Section 2

Airspace Analysis

Section 2: Airspace Analysis

2.0 The Aviation Landscape

The aviation landscape around Morecambe Bay contains a large number of airspace users and operators.

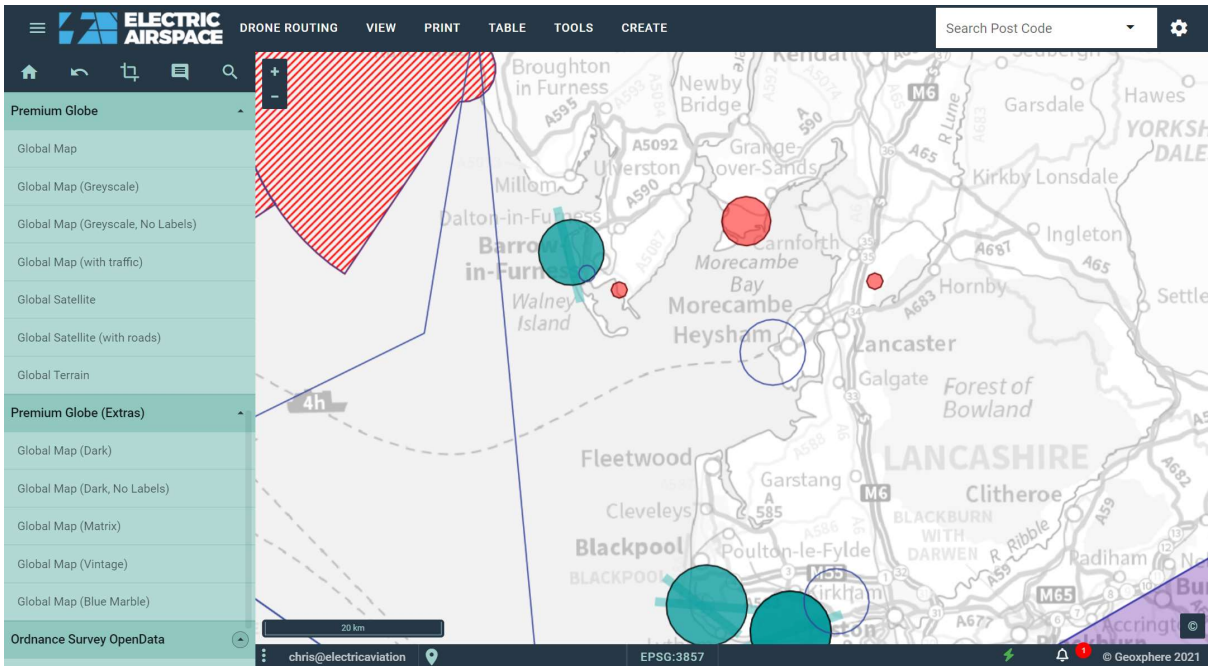
Geographically the region in question for this Airspace Change Proposal predominantly consists of tidal water.

Some small parts of the proposed routing occur over land.

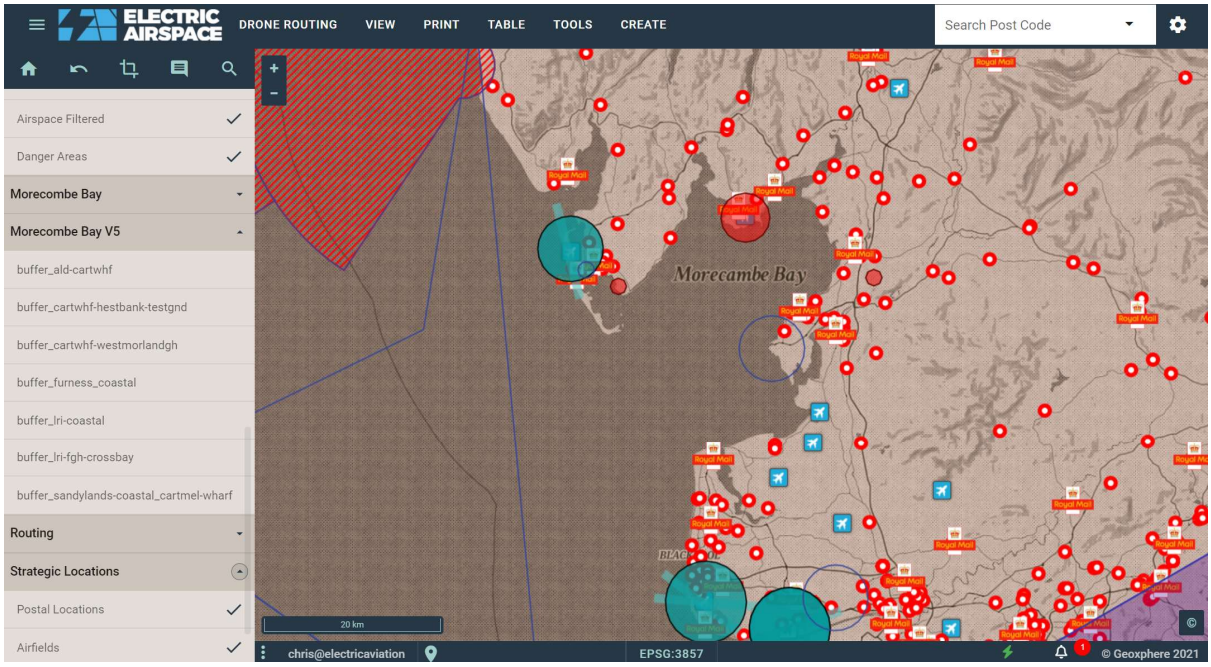
We present in this section, other additional analysis we have undertaken to educate our thinking regarding the final route proposals.

2.1 GIS Analysis

Working with our GIS partners Geoxphere Limited, Electric Aviation have developed the Electric Airspace™ XMAP portal. Funded by the Sustainable Innovation Fund, this portal allows Electric Aviation to understand the airspace for RPAS operations drawing on multiple cartographic sources.

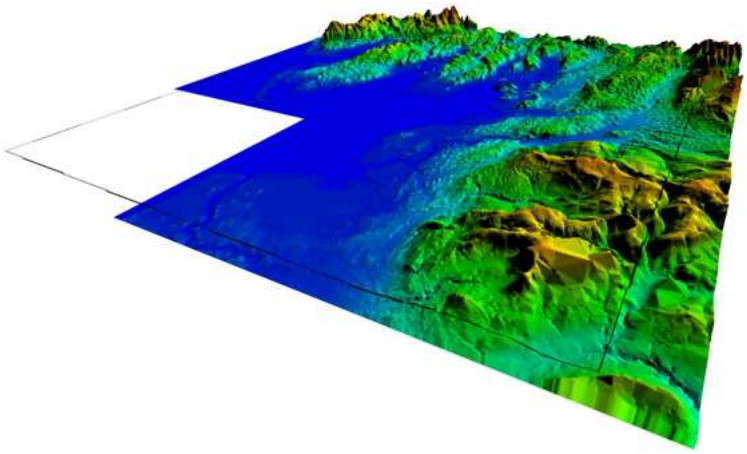


Overlaying airspace data on a standard map



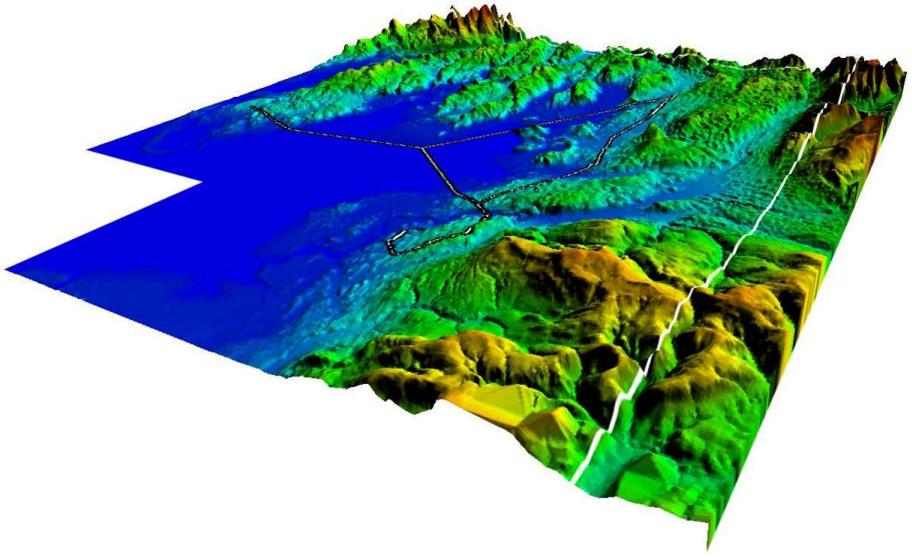
Overlaying all airspace, post offices and airfields on a vintage map

Working with Geoxphere we generated a Digital Elevation Model for the Morecambe Bay Area.



