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# Preliminary Evaluation of National Campaign Scenarios for Urban Air Mobility

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# Outline

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- Problem Statement
- National Campaign Scenarios/Use cases
- Approach
- Results
- Summary



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# PROBLEM STATEMENT

# Why UAM?

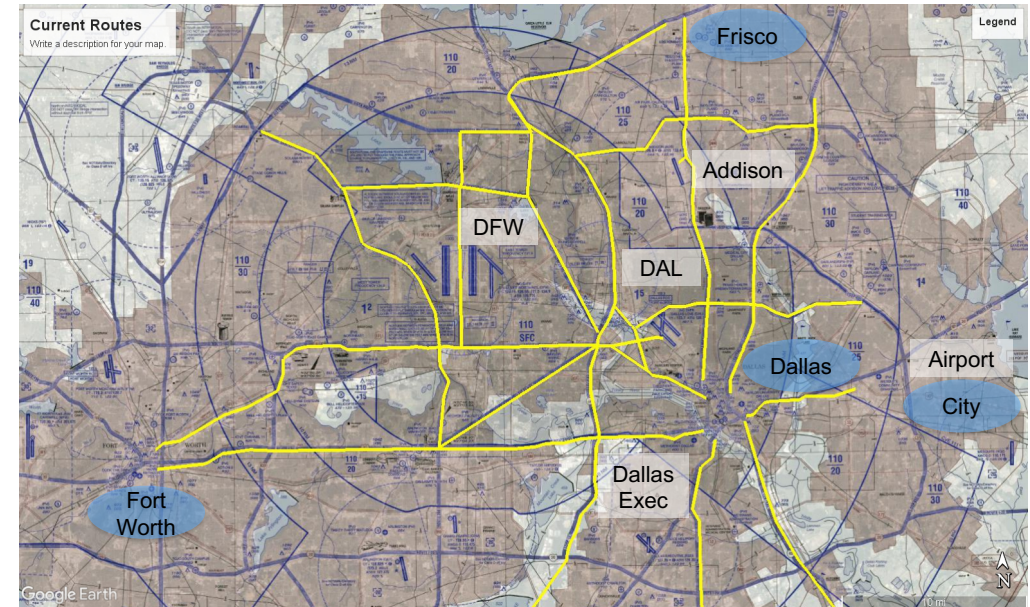
- Improve mobility
- Potential to offload road traffic
- Reduce transport time
- Reduce strain on public transit systems



Photo: Noah Berger

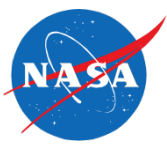
# Problem Statement

- Explored procedures for accessing controlled airspace using current day helicopter routes and procedures
  - Limitations in scalability
  - Digital communications change nature of workload not reduce workload
- Investigated UAS Traffic Management (UTM) capabilities for UAM specifications
  - UTM architecture can support UAM operations
  - Specifications need to be updated for UAM operations



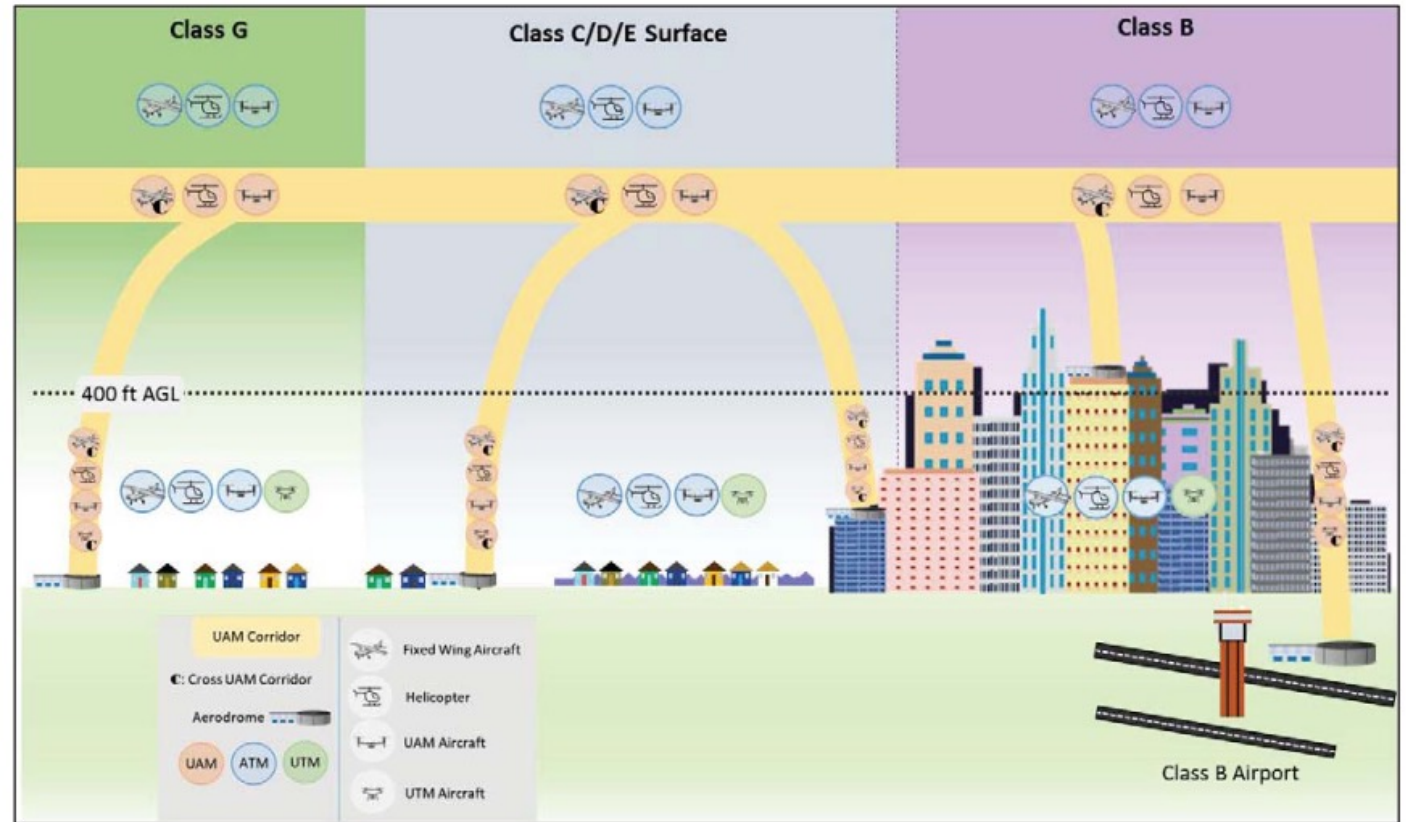
Current day helicopter routes in Dallas Area

