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Integrating Drones into NHS logistics systems: Great concept, impossible reality?

Prof Tom Cherrett

Contents

- Drones – definition and types
- Uses
- Scope for use in NHS logistics
- Problems and issues

Drones: fixed-wing

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Drones: helicopters

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Drones: multi-copter

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Drones: hybrid

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Drones in warfare

Drones in farming

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Drones in farming

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Drones in warehousing

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Drones in lifesaving

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Drones in logistics

Research Questions

- In what areas and what circumstances could drones contribute effectively to NHS logistics?
- What types of drones are most suited to these NHS areas and what would their operating criteria have to be?
- How would their operating performance be affected by routing constraints which may be dynamic in nature?
- How would they be used on a daily basis given weather conditions and routing constraints?
- What contingency options would be needed for no-fly events?

Background

- **E-Drone (EPSRC), 1/1/21 – 31/12/23 (UoS, BU, UCL, Leeds)**
- **://www.e-drone.org/**
- How to integrate drones into mixed-fleet logistics
- The energy and cost implications of NHS drone logistics
- Public perceptions of wide spread drone deployments

- **Future Transport Zone, (DfT), 1/4/21 – 30/6/24 (ST, UoS, UoP)**
- Developing a UTM for managing drones in the Solent region
- Developing drone corridors between the Solent NHS sites
- Developing safe systems for dangerous goods transport
- Understanding human factors issues in drone management

Drones in mixed-fleet logistics

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Trunking hub-to-hub

Point-to-point delivery/ collection

Patient diagnostic samples

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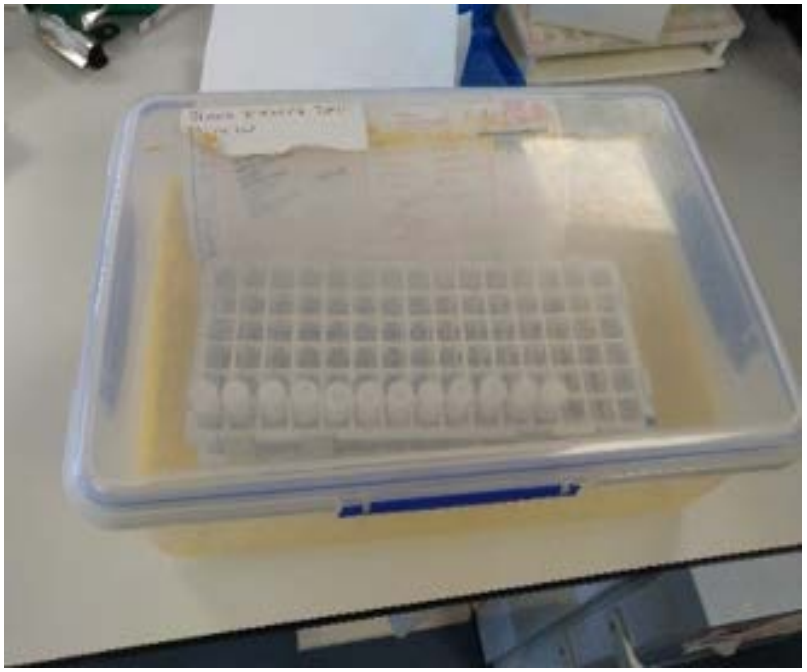
Blood Related	Body Tissue	Faeces	General Fluid	General Sample	General Swab	Sexual Health	Urine
Blood	Duodenal biopsy	Faeces	Cerebrospinal fluid	Calculus	Ear swab	Cervical swab	Catheter Urine
Plasma	Gastric biopsy		Fluid	Gallbladder	Eye swab	Endocervical swab	Midstream urine
	Isolate		Knee aspirate	Hair	Groin swab	High Vaginal Swab	Urine
	Paraffin embedded		Saliva	Miscellaneous	Mouth swab	Low vaginal swab	
	Skin biopsy NOS		Sputum	Miscellaneous spec	Nose and Throat swab	Penile Swab	
	Tissue		Synovial fluid	Nail clippings	Nose swab	Semen, Infertility	
				Skin scrapings	Perineal swab	Semen,Post Vasectomy	
					Pernasal swab	Urethral swab	
					Pharyngeal swab	Vaginal swab	
					Pus	Vulval swab	
					Pus swab	Vulvo-vaginal swab	
					RECTAL SWAB		
					Sacral swab		
					Skin swab		
					Swab		
					Throat swab		
					Ulcer swab		
					Umbilical swab		
					Wound swab		

