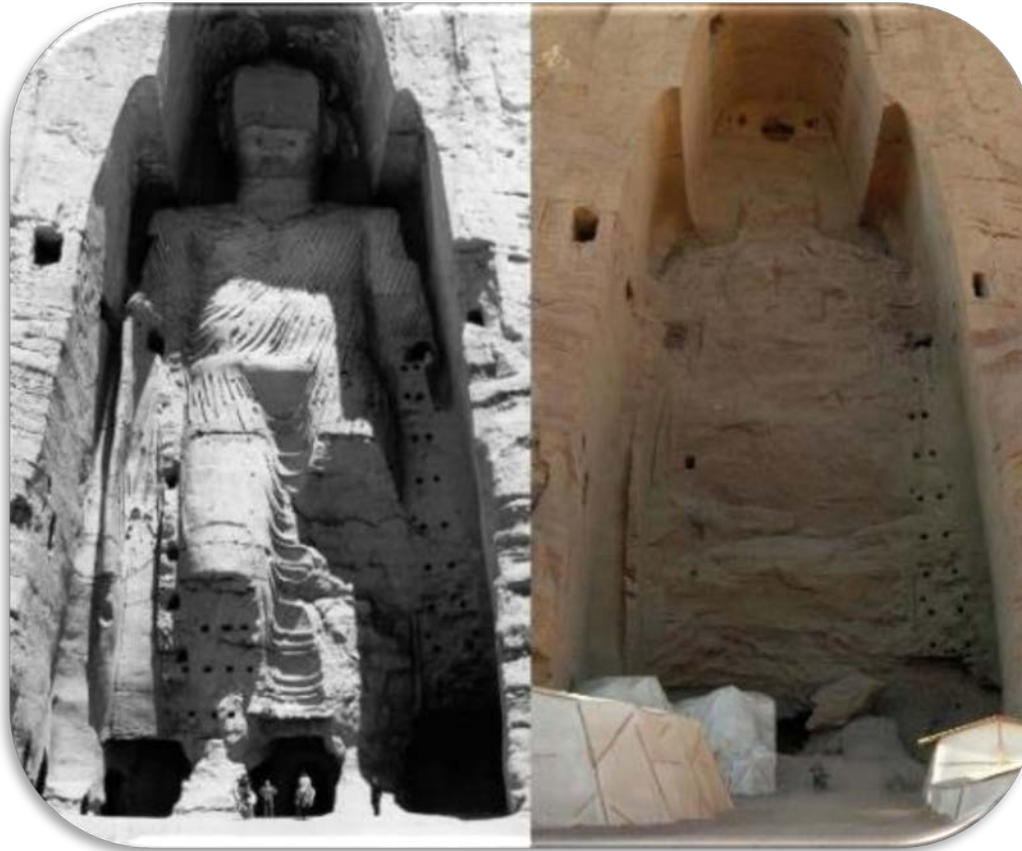
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CULTURAL RESOURCE DOCUMENTATION



Buddha of Bamiyan Source: Wikipedia

- Sometimes we can't save things; however, we can document them for posterity.

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CULTURAL RESOURCE DOCUMENTATION