Digital Elevation Model for the Morecambe Bay Area

The black box in the above image represents the Flight Radar data area used in section 2.3. The effect of the proposed "purple" route can be seen on the Digital Elevation Model below:



Digital Elevation Model showing "purple" route

We calculated that the airspace up to 5000 ft minus the terrain itself is 157,496,624,916,791.031 cubic feet (4,459.87 cubic kilometres).

That the Blue Route = 62,058,264,353.889 cubic feet (1.75 cubic kilometres) and the Purple Route = 97,044,203,281.184 cubic feet (2.74 cubic kilometres)

Thus the proposed routes represent a change in airspace volume for:

- The Blue Route a 0.0392% airspace volume change
- The Purple Route a 0.0615% airspace volume change

2.2 Environmental Analysis

In conversation with [redacted], Senior Conservation Officer, RSPB, North West (Morecambe Bay, Lancashire, Manchester, Merseyside & Cheshire) we know that:

The Morecambe Bay and Duddon Estuary SPA is situated along the coast of northern Lancashire and southern Cumbria and includes the second largest embayment in Britain, after the Wash in Norfolk. The protected area represents the largest continuous area of intertidal mudflats and sandflats in the UK.

The site includes several major estuaries where the river Wyre, Lune, Kent, Leven and Duddon enter the Irish Sea.

The SPA is a highly dynamic coastal and estuarine system which creates continually shifting channels, creeks and pools and the total extent, distribution and character of most subtidal and intertidal habitats are therefore subject to high levels of change over both short and long periods of time.

High numbers of various polychaete worms, bivalve molluscs, crustaceans and other invertebrates are present and contribute significantly to the diet of many bird species in the SPA.

reas of coarse sediment, boulders and cobbles create intertidal reefs, known locally as 'skears', which provide a hard substrate for dense beds of mussel that can cover large areas. Several invertebrate species, specifically; mussel, cockle and shrimp are also of significant importance at an economic level.

There is a long history of mussel, cockle and shrimp fishing, particularly in Morecambe Bay.

The boundary of the SPA is formed by the amalgamation of two existing SPAs (Morecambe Bay SPA and Duddon Estuary SPA), and the addition of a marine foraging area for terns. The protected site comprises areas for breeding seabirds, foraging breeding seabirds, non-breeding seabirds and waterbirds utilising a range of habitats.

The original features of the two SPAs are retained, with the addition of newly qualifying species. There are currently 27 features including two assemblages; in the breeding season the area regularly supports nearly 62,000 individual sea birds and in the winter it regularly supports over 210,000 individual waterfowl (Liley et al., 2015).

Morecambe Bay and Duddon Estuary SPA supports greater than 1% of the GB population of three Annex I species in the breeding season (little tern Sternula albifrons, Sandwich tern Thalasseus sandvicensis, common tern Sterna hirundo) and six Annex I species in the non-breeding season (whooper swan Cygnus Cygnus, little egret Egretta garzetta, golden plover Pluvialis apricaria, bar-tailed godwit Limosa lapponica, ruff Calidris pugnaxand Mediterranean gull Ichthyaetus melanocephalus). In addition, the site supports over 1% of the biogeographical populations of 16 regularly occurring migratory birds – two in the breeding season (lesser black-backed gull Larus fuscus graellsii and herring gull, Larus argentatus argenteus) and 14 in the non-breeding season (redshank Tringa totanus, knot Calidris canutus, pintail Anas acuta, ringed plover Charadrius hiaticula, pink-footed goose Anser brachyrhynchus, shelduck Tadorna tadorna, oystercatcher Haematopus ostralegus, grey plover Pluvialis squatarola, dunlin Calidris alpina alpina, curlew Numenius arquata, turnstone Arenaria interpres, black-tailed godwit Limosa limosa, sanderling Calidris alba, lesser black-backed gull, Larus fuscus).

Finally, it also regularly supports a breeding seabird assemblage of over 20,000 individuals, including the qualifying breeding features as main components, and a waterbird assemblage of over 20,000, including all non-breeding qualifying features as well as 19 other species as main components.

Several of these species occur in nationally and internationally important numbers and it is not uncommon during severe weather for the SPA to attract even greater numbers with birds attracted from other areas by the relatively mild climate and abundant food resources.

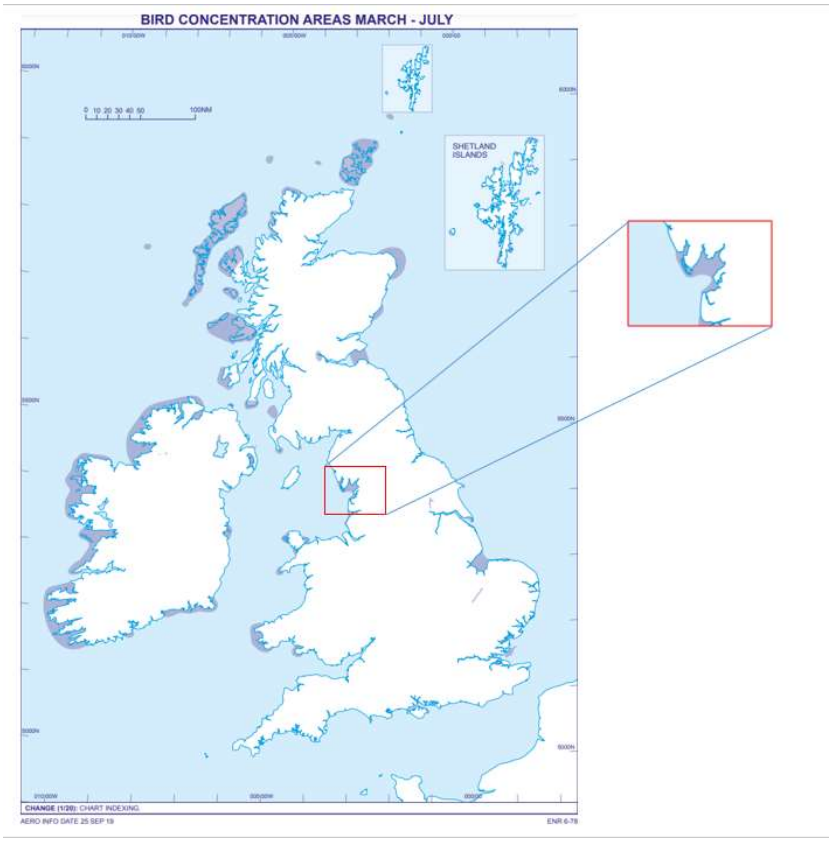
In wave sheltered and estuarine areas the intertidal sediment transitions into large and extensive areas of saltmarsh and pioneer saltmarsh which form an important roosting habitat for many bird species.

At high tide the birds then congregate at roost sites on the shore, and very large numbers of birds can be concentrated along the shore at a very limited number of locations.

It is therefore of paramount importance that the routing and times of operation upon the routes are effected to minimise the impact to these bird species.

We are also aware that Ospreys use Foulshaw Moss Nature Reserve as a nesting site. A pair of ospreys usually breed here in the summer.

It is our intention to continue our dialogues with the RSPB once the CAA indicate route acceptance, such that our operations will provide as little disturbance to the wildlife as possible.



ENR6.78

We note that from the AIS that none of the route falls in any declared Bird Sanctuaries, that ENR6.78 and ENR 6.79 detail that the majority of the proposed Area of Operations are noted as Bird Concentration Areas.

Whilst our proposed TDA will operate below the 1500' as mentioned in ENR 5.6(2.1)(2.2) we acknowledge that from ENR5.6(2.2)

"it is a fact that birds rarely hit an object moving slower than 80 knots"

This is important as our planned speed is less than 80 knots, so we subsequently reduce the risk of "birdstrike". Furthermore that as we propose operating a vehicle with a 4.4m wingspan and one that is powered electrically, that the noise of operation will not disturb the wading, breeding or roosting birds.