Evolve a UAM Specification from UTM to enable UAM operations ranging from nominal trajectory following to off-nominal use cases e.g., re-routing around TFRs



# FAA NextGen Conops v1.0 on UAM Operations

- Air traffic management vision for near-term UAM operations
- FAA-defined UAM corridors with specific performance requirements
- Vehicles planned for UAM likely to be electric Vertical Takeoff and Landing (eVTOL)
- Aircraft operator connection to a “Provider of Services for UAM” (PSU) will be required
- Separation within corridors assigned to pilots, operators, and PSUs, not ATC
- UAM operations will start with today’s rules and procedures and evolve to incorporate Community-Based Rules (CBRs)

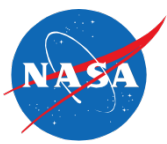


The assumptions used in this research were developed in collaboration with FAA

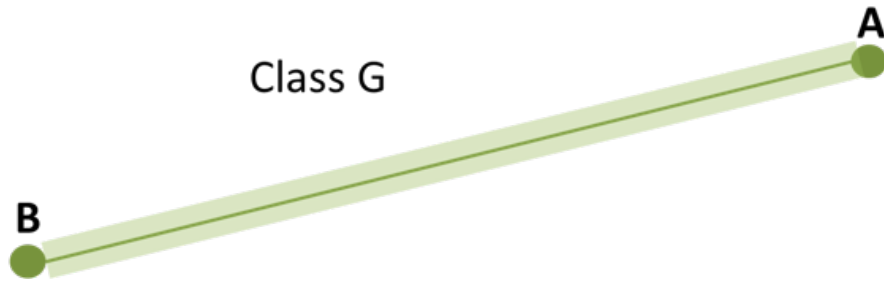


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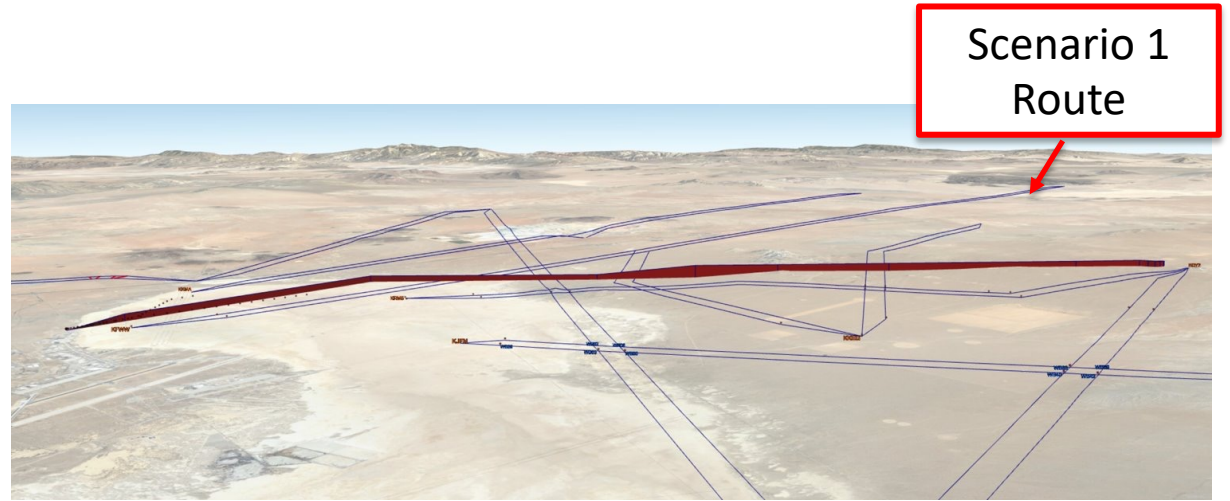
# **NATIONAL CAMPAIGN SCENARIOS**