Source: Agisoft

- We can recreate, analyze, and preserve architecture

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APPLICATIONS

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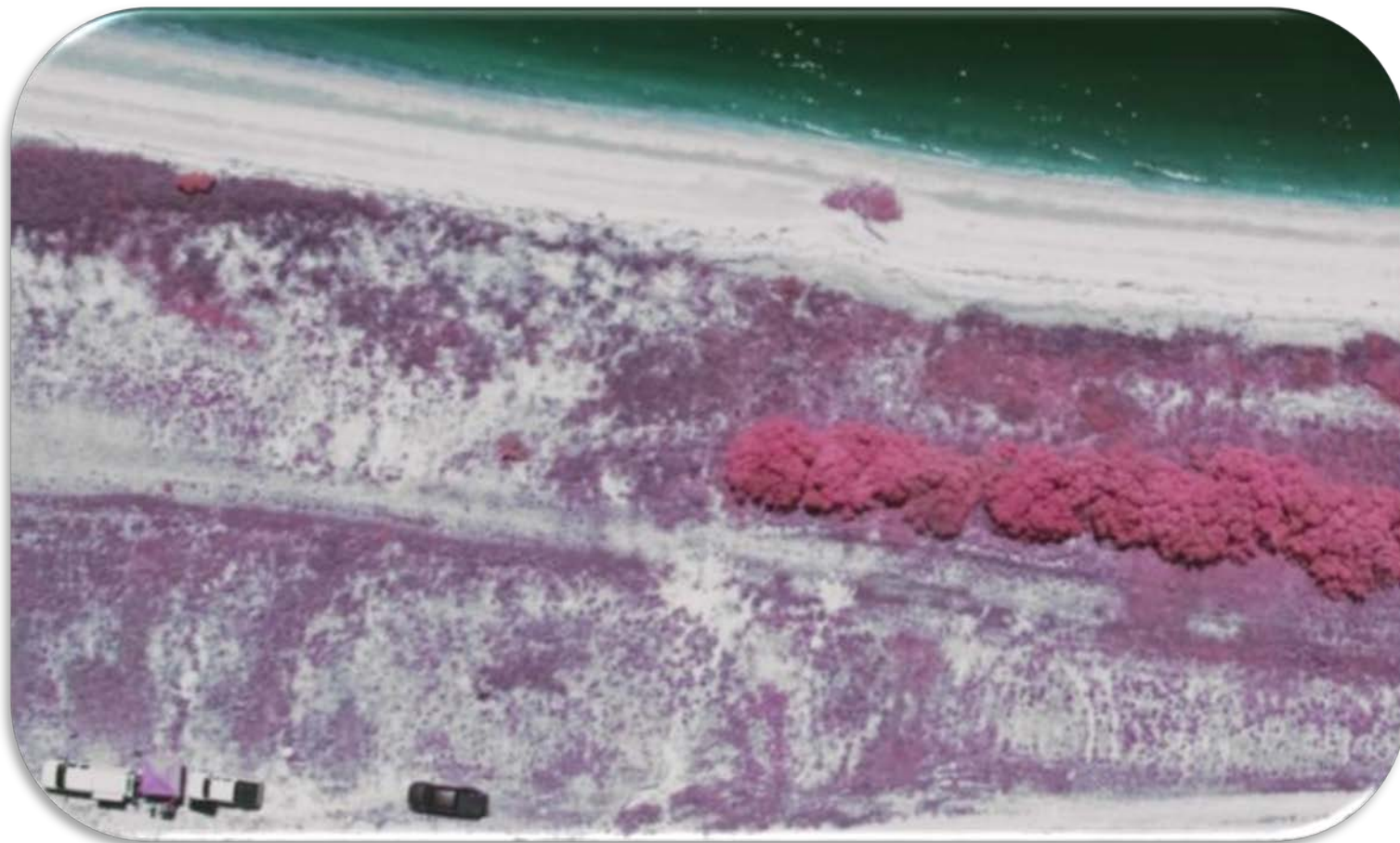


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CIR STANDARD MAPPING PAYLOAD



- Some plant species are spectrally more separable in near-infrared wavelengths.