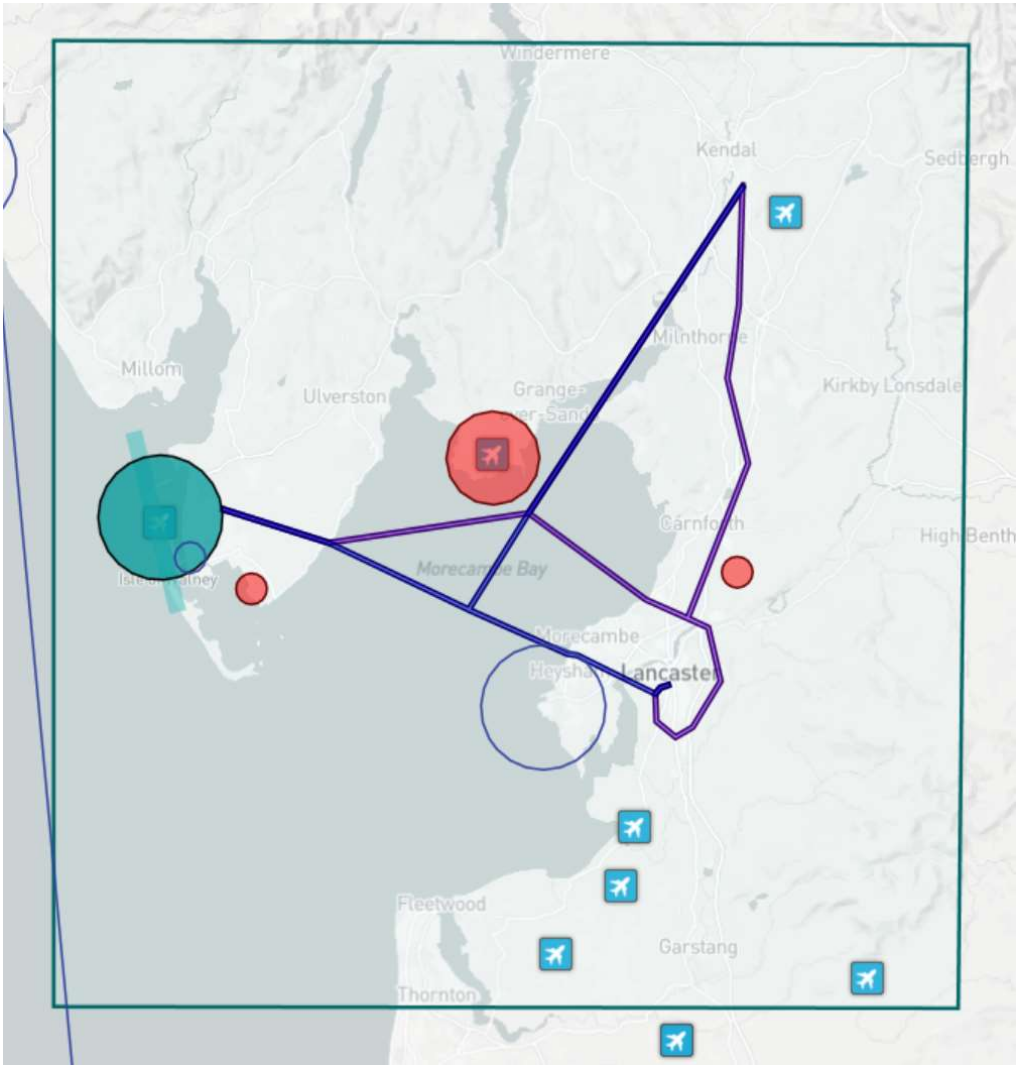
It is our intention to continue engagement with the RSPB and other environmental groups as this Airspace Change Proposal progresses.

2.3 Lessons from ADS-B

Electric Aviation contracted Flightradar24 AB Stockholm (FR24) to provide one year's data, August 2020 to July 2021, of all flights where the craft was below 5000 feet at some point within an area bounded by a box of the following coordinates:

Latitude	Longitude
54.3845562	-2.5268555
54.3821569	-3.3604431
53.8687246	-2.5364685
53.8695343	-3.3604431

This box represented, in Electric Aviation's opinion, a good cartographic footprint of the Morecambe Bay area from which to analyse the flight data captured by FR24.



Flightradar24 provides aircraft information from data fed through three sources:

1. Automatic Dependent Surveillance-Broadcast (ADS-B)
2. Multilateration (MLAT)
3. Secondary Surveillance Radar (SSR)

- ADS-B is replacement to conventional RADAR based surveillance that is now being implemented all over the world. In this dataset it is the primary data source and is the most detailed. Aircraft equipped with ADS-B derive their position information from a GPS network and transmit that information along with a host of other data to ATC or any ADS-B receiver on ground. FR24 has a network of their own ground ADS-B receivers and even provides equipment free of cost to enthusiasts willing to host them in areas of sparse coverage. Data received and decoded by FR24's receivers is passed to FR24 for aggregation and hosting and FR24 have several related services plus a public web portal where flight details may be viewed

- MLAT - Although ADS-B is a leap through in surveillance, aircraft need to be equipped with an ADS-B transponder in order to be detected by ADS-B ground receivers. MLAT leverages a ground network that detects transmissions from a variety of different types of transponder, rather than being ADS-B specific. By noting the tiny differences in time of when various receiver stations on the network observe a reply, the position of the aircraft can be calculated. Unlike RADAR based surveillance, which actively transmits a pulse and analyses the reply, MLAT passively observes signals emitted by an aircraft and requires no upgrade to the avionics

- SSR - Secondary radar is the oldest of the 3 technologies discussed; a rotating antenna transmits interrogation messages continuously into an airspace. When the aircraft intercepts a message and makes a reply, the rotation angle of the antenna and time delay between message and response is used to derive a position for the aircraft.

All the data FR24 collect is thus derived from some form of technology where an active response is received from the aircraft's transponder or other Electronic Conspicuity device. It should consequently be borne in mind, and no doubt the microlight pilots will want it outlined clearly, that FR24 data will not include flights by aircraft not equipped with ADS-B or a transponder.

It would be fair to say that microlights are one of the classes of aircraft that are perhaps least likely to be transponder equipped, but we've been able to determine from the data analysed as part of this study that an appreciable number of microlights are indeed capable of such electronic conspicuity and we feel it valid to assert that they are suitably representative of the microlight population as a whole, in terms of the types of flights that they make. In other words, there is no reason to believe that microlights that are not transponder equipped are put to considerably different use than those that are.

2.3.1 Analysis Introduction

Having received the Flight Radar 24 data for the Morecambe Bay area as defined above, Electric Aviation contracted in Miralis Data Limited to act as external data scientists for the project.

Electric Aviation set Miralis Data the task of identifying the following data

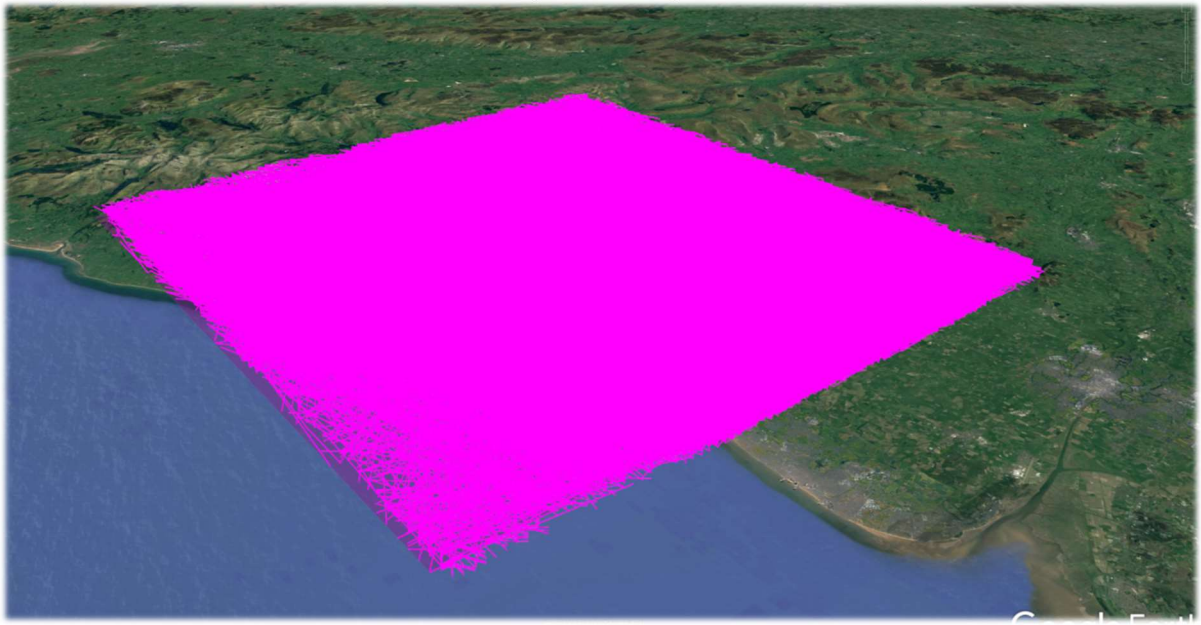
1. Number of flights that actually passed over the bay
2. Number of flights sub 500' that actually passed over the bay
3. Number of flights landing on the bay area itself, i.e. the sands of Morecambe Bay
4. Distribution of flights from North to South, East to West etc. across the Bay Area
5. Distribution of types of flights
6. Infringements of restricted and dangerous zones

A flight may cover more than one cycle of ground-air-ground and typically relates to a continuous period of operation of the transponder. For some flights the aircraft was in the air before it entered the analysed region and was still in the air when it left the analysed region, as the aircraft was transiting across the region destined for elsewhere. For other flights the aircraft took off, flew within the region and landed again within region. Flights were analysed equally regardless of whether they were a local flight or a transiting one.