# Scenario 1: Trajectory Planning & Compliance



Notional Scenario 1

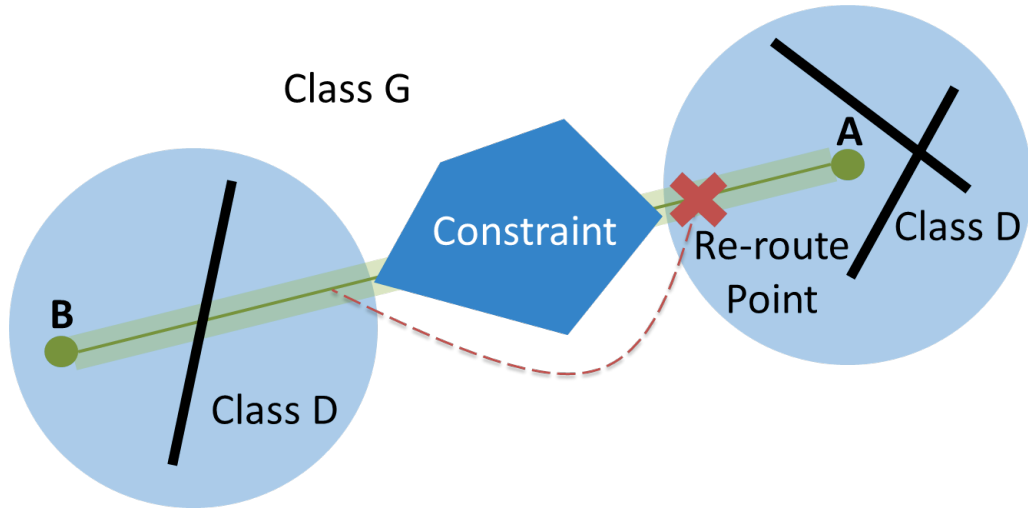


Routes in Class G

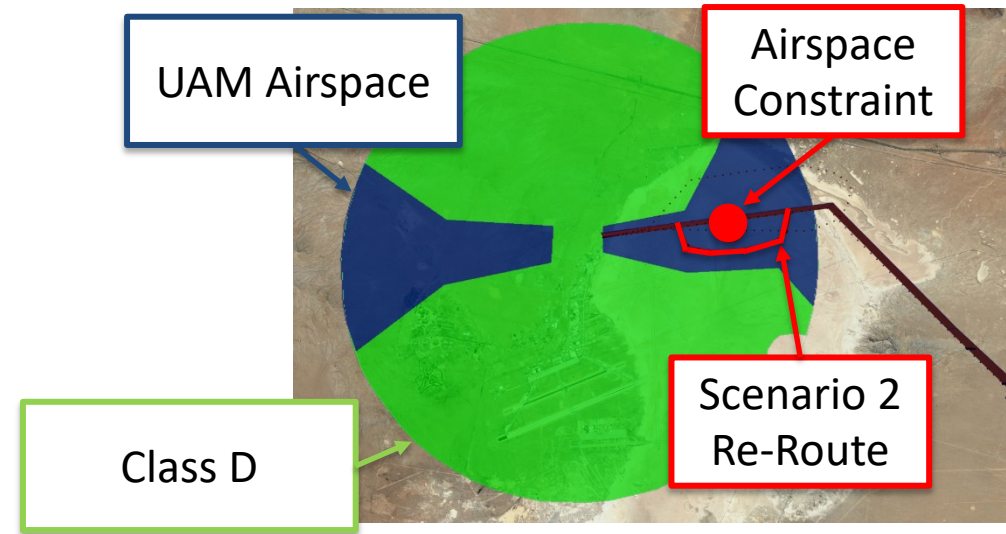
Element	Assumption
Airspace	Class G, Visual Flight Rules (VFR) under Day Visual Meteorological Conditions (VMC)
UAM Routes and Vertiports	UAM routes and Vertiports are <b>not</b> shared among operators
Background Traffic	Legacy traffic and small Unmanned Aircraft Systems (sUAS) not included in the simulation
ATC Communication	Verbal communications not required