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SPECIES IDENTIFICATION

- Resolution sufficient to identify structural properties of plants



Purple
is
Cogon
Grass

Orange
is
Brazilian
Pepper

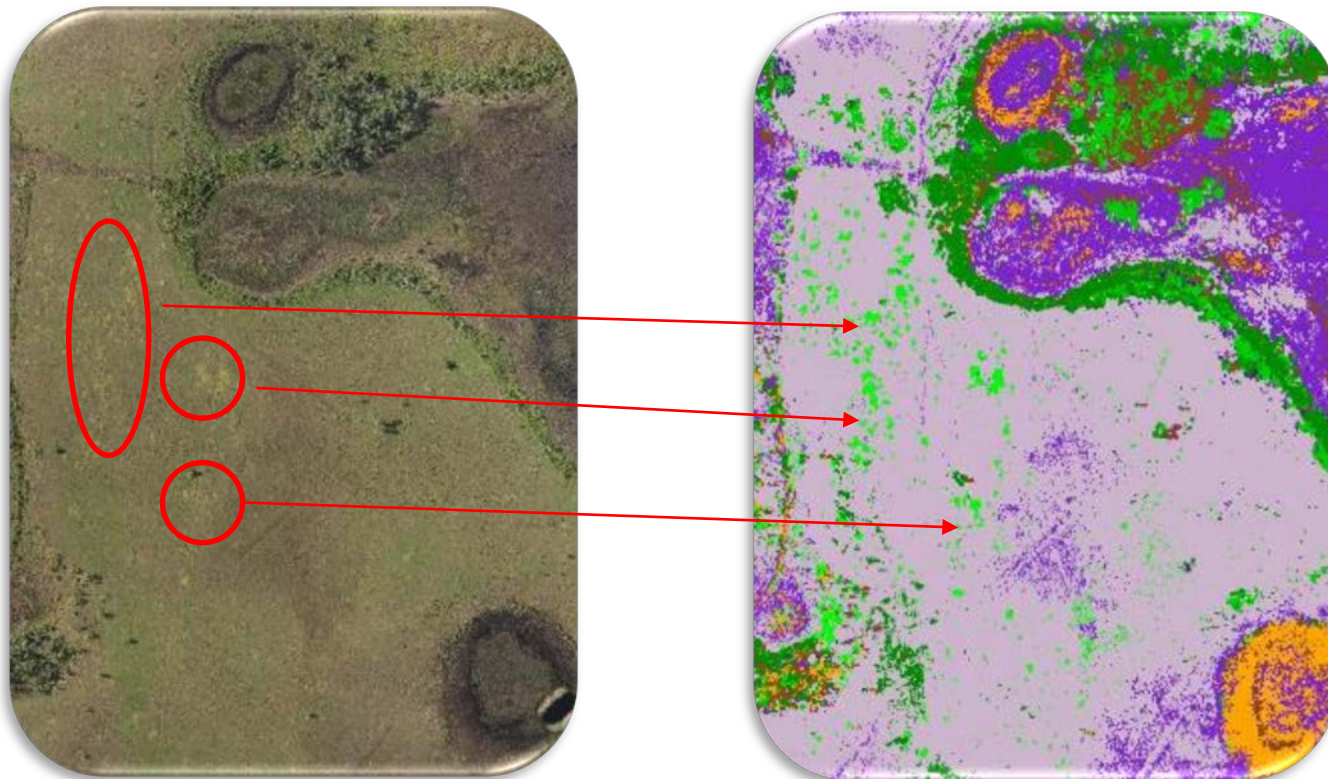
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SPECIES IDENTIFICATION/CLASSIFICATION