It should be noted that this data covers the lockdown periods imposed as a result of the pandemic and as such this data should be viewed in this context.

2.3.2 Overview: Flights in the Morecambe Bay region

As an initial visualisation, the path of every flight in the dataset was plotted onto a map in Google Earth, to see if any regions were particularly avoided or heavily trafficked:

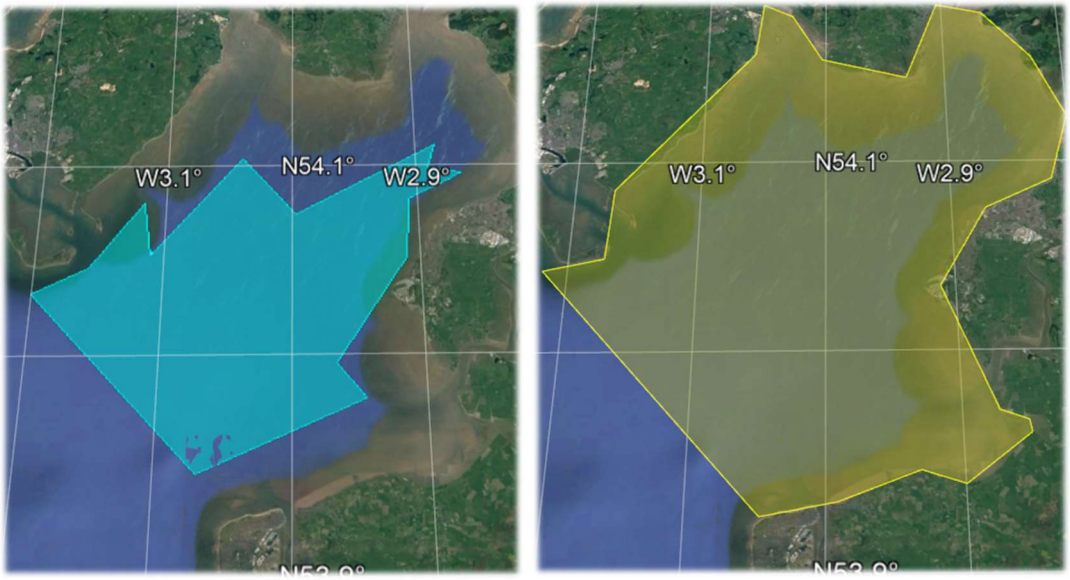


All flights over the bay area for the period 1st August 2020 through 31st July 2021

The Flight Radar 24 data showed that there were 13,215 flights between 1st of August 2020 and 31st of July 2021, and there weren't any compelling indications from the holistic view, that any areas were treated specially. Generally, flights track all over the region.

Because we wanted to analyse types of flights over the area and to discriminate between flights that landed on the bay area, those that flew over it and those that did not.

Morecambe Bay was divided into two shaped zones. One describes the outline of the typical low tide region, i.e. the area of the bay that is water at low tide ("Morecambe Bay Water"), sourced from satellite imagery of the intertidal zone. The other region takes in the area of the sands/beaches bordering the bay and across the mouth of the bay.



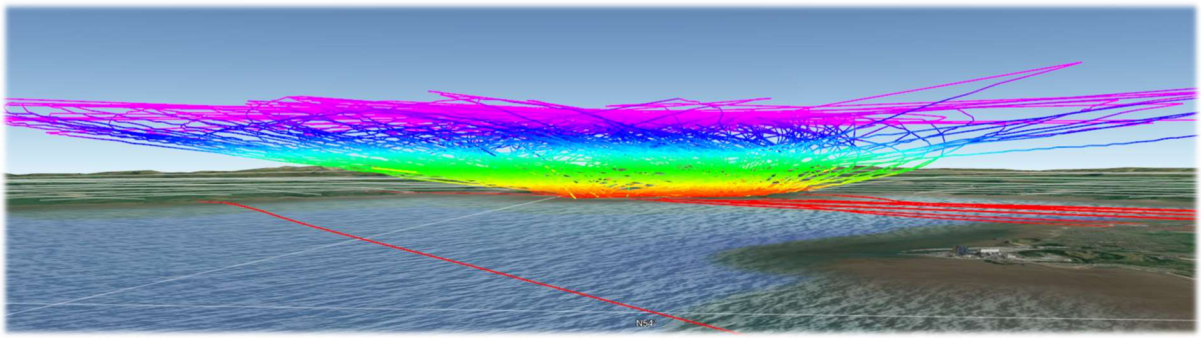
Morecambe Bay (Water) region and Morecambe Bay (Including Sands) respectively

We also developed the visualisation to be capable of representing different altitudes in varying colour. By assigning a colour in the rainbow range of primary and secondaries used by computing (red, yellow, green, cyan, blue, magenta in that order) to the range of heights, for example between 0 and 500 ft, it makes it easy to visually assess individual and small groups of flights such as this microlight flight from into Rossall Field:

Height coloured single flight path data from FR24 rendered into Google Earth

Throughout this document we use the rainbow visualisation on differing datasets with various upper altitudes stated on each visualisation. The range is divided into 7 segments and fade through is continuous. Red is 0m AMSL and the upper bound (plus anything above it) is magenta. A visualisation of flights between 0m and 500m would thus start out at red, fade through to yellow by 100m, fade to green by 200m, cyan by 300m, blue by 400m and be pink at 500m. Line segments are created by successive readings defining the start and end point. Sometimes altitude readings from craft jump considerably from one segment to the next; if an aircraft had climbed from 0m to 400m between two readings, the entire line is coloured using the average of the two readings (200m)

In rare cases altitude readings are not available and the course plots in red



Skydive related flight activity at Cark, multiple flight paths (altitude visualisation)
Upper pink bound here is around 1500m/5000ft

2.3.3 Question 1 - Flights passing over Morecambe Bay sands – any altitude

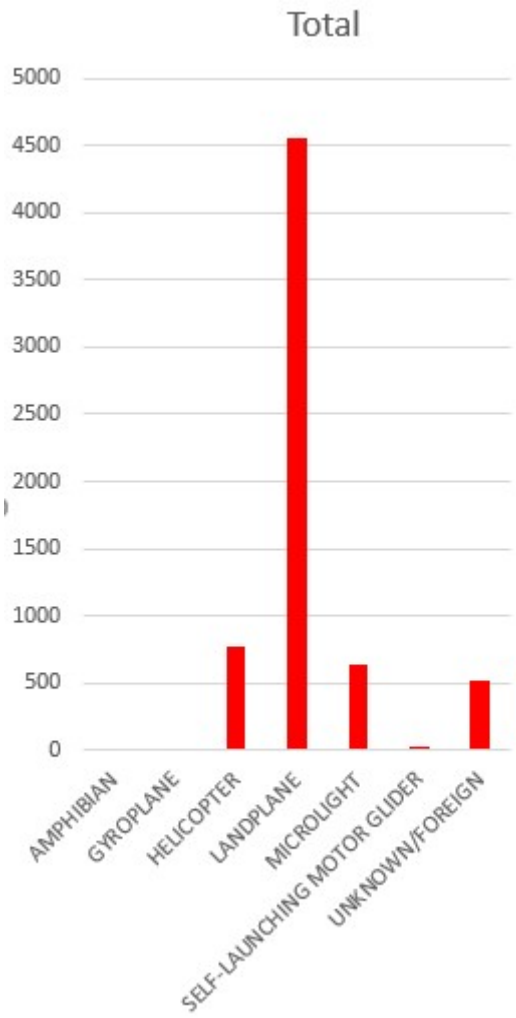
We asked this question chiefly to give context to subsequent queries; the region data provided by FR24 had 6518 flights where some part of the flight was over the Morecambe Bay Sands region. In practical terms it means that around half the flights in the overall region didn't pass over the sands and are present because they clip a corner or track an edge of the region, for example.

Flights are predominantly executed by craft the CAA class as LANDPLANE, HELICOPTER and MICROLIGHT.