# Scenario 2: Re-routing around Airspace Constraint



Notional Scenario 2

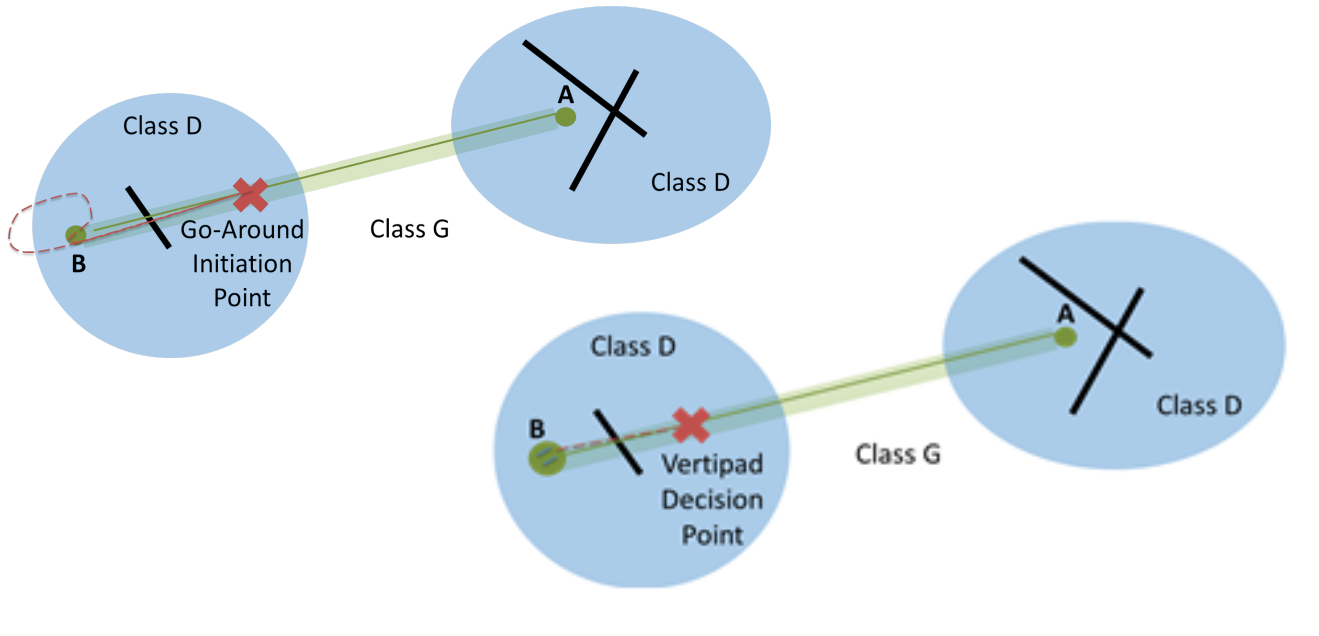


Temporary flight restriction and re-route

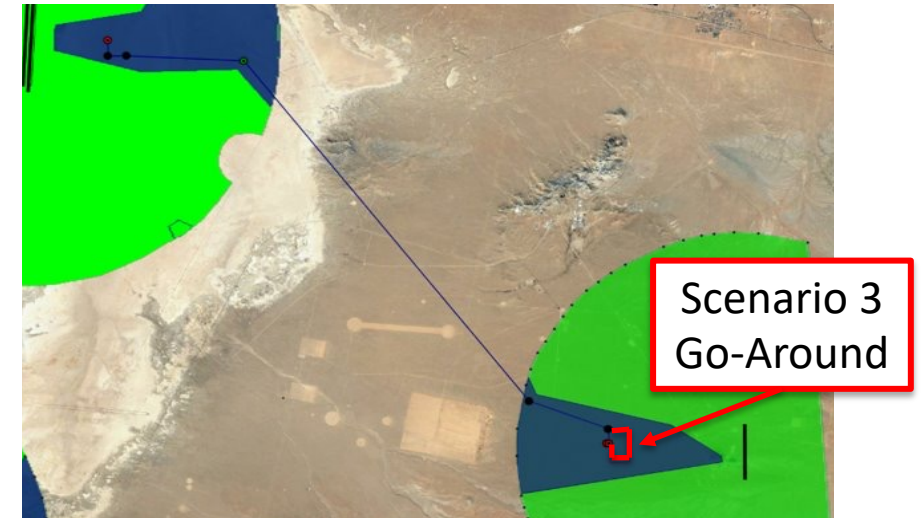
Element	Assumption
Airspace	Class D/E/G
Adaptation	UAM routes and re-routes predefined, shared with partners
ATC Communication	Current day verbal communications not required, the entry and exit from 'UAM Airspace' is pre-authorized
Constraint Creation	Announced by a NASA service
UAM Re-route	Re-route flight path does not require ATC authorization because it is with 'UAM Airspace' and provided as updated plan to PSU



# Scenario 3: Vertiport Operations



Notional Scenario 3



Go-Around in Class Delta

Element	Assumption
ATC Communication	ATC Communications not required; Go-Around published
Go-Around trigger	Operator triggers the go-around or PSU detects a conflict on the landing pad and triggers the go-around or lands on alternate landing pad
UAM Go-Around path	The UAM go-around path is pre-defined plan and is taken by the flight