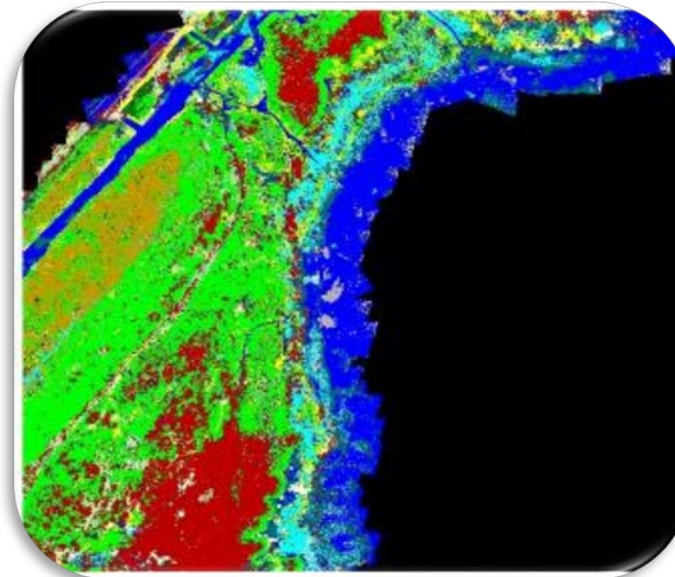
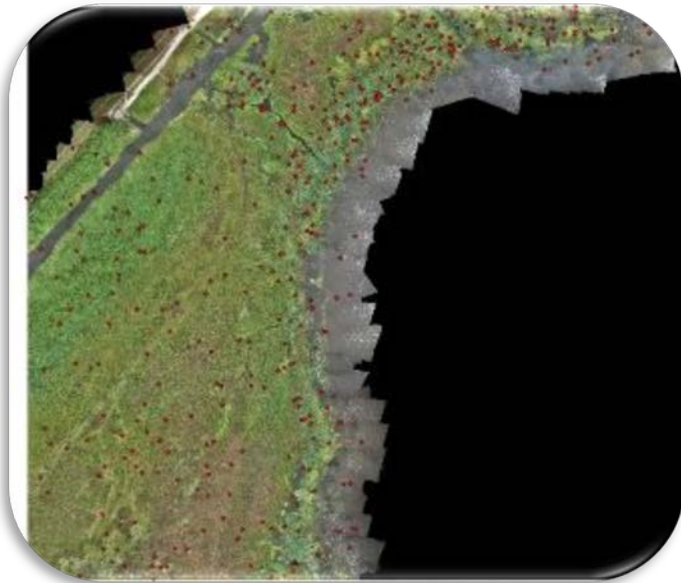


Species delineation near Lake Placid Florida.

- Spectral and geometric properties of objects within the image can be used to automatically identify areas of interest.



OBJECT BASED AQUATIC SPECIES IDENTIFICATION



Eagle Bay, Lake Okeechobee Florida ~2013

- Object based detection of plant communities using contextual information is an area of active research

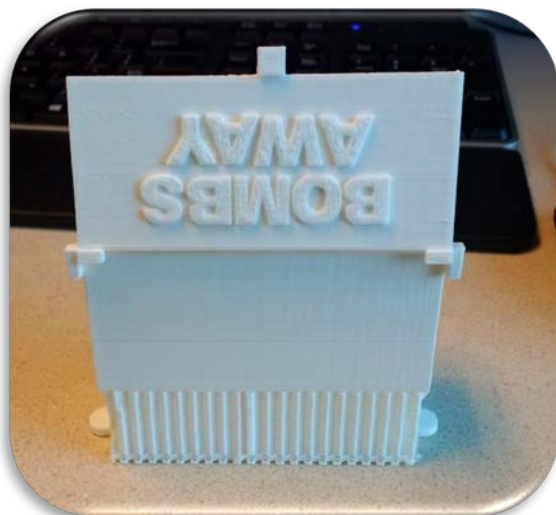
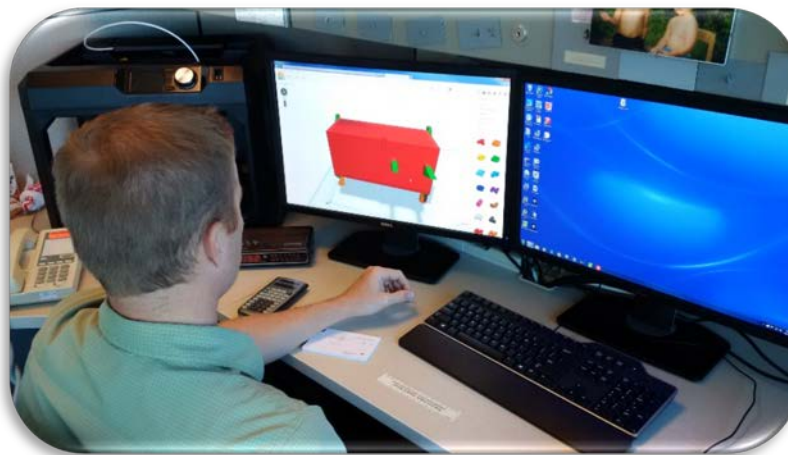
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BIOCONTROL RELEASE FOR ISM