Patient diagnostic samples



- UN3373 DG classification
- PI650 packaging

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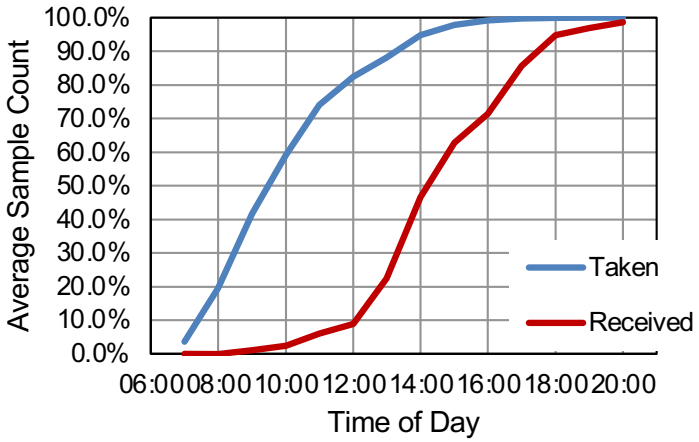
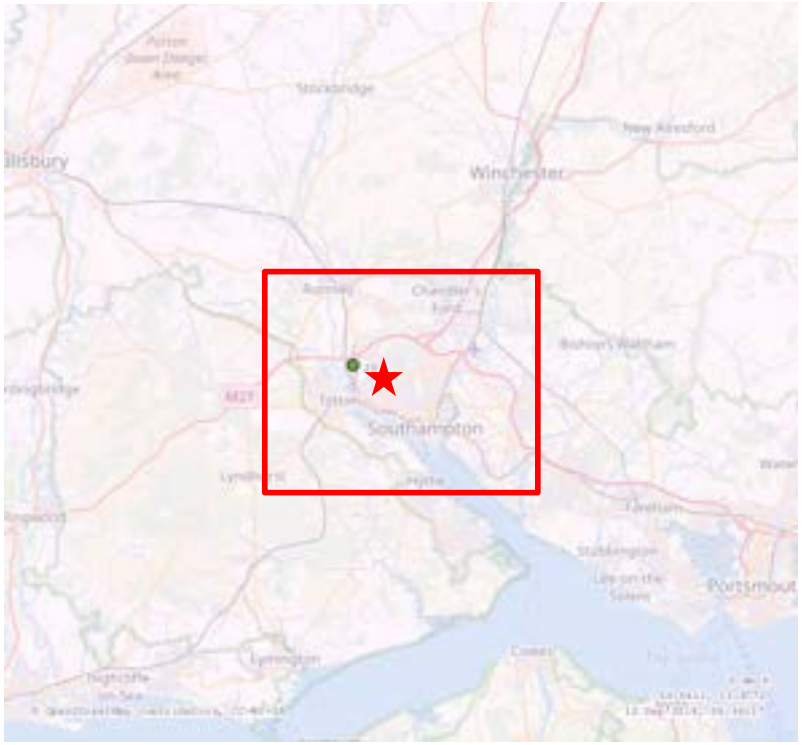
Patient diagnostic samples

Pathology business-as-usual





Blood

- Not classed as DG if for transfusion
- Often travels ‘unaccompanied’ on ferry

Chemotherapy drugs

- UN1851, 3248, and 3249.
- Also known as cytotoxic drugs
- Drugs are carried in their individual canisters/tubes/vials.
- Can have shelf life of 4 hours (e.g. Vidaza for Leukaemia)

Drones for aid logistics

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Drones for aid logistics

Drones for aid logistics

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Current UoS work

Isle of Wight, Isles of Scilly, Scottish Islands – (Ultra)

Isle of Wight – (Skylift/Apian)

Covid-19: Air bridge trial (Mar – May 2020)

- **<u>Aim:</u>**
- **Set up an Airbridge between the IoW and the mainland for delivery of NHS supplies via drone.**

<u>Operational challenges:</u>

- Taxiing on a busy airfield
- Communicating with ATC
  - Holding for other traffic (both on the ground and in the air)
  - Complying with land requests from Coast Guard Helicopters
- Transitioning to BVLOS flying
- Handover between two ground station operators