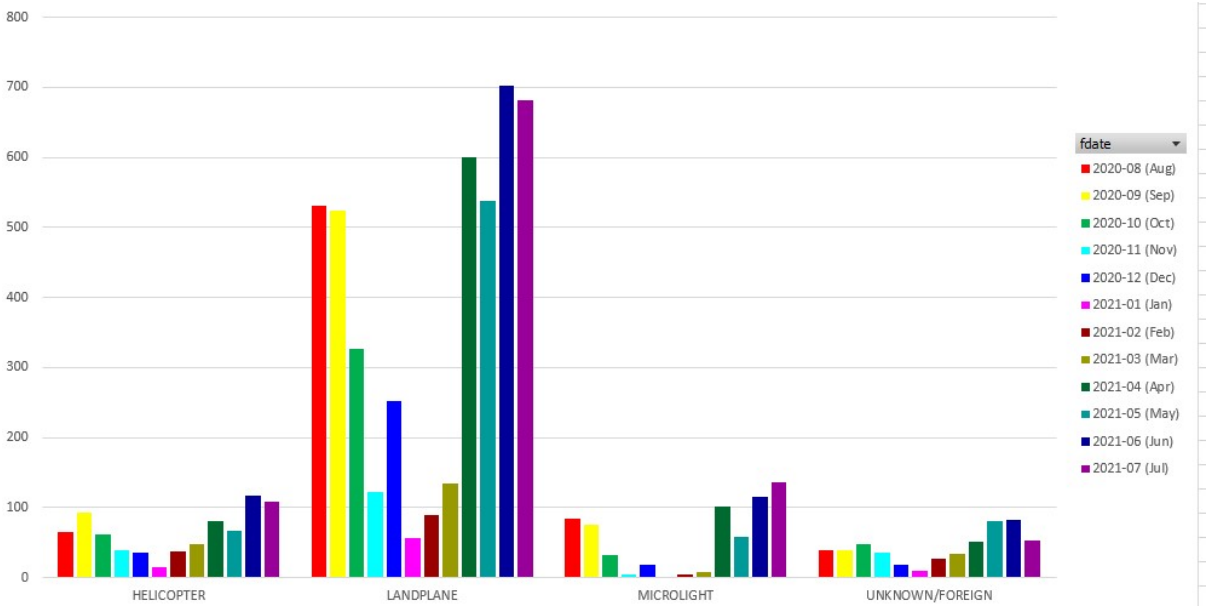
The CAA often registers craft in the ultralight category as LANDPLANE and it should hence be remembered that some of the flights here are categorised as a LANDPLANE but visually, and performance characteristics-wise they are more closely related to MICROLIGHT category. This is evident on some later graphs where the visualization shows a "LANDPLANE" touching down in areas typically frequented only by microlights; in rare cases they're truly planes with STOL characteristics rather than ultralights.

We mention this because we ascribe differing behaviours to microlight vs plane flights and to pre-empt any potential complaint that the microlight group are unfairly characterised; it is more likely to be the opposite, with craft that look and are flown like microlights actually being attributed to a different category entirely.

Less than 10% of flights at these levels are foreign registered aircraft for which category has not been determined.

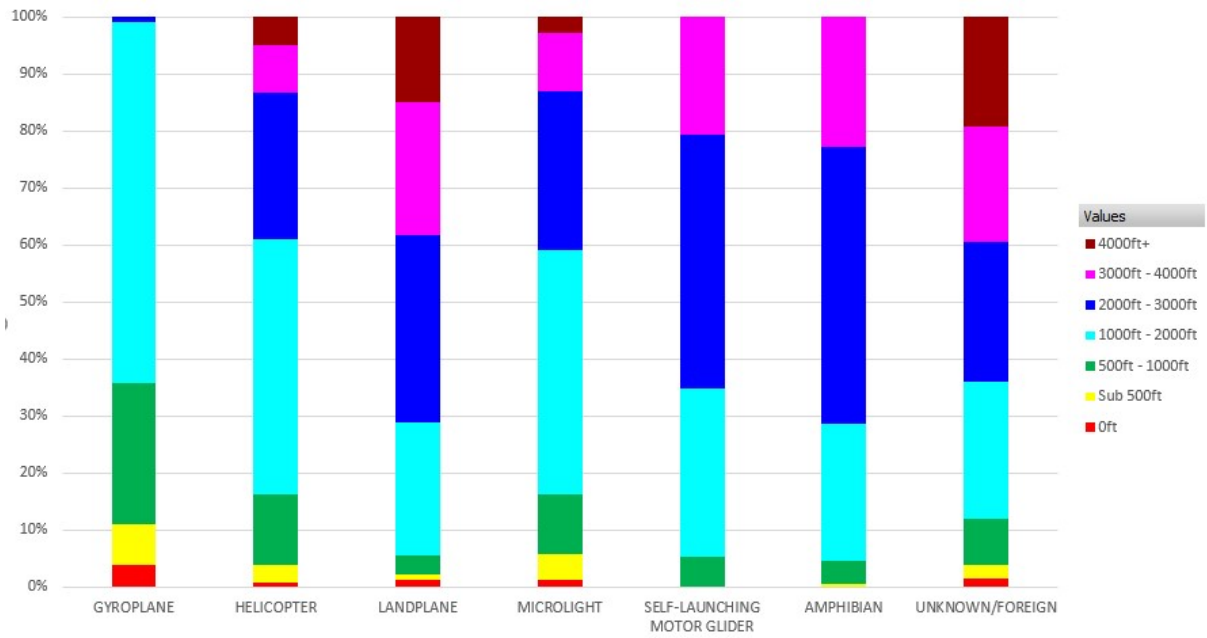


Seasonal (and possibly pandemic/lockdown) related effects on number of flights performed were similar across all categories, though microlight use reduction was slightly sharper during colder months than for other categories:



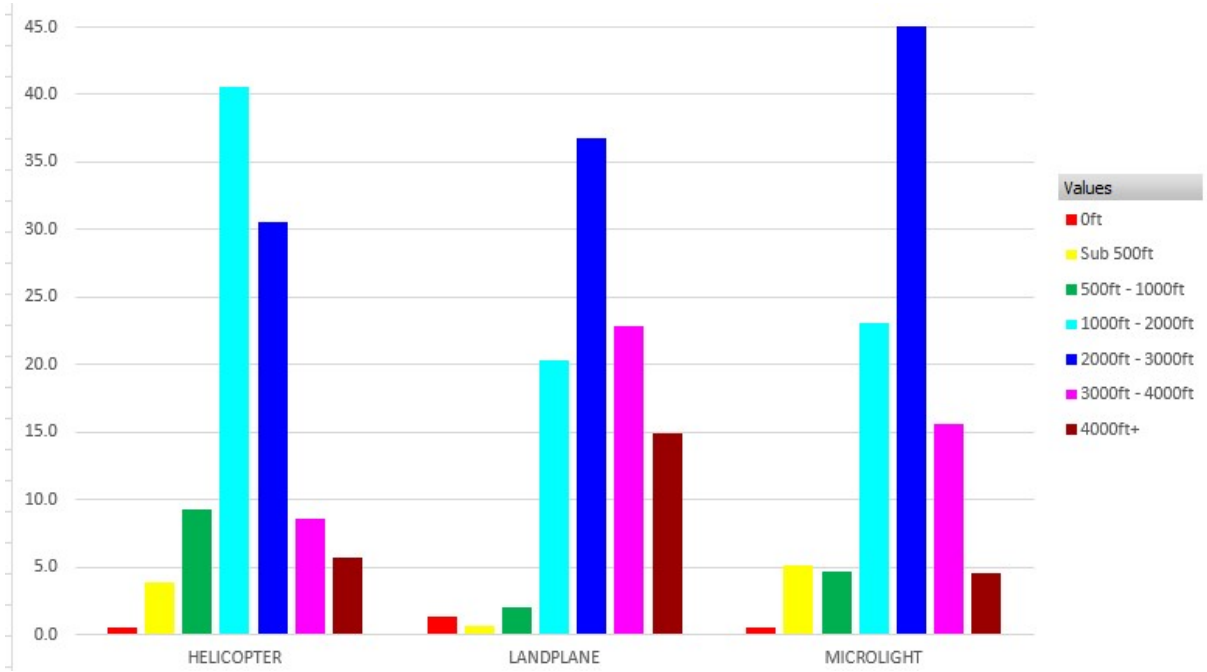
Number of flights by category and month of year

Profiling the types of aircraft and dividing the observed altitudes into bands allows for a useful breakdown of altitude profiles throughout the year. Gyroplane, Amphibian and Glider categories aren't strongly represented in the dataset but appear here because even a few flights can record an altitude spread of statistical significance for comparison with other categories