BIOCONTROL RELEASE FOR ISM



- Pilot project to release *Megamelus Scutellaris* to control water hyacinth
- Second generation design underway



FREQUENTLY ASKED QUESTIONS

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GENERALIZED FEATURES ON CORPS UAS

Function	Fixed Wing	VTOL
Advantages	Cost-effective for large areas, multiple payloads	Detailed data collection, terrain can be uneven
Landings	belly approach, water or long flat strip	Flat land touch down, Flexible
Take-off	Hand launched, catapult launcher	Flat Land, Flexible
Flight Coverage	>1,000 acres/day	800 acres/day
Flight Times	45 minutes to	< 30 minutes
Energy Source	Battery	Battery
Size	3 – 10 ft.	Usually < 2 ft.
Weight	1.5 – 20 lbs. average (<55 lbs.)	<55 lbs.
Average Flying Altitude	400-800 ft. (Capable of <2,500 ft. AGL)	<400 ft.
Flying Conditions	Various, light to moderate winds, light rain, clear conditions	Mostly good weather, light winds



TYPICAL COSTS – ROLL YOUR OWN...



\$300,000 Riegel RiCopter



\$400 Phantom Vision 3

- Equipment cost and capability has a wide range.
- Costs do not necessarily correspond to:
 - Capability
 - Usability
- Administrative setup
 - Initial Admin 40 hours
 - Train 3 people 54 hours
 - Additional sites 3 hours each
- Post processing time depends on requirements



UAS != SILVER BULLETS...

Method	Advantage	Disadvantage
Satellite	Large areas, low cost, multi-spectral	Low spatial resolution, low accuracy terrain models
Airplane	Large areas, multi-spectral, terrain modeling	Med-high cost, contracting can be slow
UAS	Middle and smaller areas, high spatial resolution,	Uncertain terrain models, mosaic artifacts, “low” risk areas only
Field Survey	Very accurate, good terrain modeling, terrestrial/mobile LiDAR,	High cost, some areas difficult to access, smaller areas.

- Consider all the options and select the best tools for the project requirements

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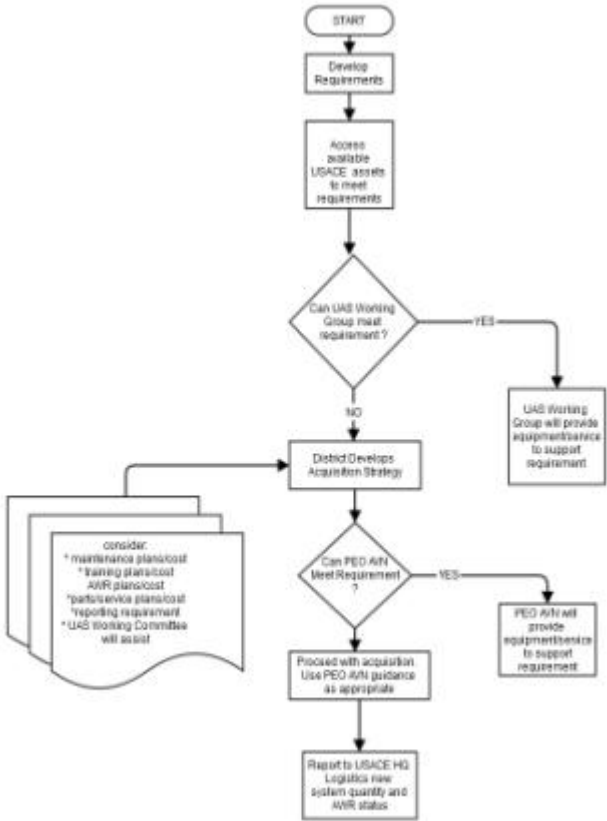


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WHAT DO I HAVE TO DO?