The Ultra UAV

The Ultra UAV – Payload bay

First load for St Marys, IOW

Apian – Skylift Mugin V50

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Apian – Skylift Mugin V50

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Apian – Skylift Mugin V50

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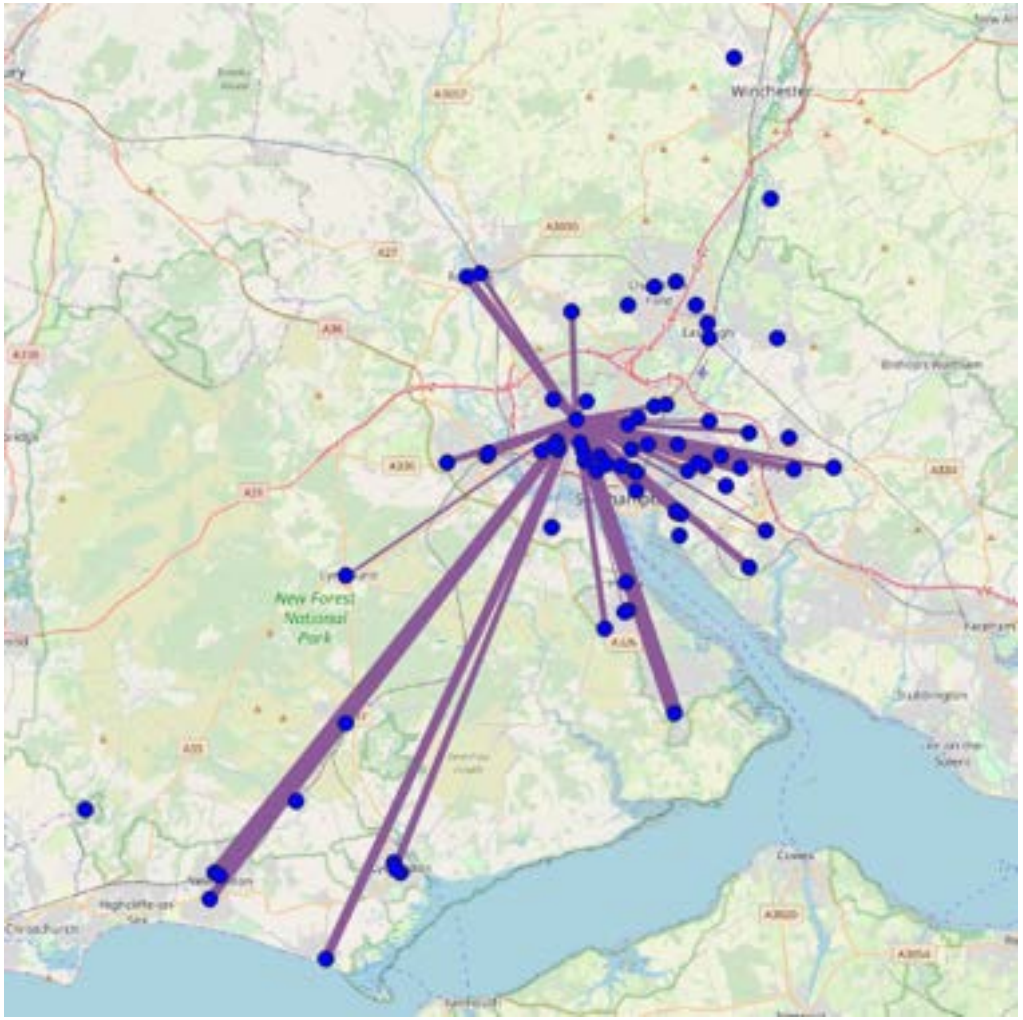
‘Sustainable Specimen Collection Problem’: SSCP

Samples to be transported:

- From a set of known locations to one single location
- As fast as possible
- Maintaining reasonable road vehicle use
- Reducing emissions