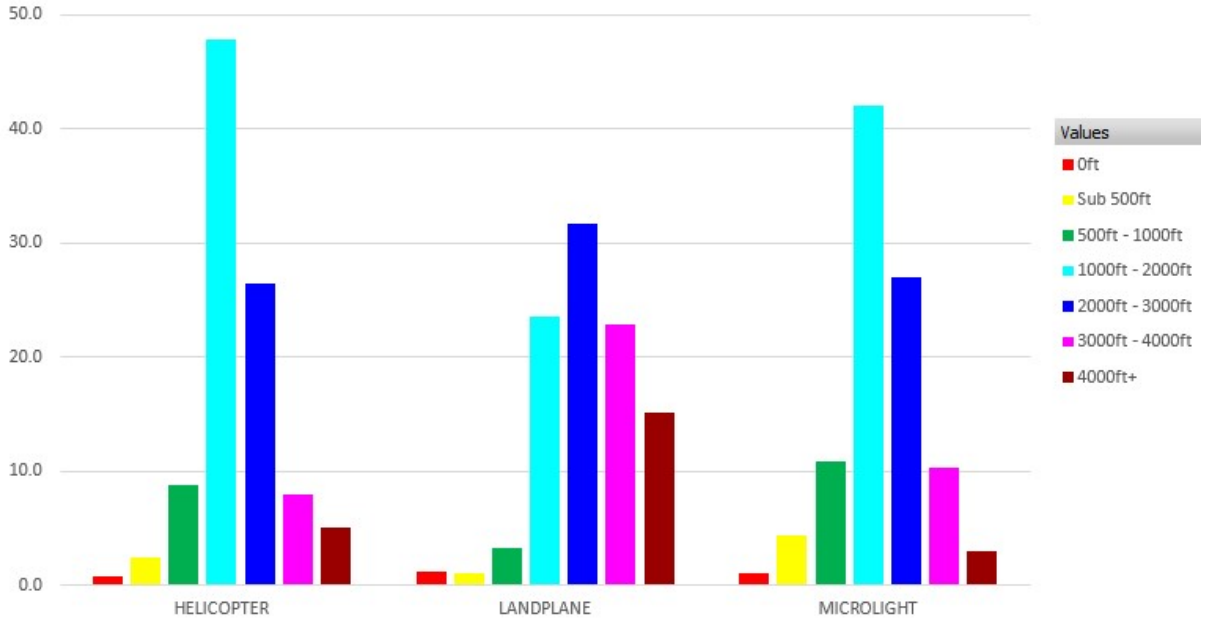


Percentages of altitude bands by craft type

Helicopters and microlights were broadly consistent in their altitude spreads regardless the average air temperature. Planes typically fly higher than the other groups. In colder months it was interesting to note that microlight use fell to around 10% of summer levels, and microlights on average flew higher, swapping the "40% of time in the 1k-2k bracket" for "40% of time in the 2k-3k bracket"



Aggregating for Nov-Feb: microlight altitudes are predominantly 2k-3k



Aggregating for May-Aug: microlight altitudes are predominantly 1k-2k

2.3.4 Question 2 Number of flights sub 500' that pass over the bay

How many flights, and from which categories of aircraft, occur such that one or more altitude reports from the craft are in the range 1ft-500ft, while the aircraft is flying over the Morecambe Bay Sands region? Are any flights entirely low level?

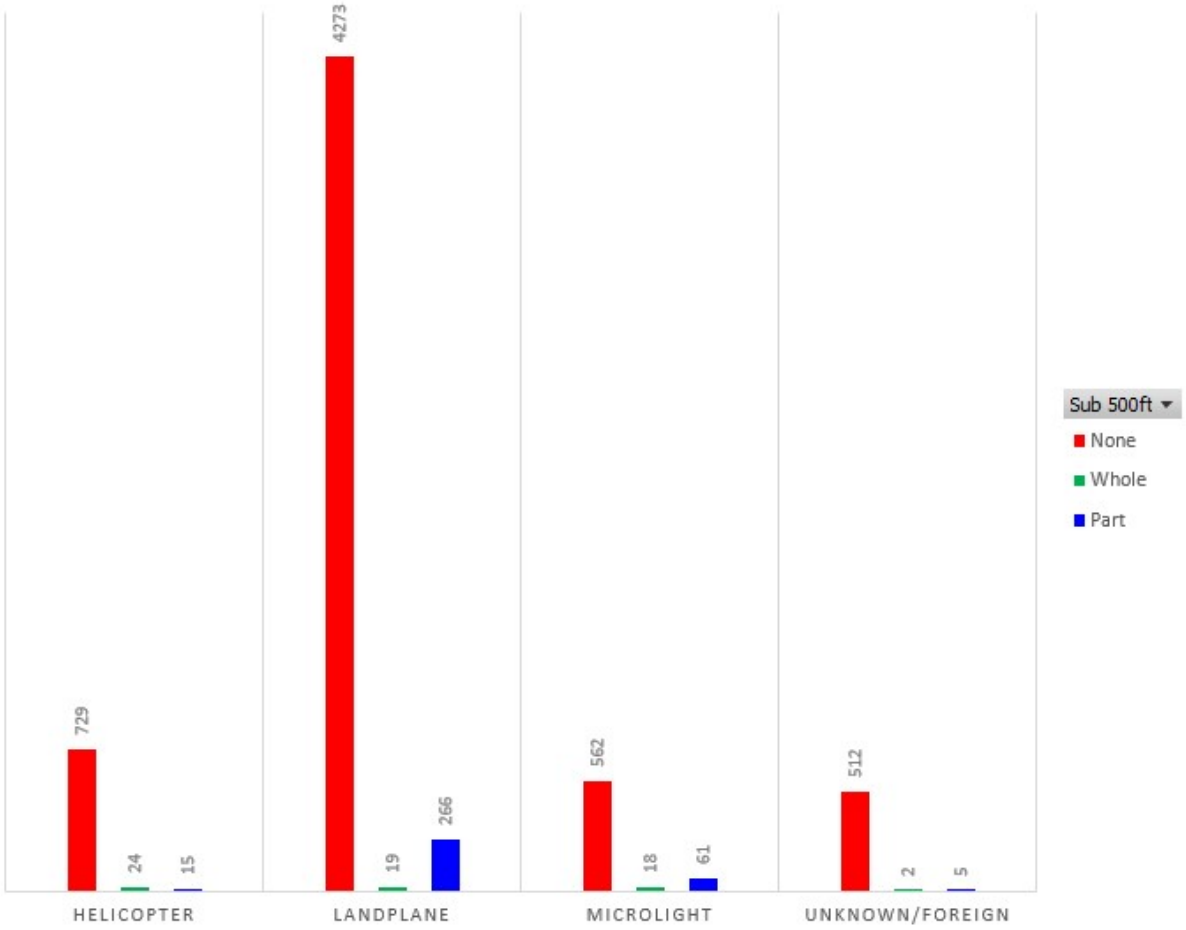
We asked this question of the data to better understand the degree to which both low level flying and forced landings practice occurs.

Feedback from local microlight groups makes the claim that these activities are carried out often and that erecting a Temporary Danger Area will excessively curtail the operation.

In raw numbers, out of 6518 flights and after excluding amphibian, gyroplane and gliders (for reasons of low representation) reducing the count to 6486, we analysed the minimum and maximum altitudes registered while the craft was over the bay sands region*.

From this we can determine if a flight operated wholly, partly or never under 500ft.

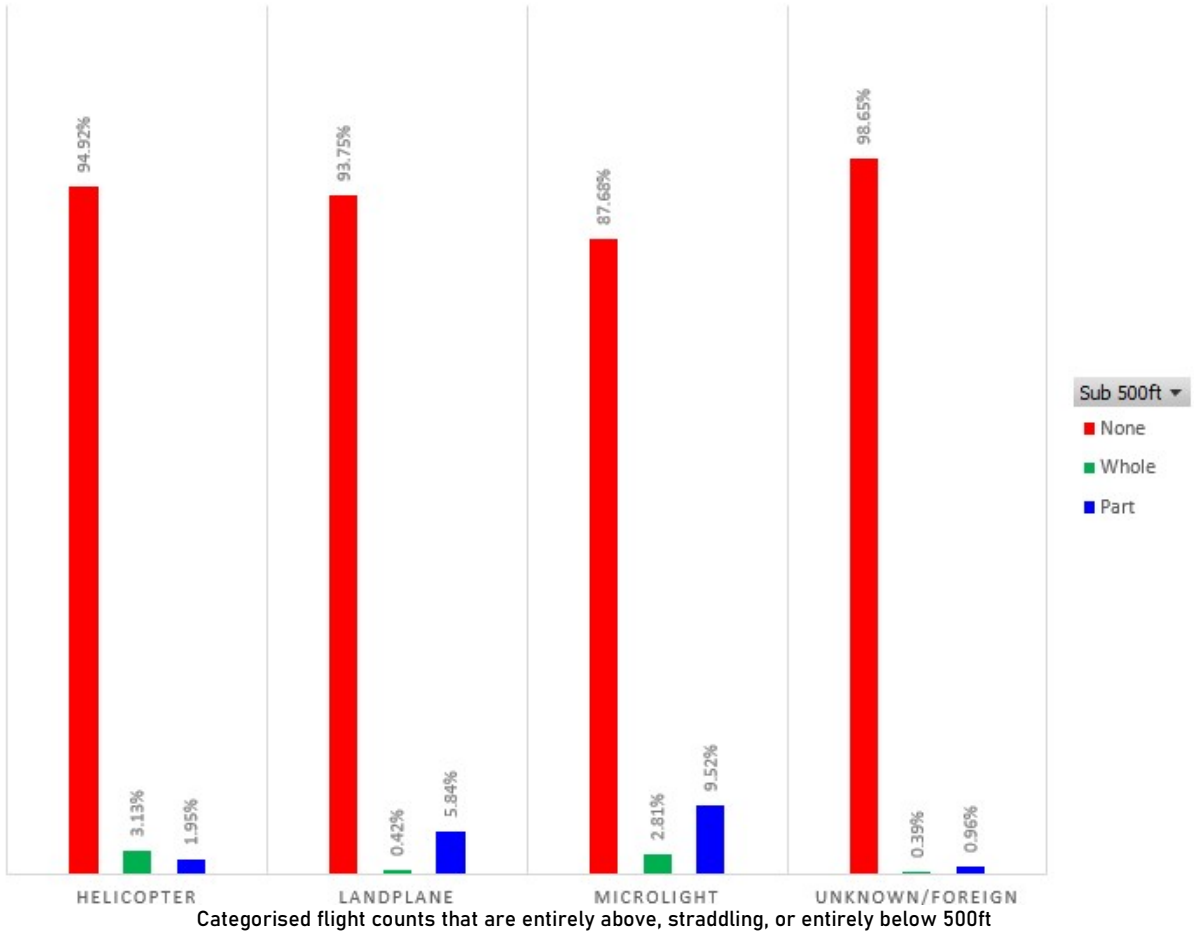
Broken down by craft category:



Categorised flight counts that are entirely above, straddling, or entirely below 500ft

* a micro-proportion of aircraft that perpetually report 0 altitude, implying they lack the ability/equipment to report, are included in sub 500ft counts.

As well as raw counts, we expressed them as a percentage of the total number of flights by that category:



Categorised flight counts that are entirely above, straddling, or entirely below 500ft

Regardless the category, aircraft are seldom observed making low flights over Morecambe Bay sands. Only 390 flights out of 6486 featured any component below 500ft.

63 flights operated entirely below 500ft which, as a ratio, indicates that entirely-low-level flight occurs fewer than once in every one hundred flights

2.3.5 Question 3 Numbers of craft landing on the bay

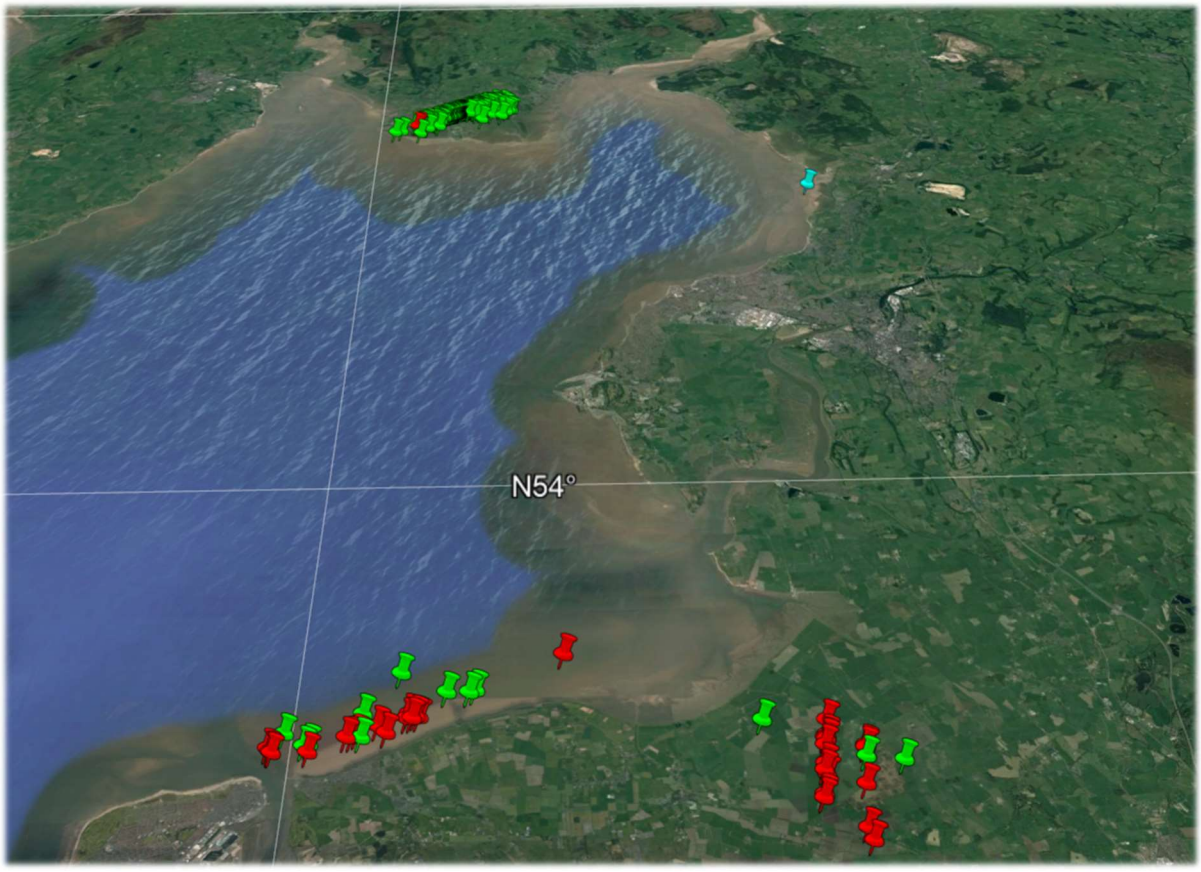
We searched the "flights that were partly or wholly below 500ft over Morecambe Bay sands" data for patterns that indicated a potential landing.

There is no definitive event emitted by a transponder upon a landing occurring, so we established a software rule to look for 3 successive altitude readings that resulted in an overall descent and low (less than 10m) reported final altitude, followed by a period of relative inactivity from the transponder of around ten times its normal update frequency. For example, if a transponder normally sends updates approx. every 15 seconds, a series of descents culminating in event X followed by another event Y where Y was 150 seconds or more since event X, then X was assumed to be a landing.

144 low level flights (where the period of sub 500ft flight occurred over Morecambe Bay sands) appeared to contain landings. One aircraft (N750AY, a Pacific Aerospace 750XL operated out of Cark by SkyDive NorthWest) is responsible for a disproportionate number of those. Removing it from the results reduces the count to 38.

Generally, aircraft that engage in low flights over the bay land in only a few places in the region, clustering around Pilling sands, Rossall Field and Cark AF. Microlights land at Cark much less often than planes do, and Rossall Field traffic is exclusively microlight related.

On Pilling Sands the ratio appears to be around 10 microlights per 1 plane, but numbers are low. At these counts errors are more significant, so we're only willing to draw rough conclusions from this set; landings are rare as a percentage of the overall flight count, confined to select locations and nearly exclusively by microlight/ultralight aircraft



Locations of events that appear to be landings. Green: landplanes, Red: microlights

Note: pins in green at Rossall Field are ultralights but are categorised as landplanes by the CAA. Only 2 green pins on Pilling Sands are true planes (1x Cessna F150, 1x Jodel D11), the rest are ultralights (for example a TL-3000 Sirius and Zenair CH60) that show in green because the CAA records their category as “fixed wing landplane”

2.3.6 Question 4/5 Distribution of locality of flights & breakdown of types/areas of activity

What are typical aircraft movements over the bay? What types of aircraft engage in what types of flight and how far do those flights extend?

We ask this question in order better understand what types of flight a TDA could have an impact upon. By defining a set of lat/long near the edges of the inspected region and then checking to see whether aircraft positions are reported in both the north/south or east/west border regions we can assess whether a flight is extending to the edges of the region/transiting. Also, by examining the reported heading data for consistency of value, we can assess whether a flight was taking a generally straight track, or a highly varied one.
To do this we look at the standard deviation; the "average difference from the average heading". A flight where the average of the variation between headings was more than 30 degrees was classed as a "varied heading flight".

For flights that had more consistent headings we used the average heading to give an overall track for the craft.