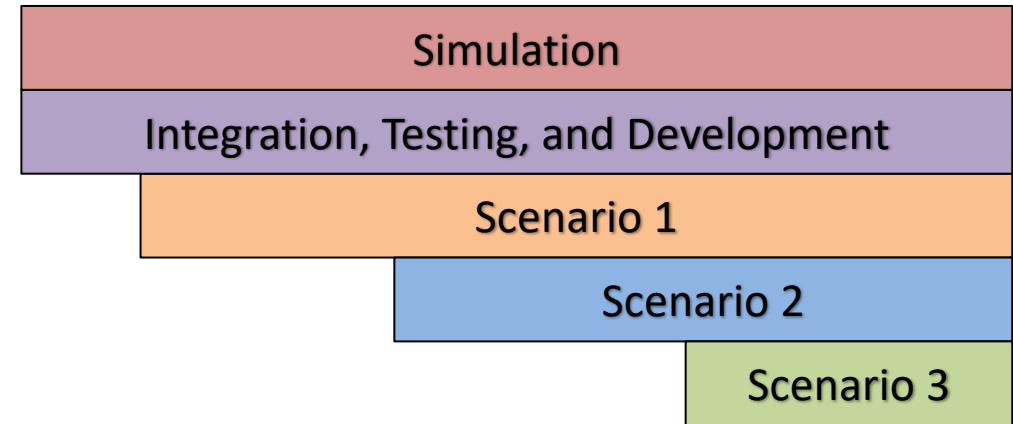


# APPROACH



# Test Approach

- Iterative build-up of features
  - Each scenario built on the capabilities of the preceding scenario
  - Needed to pass the previous scenario to move on to the next



- Testing consisted of 4 main activities





# Data Collection Approach

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- Data Collection Configuration:
  - Partner PSU
  - Discovery Synchronization Service (DSS)
  - NASA Data Collection PSU
  - Data Pipeline
- Types of Data Collected