Minimise the maximum delivery time

Minimise total driving time

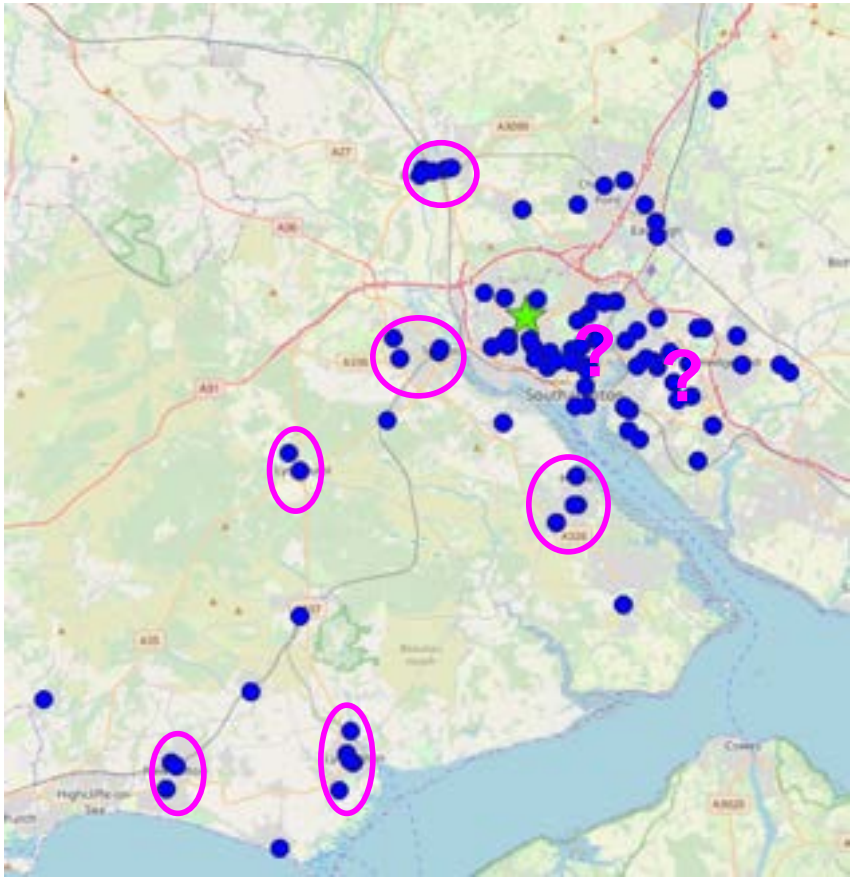
Minimise number of road vehicles used

Route Generation

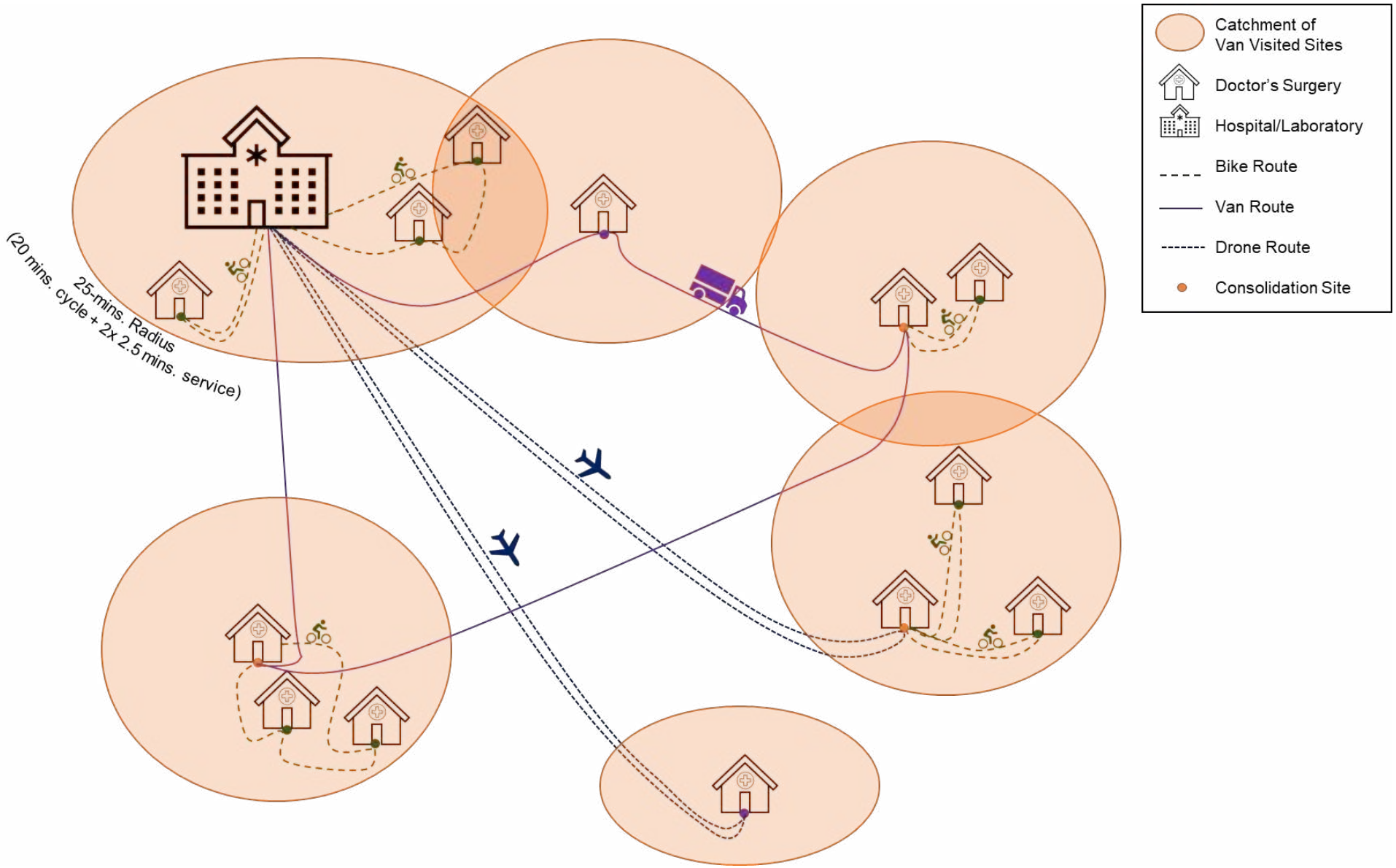
- **Cycling**
  - Consolidate to surgeries or deliver direct to hospital
  - 25-minute maximum round trip time
  - Cycles limited to carry 3 surgery's worth of samples
  - Fully enumerated