Acquisition Process



Air Worthiness Release Process



Start reading...

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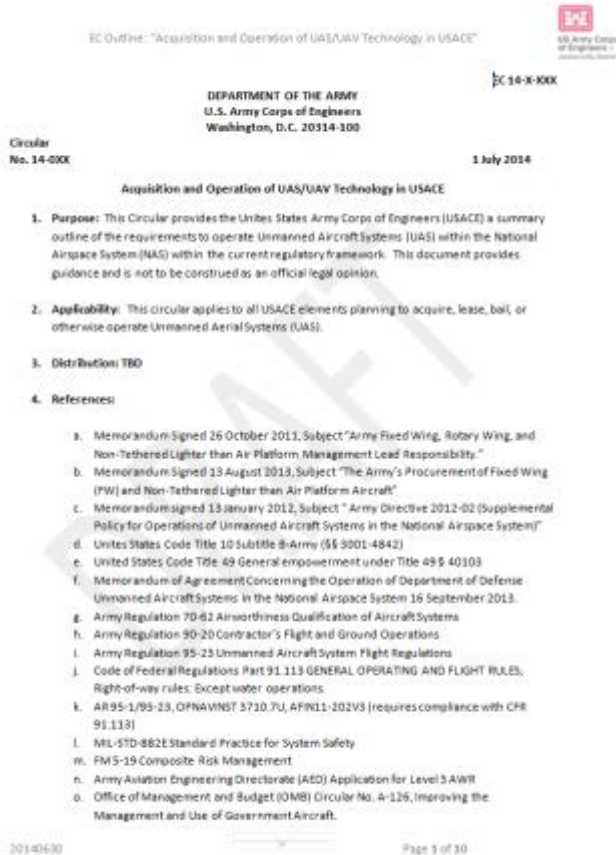


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EC 1110-1-106



- USACE EC on UAS Acquisition and Operation

- Summarize most Army aviation policy

- Established Working Committee
 - Required to obtain approval before purchase

- Reporting requirements
 - Equipment to DOL
 - AWR to webapp



UAS COMMUNITY OF PRACTICE

- Under Geospatial COP
- Sharepoint site
- Internal USACE UAS Email Distribution
- Example Documents
- Community Discussion and Forums (presently not utilized)
- Lots of unused capability for virtual teaming and collaboration

If you're interested
in UAS,
WELCOME!

**YOU ARE THE
COP**

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STILL OVERWHELMED?

- Consider partnering on a pilot project
- get a “taste” before the banquet
- MVN
- SAJ
- LRH
- MVS
- ERDC-GRL
- ERDC-EL
- ERDC-CERL
- CRREL



Costs range between \$3-5K per day



SAJ REGIONAL CX

- SAD Regional Center
 - Host's ~annual USACE UAS Meeting
- National Lead for USACE UAS Operations
 - Policy interpretation
 - Technical Expertise
 - 4 system types
 - Custom payload integration
 - Bug drop, thermal camera, etc.
- Full spectrum UAS program with support equipment
 - Airboat
 - Powerboat
 - UTV