  - Exchanged PSU Network Messages
  - Operation planning
  - Times for exchanges and responses
  - Vehicle telemetry
- Calculated Metrics
  - Size of operational volumes and conformance to the operational volumes
  - Intersections of operational volumes between operations
  - Operations impacted by an airspace constraint and re-planned (e.g. re-route, go-around)



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# RESULTS

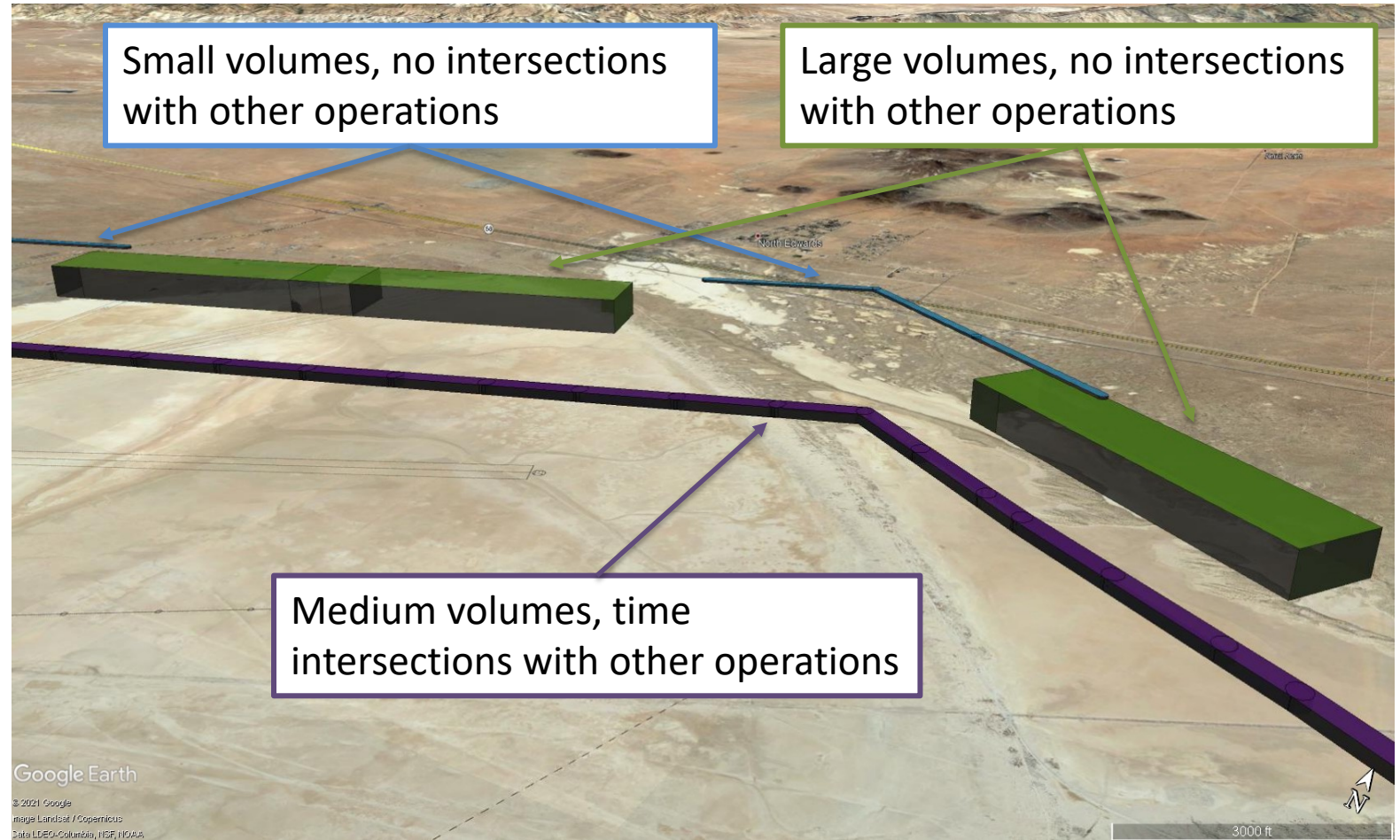
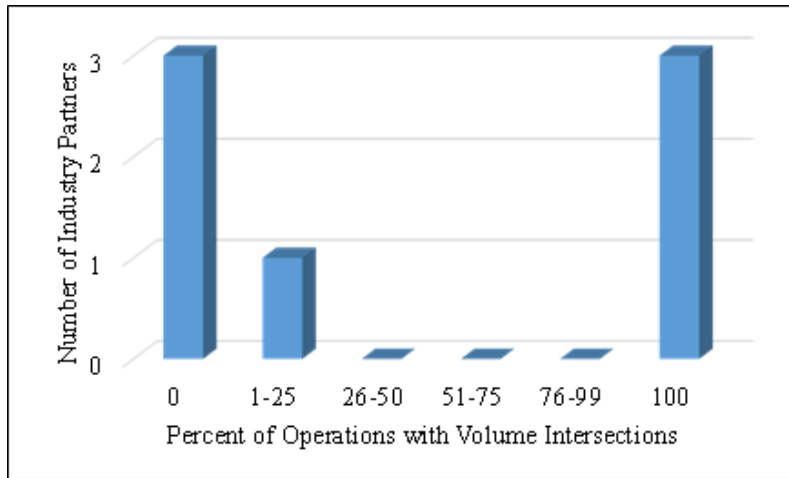