- **Vans**
  - Milk round, starting and ending at hospital
  - 90-minute maximum round trip time
  - Assumed no limit on capacity (van>>packages)
  - Greedy style heuristic used in construction

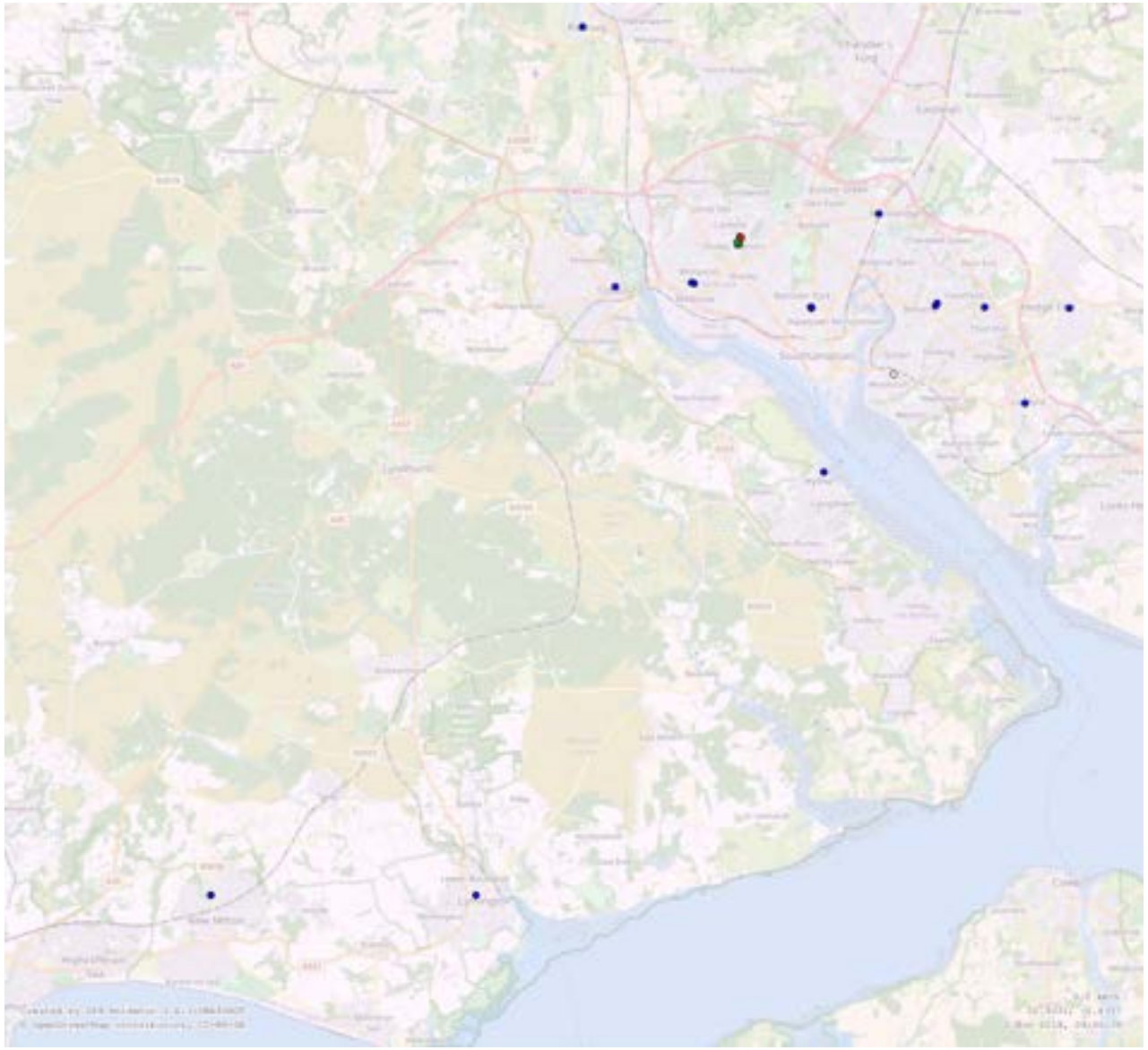
- **Drones**
  - Out-and-back only, single stop starting from hospital
  - Range limited by battery capacity
  - Fully enumerated