•Source: shameless self promotion

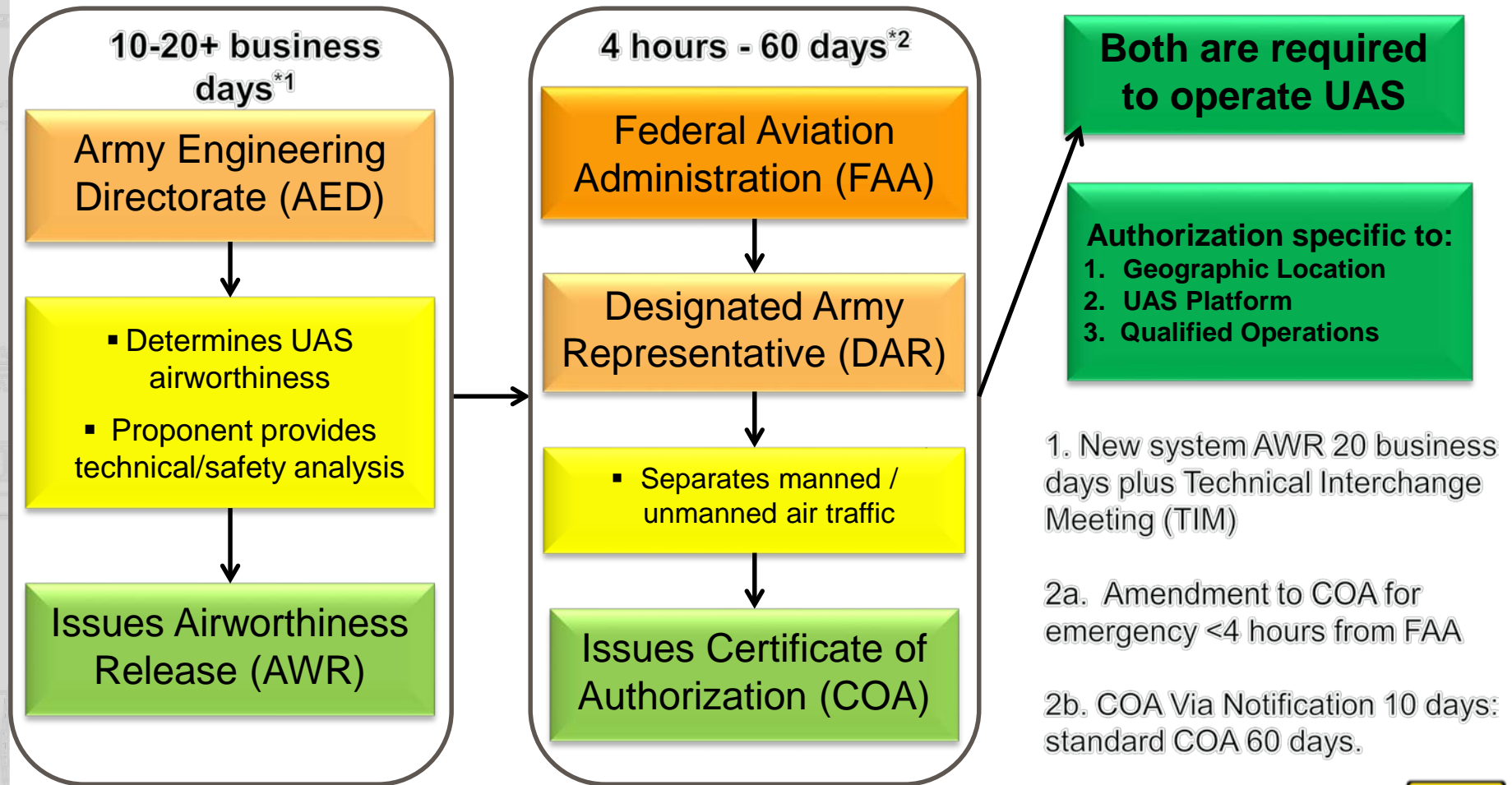
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TIME FRAMES



ASSUMES MISSION IS COVERED BY APPROVED SEC DEF PERMISSABLE USE MEMORANDUM (PUM)



CONSTRAINTS

AR 70-62 requires AWR:

- Airworthiness Qualification Level (AQL) 3
- Not undergone rigorous airworthiness qualification
- Avoid flying over people, roads, homes, etc.
- Limited to Line Of Sight operation (LOS)
- Depends on conditions, typically 1.5km



LET'S TALK MORE

Give us a shout...

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Tom Spencer 904-232-1579

Thomas.M.Spencer@usace.army.mil

Consider signing up for the SAJ UAS Newsletter

Our website:

<http://www.saj.usace.army.mil/Missions/UnmannedAerialVehicle.aspx>

Image Service with examples

<https://sajgis.saj.usace.army.mil/uas/>

NOTE: CAC authentication, USACE only



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