# Industry Partner Simulation Performance

Scenario	Number of Industry Partners Completed	Total Number of Test Runs	Total Number of Operations Flown
1	7	13	70
2	4	8	39
3	2	4	14



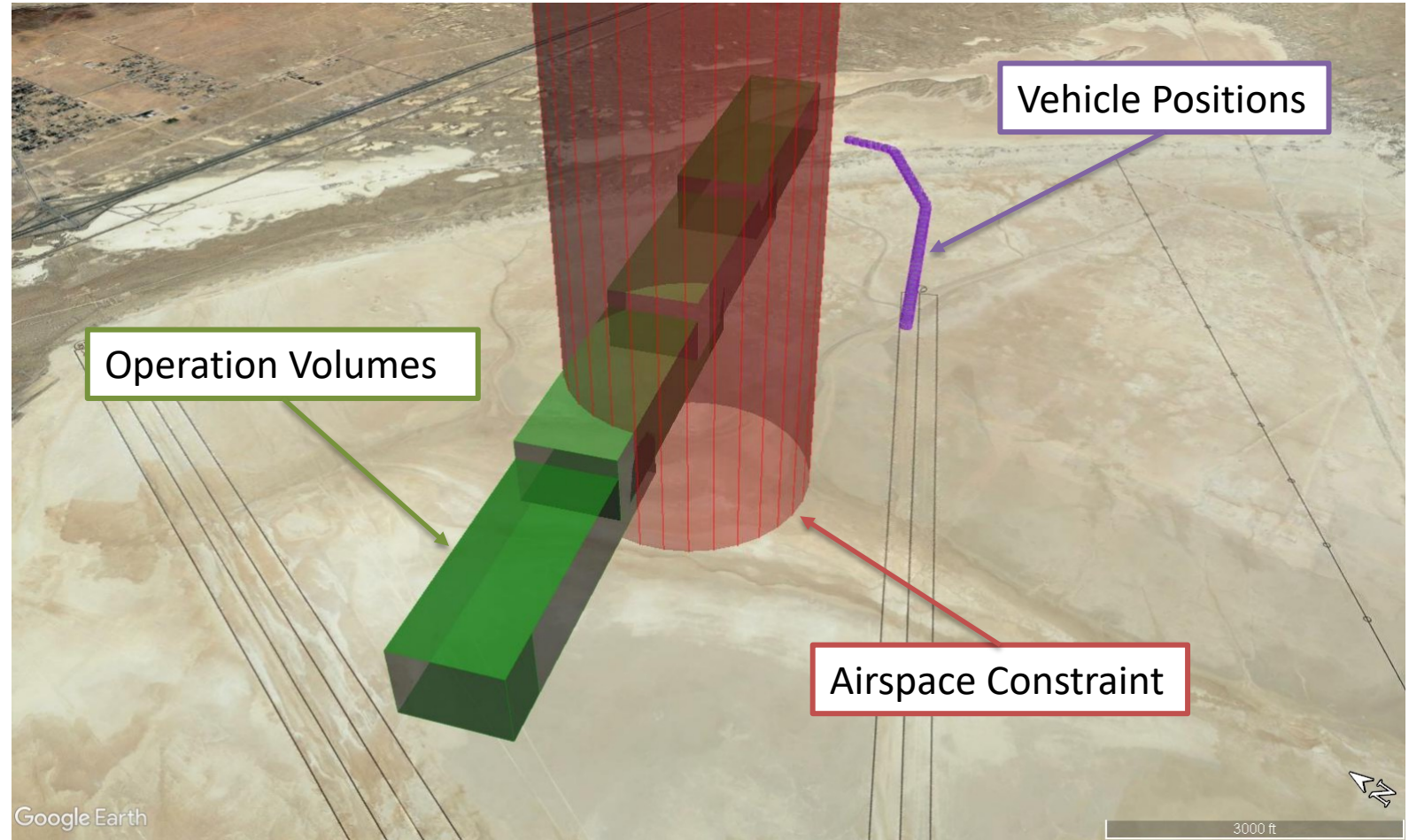
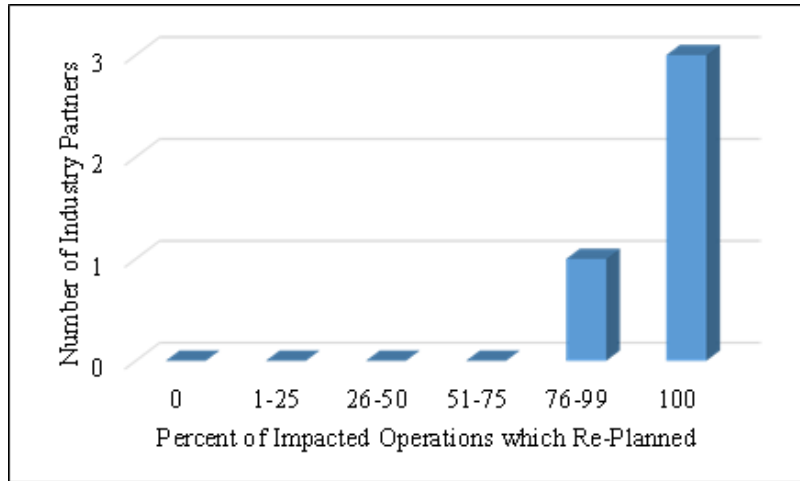
# Scenario 1: Trajectory Planning & Compliance



Volumes sizes are chosen by operator and method to determine size needs to be standardized to support equitable use of the airspace