Consolidation Concept – Introducing Drones



Vans, Bikes & Drones – How might this look?



DHL Parcelcopter

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Programme Stopped

Amazon PrimeAir

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Programme Stopped

http://www.bbc.co.uk/news/technology-25180906

Wing - Australia

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Drones – operating constraints – *Weather*

- Impacts of wind gusts on performance
- Impacts of precipitation on performance
- Reliability of drone logistics services long-term
- Planning and delivery of contingency services
- Cost of contingency services

Drones – operating constraints – *Payload capability*

- Payload size (capability to carry existing NHS consignments in standardized packaging)

Drones – operating constraints – *Payload capability*

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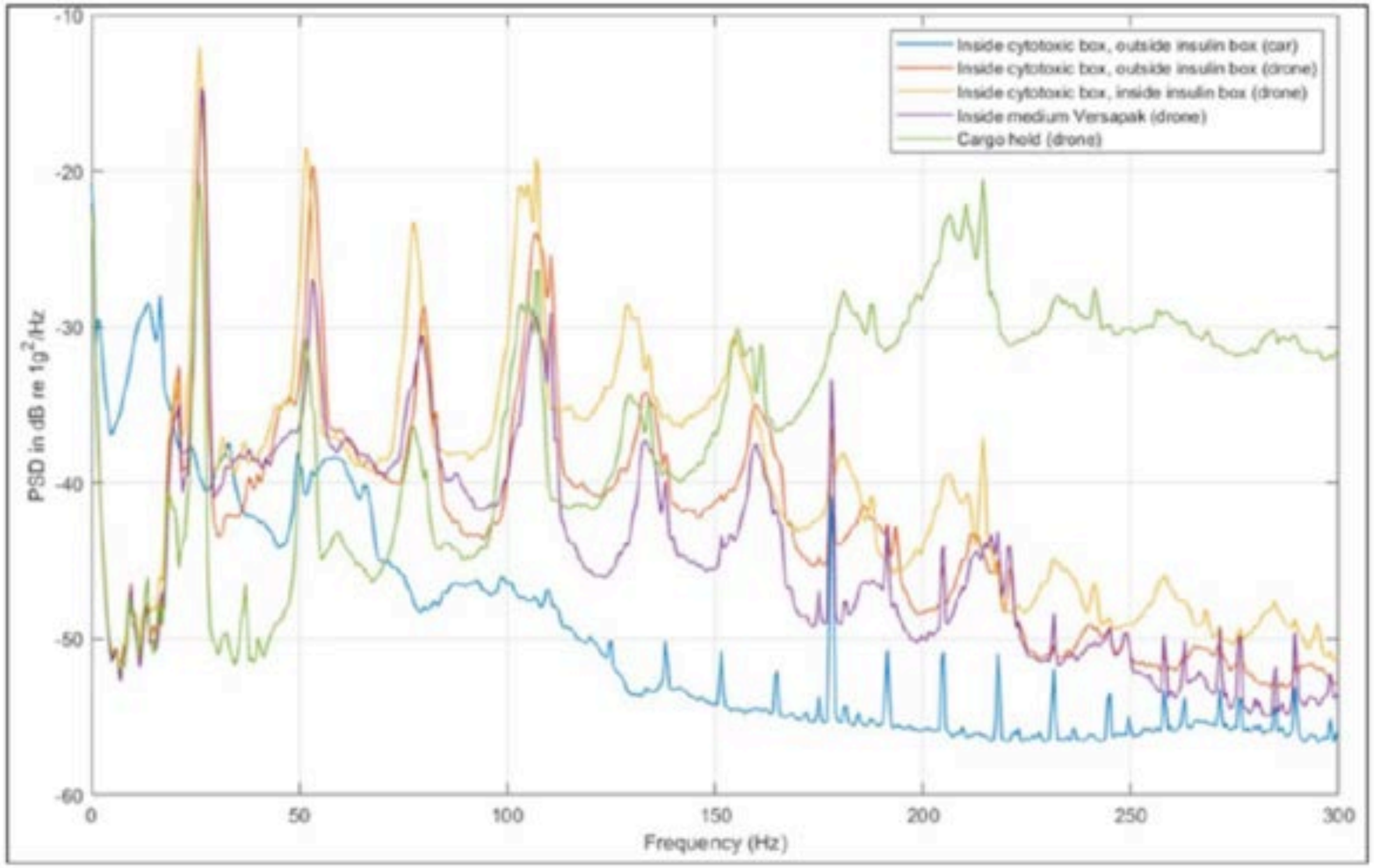
- Payload integrity (stability of payloads resulting from flight)



Drones – operating constraints – *Payload capability*

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- Payload protection (crash proof containers)

Drones – operating constraints- *Routing*

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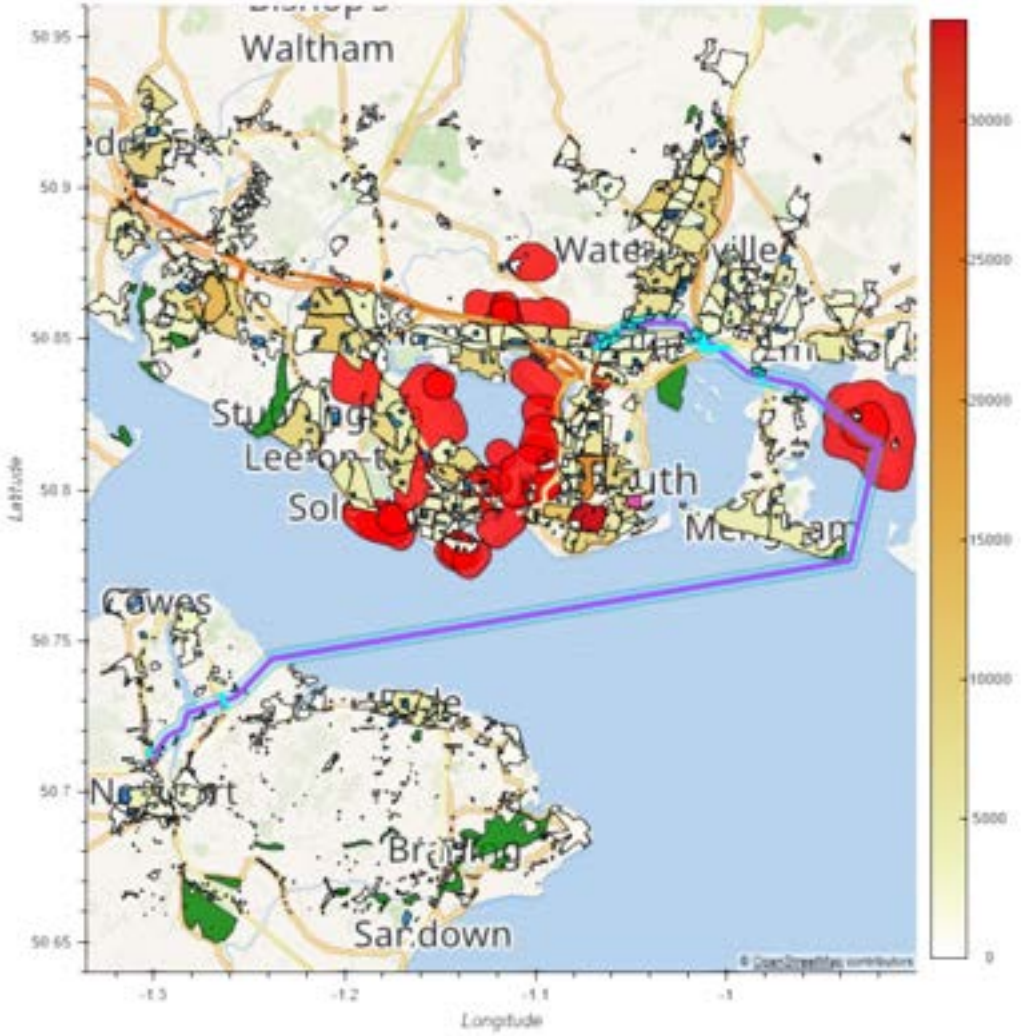
- How will drone routing be impacted by the need to minimize: i) air risk; ii) ground risk
- What can you not fly over?
- What is the relative ground risk at certain times of day?
- How do routes impact on energy consumption?

QA to St Marys



Nature Reserves

leisure=nature_reserve

Military Areas

landuse=military

amenity=school

amenity=school

amenity=hospital

amenity=hospital

- 300m safety buffer
- Static Residential Population: 5998
- Dynamic Roads Mean Pop. (Tuesday 1600): 79persons/min
  - Flight speed required for specific estimate

TDA: a "Blunt Instrument" for airspace management

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- Segregates airspace
- Unpopular with airspace users
- Inefficient
  - No crewed traffic when active
  - Only one UAV operation
- Temporary
- A lot of effort

Drones – operating constraints

- Reliability, safety standards, quality assurance (components)

GOV.UK Topics Departm

→ Coronavirus (COVID-19) | Guidance and support

Home > Air Accidents Investigation Branch reports

AAIB investigation to Alauda Airspeeder Mk II, (UAS, registration n/a) 040719

Loss of control resulting in a fly-away and eventual crash, Goodwood Aerodrome, West Sussex, 4 July 2019.

From: Air Accidents Investigation Branch

Published 18 February 2021

Drones – operating constraints

- Integration with the existing logistics system

Drones to assist NHS logistics
Key barriers to overcome

- Managing drones in shared airspace alongside crewed aircraft
- Designing platforms that can carry ‘realistic’ medical consignments
- Proving the credibility of drones to the MHRA
- Reliability & capability as a logistics system
- **COST!!!!!!**

Drone traffic control?

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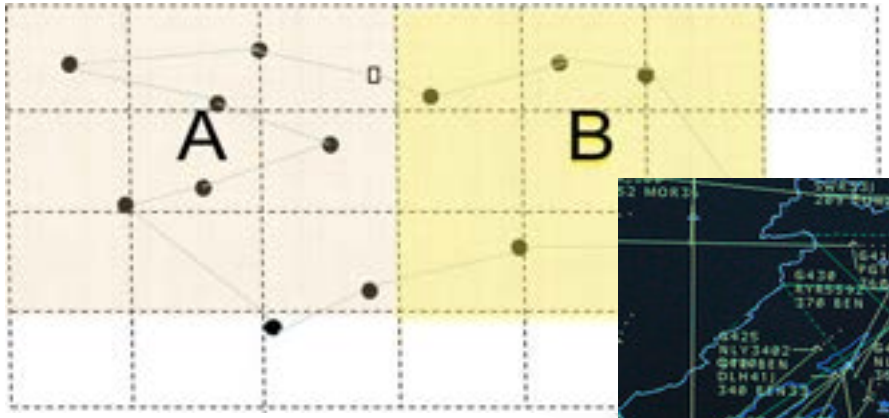

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Thankyou

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