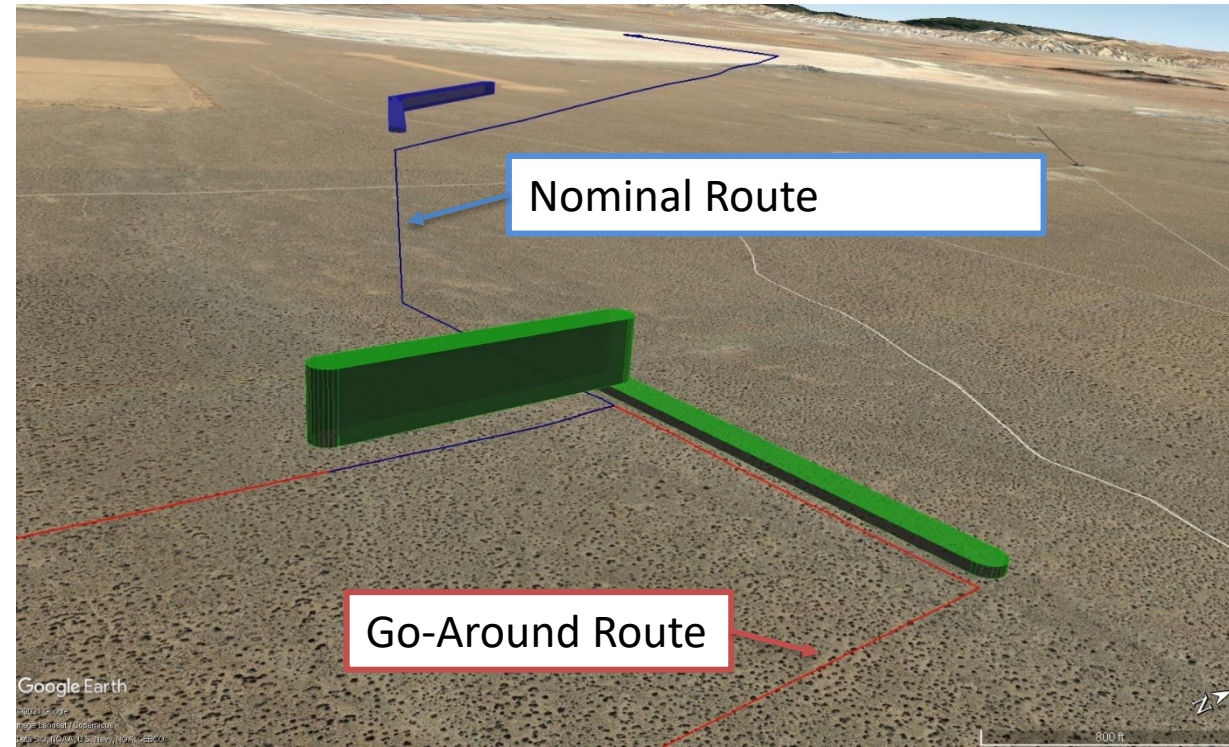
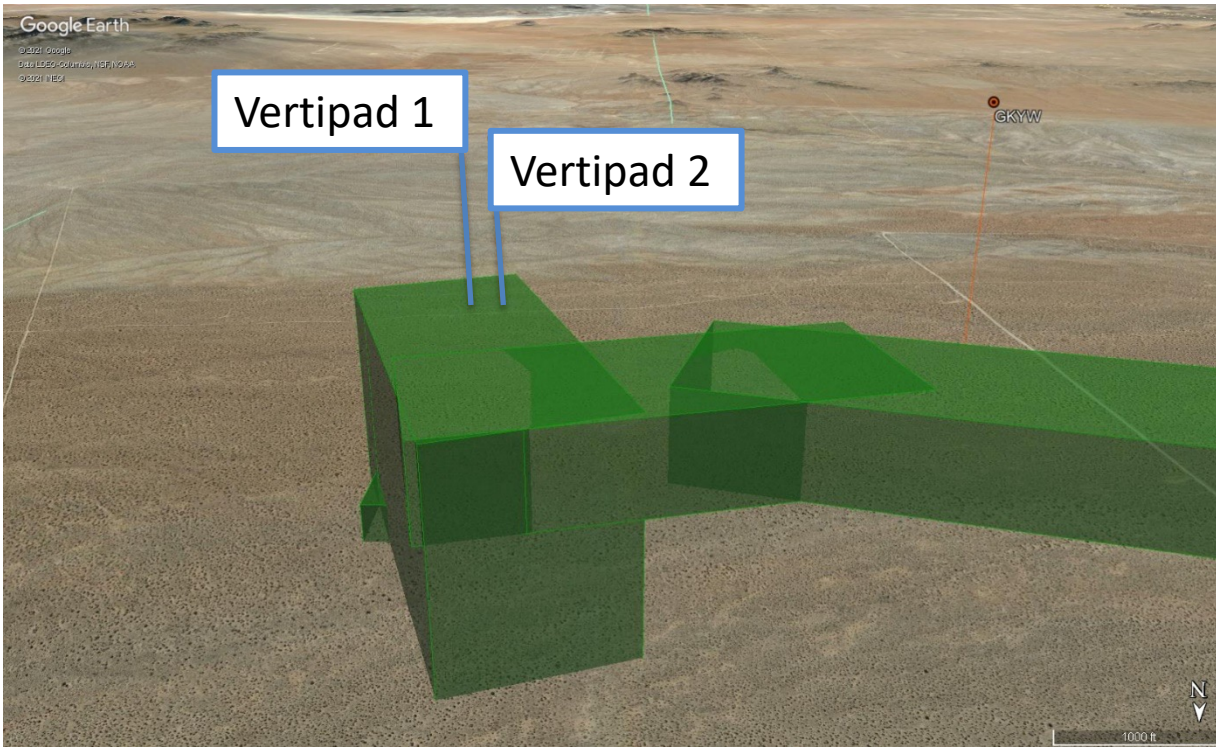
# Scenario 2: Re-routing around Airspace Constraint



Additional requirements are needed to minimize the possibility of operation plan rejections for airborne operations



# Scenario 3: Vertiport Operations

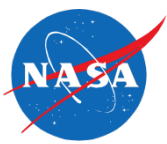


As the operational space becomes more confined (such as around vertiports) additional requirements for method to standardize volumes are needed.



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# SUMMARY



# Summary

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## Summary

- Industry partners exercised NC Scenarios including nominal and off-nominal operations
- Identified areas which would need additional requirement definition

## Future Research

- Explore the evolution of UTM standard for UAM operations
- Investigate use of 4 Dimensional Trajectories (4DT) as an alternative to scheduling of volumes
- Creation of a service for defining Airspace Structures



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# QUESTIONS?

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**BACKUP**



# X3 UAM Airspace Simulation Platform