Registration	Category	Distance	Track	Counter
PUBLIC UK	LANDPLANE	local	varied	3234
?	?	local	varied	1406
?	LANDPLANE	local	varied	1059
PUBLIC UK	LANDPLANE	N/S or S/N extents	varied	1036
PUBLIC UK	HELICOPTER	local	varied	1018
PUBLIC UK	MICROLIGHT	local	varied	1000
PUBLIC UK	HELICOPTER	N/S or S/N extents	varied	294
PUBLIC UK	LANDPLANE	N/S or S/N extents	S	191
?	?	local	N	186
PUBLIC UK	LANDPLANE	local	S	184
?	?	local	S	154
PUBLIC UK	LANDPLANE	local	SE	139
?	?	N/S or S/N extents	varied	139
PUBLIC UK	MICROLIGHT	N/S or S/N extents	varied	135
PUBLIC UK	HELICOPTER	local	NW	115
PUBLIC UK	HELICOPTER	local	N	112
PUBLIC UK	LANDPLANE	local	NE	111
PUBLIC UK	HELICOPTER	local	SE	109
PUBLIC UK	LANDPLANE	local	N	106
PUBLIC UK	LANDPLANE	local	NW	99
PUBLIC UK	LANDPLANE	local	E	90
MILITARY UK	LANDPLANE	local	NE	89
PUBLIC UK	LANDPLANE	local	SW	89
PUBLIC UK	HELICOPTER	N/S or S/N extents	S	89
PUBLIC UK	HELICOPTER	local	S	88
PUBLIC UK	HELICOPTER	local	NE	79
MILITARY UK	LANDPLANE	local	varied	79
?	?	local	NW	77
PUBLIC UK	LANDPLANE	local	W	74
?	HELICOPTER	local	varied	72
PUBLIC UK	LANDPLANE	N/S or S/N extents	SE	53
PUBLIC UK	MICROLIGHT	local	SE	49
?	?	local	SE	48
?	?	W/E or E/W extents	varied	46
PUBLIC UK	LANDPLANE	N/S or S/N extents	N	46
PUBLIC UK	HELICOPTER	local	E	45
?	?	N/S or S/N extents	S	43
PUBLIC UK	MICROLIGHT	local	S	40
MILITARY UK	?	local	varied	39
?	?	local	W	38

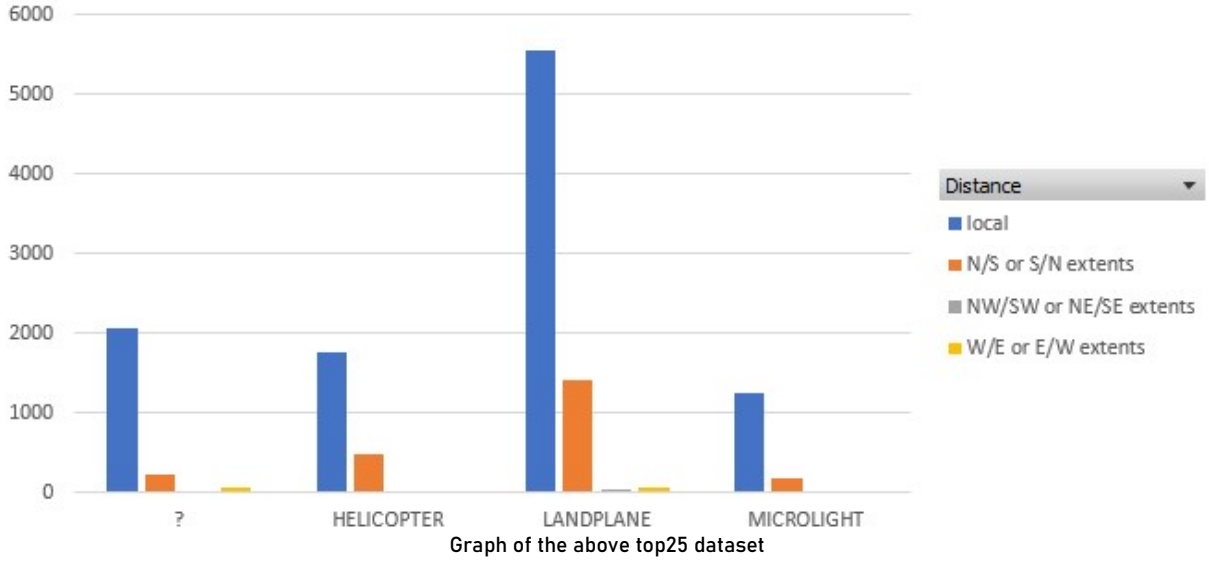
Top 40 by count of flight classifications; whether the flight was observed over opposing sides of the region or more local, and what was the general track.

Local flying without a dedicated track accounts for a significant majority of all flights in the region. Looking at just the extents dimension, we can make broad assessments of the types of flying that craft undertake.

Planes and helicopters engage in a ratio of local:distance flights that is between 3:1 and 4:1. Microlights have a local:distance ratio closer to 10:1. These figures appear to be in line with what one might expect from anecdotal evidence or common perception; microlighting in the Morecambe Bay Area is a relatively local flight activity.

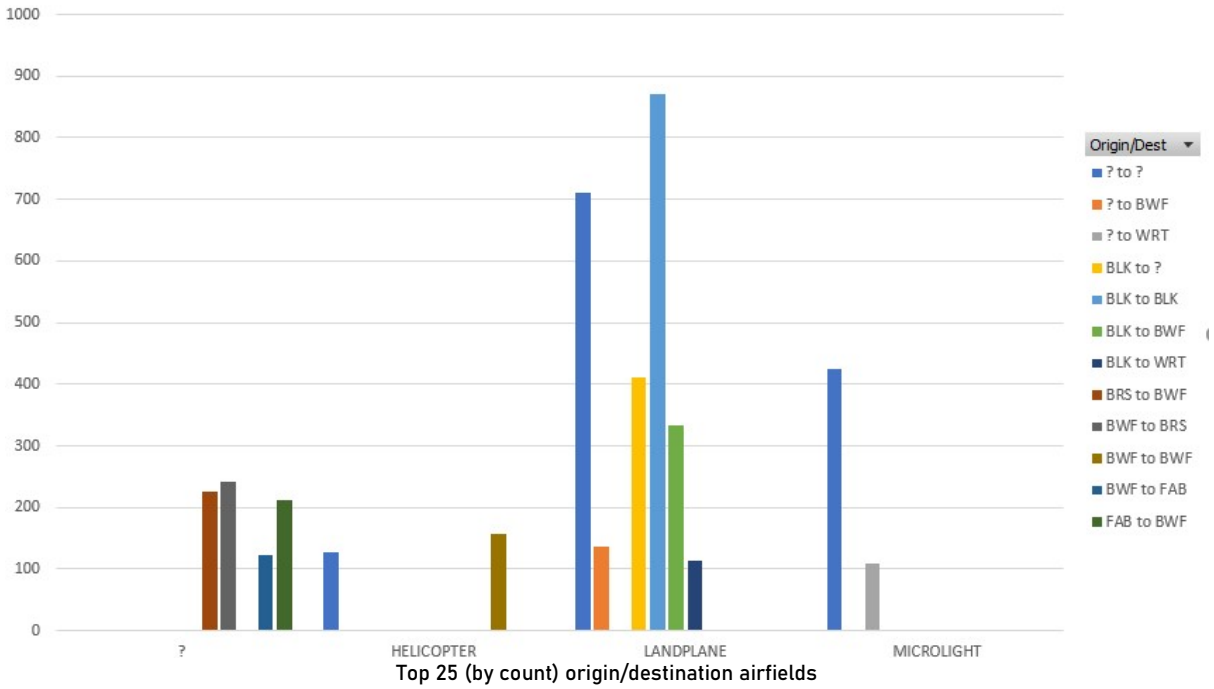
Category	Distance	Counter
LANDPLANE	local	5539
?	local	2072
HELICOPTER	local	1757
LANDPLANE	N/S or S/N extents	1417
MICROLIGHT	local	1240
HELICOPTER	N/S or S/N extents	486
?	N/S or S/N extents	227
MICROLIGHT	N/S or S/N extents	168
?	W/E or E/W extents	74
LANDPLANE	W/E or E/W extents	59
FIXED-WING SELF-LAUNCHING MOTOR GLIDER	local	42
LANDPLANE	NW/SW or NE/SE extents	37
HELICOPTER	NW/SW or NE/SE extents	26
GYROPLANE	local	21
?	NW/SW or NE/SE extents	16
GYROPLANE	N/S or S/N extents	8
HELICOPTER	W/E or E/W extents	8
GLIDER	local	7
MICROLIGHT	NW/SW or NE/SE extents	5
FIXED-WING AMPHIBIAN	N/S or S/N extents	4
FIXED-WING AMPHIBIAN	local	1
MICROLIGHT	W/E or E/W extents	1

Top 25 by count of aircraft type and apparent extensiveness of flights



Graph of the above top25 dataset

Reviewing the top 25 claimed origin and destination airfields by flight count shows that most of the top activity over the bay region is derived from Blackpool and Barrow with helicopter flights occurring exclusively from/to the latter. These airfields have no representation from microlight flights though a small number of microlight flights claim Warton as a destination:



Top 25 (by count) origin/destination airfields

The full dataset amounts to 2497 origin/destination pairs, with a breakdown for military/non-military/other, category of craft, flight extent region borders/local and overall track.

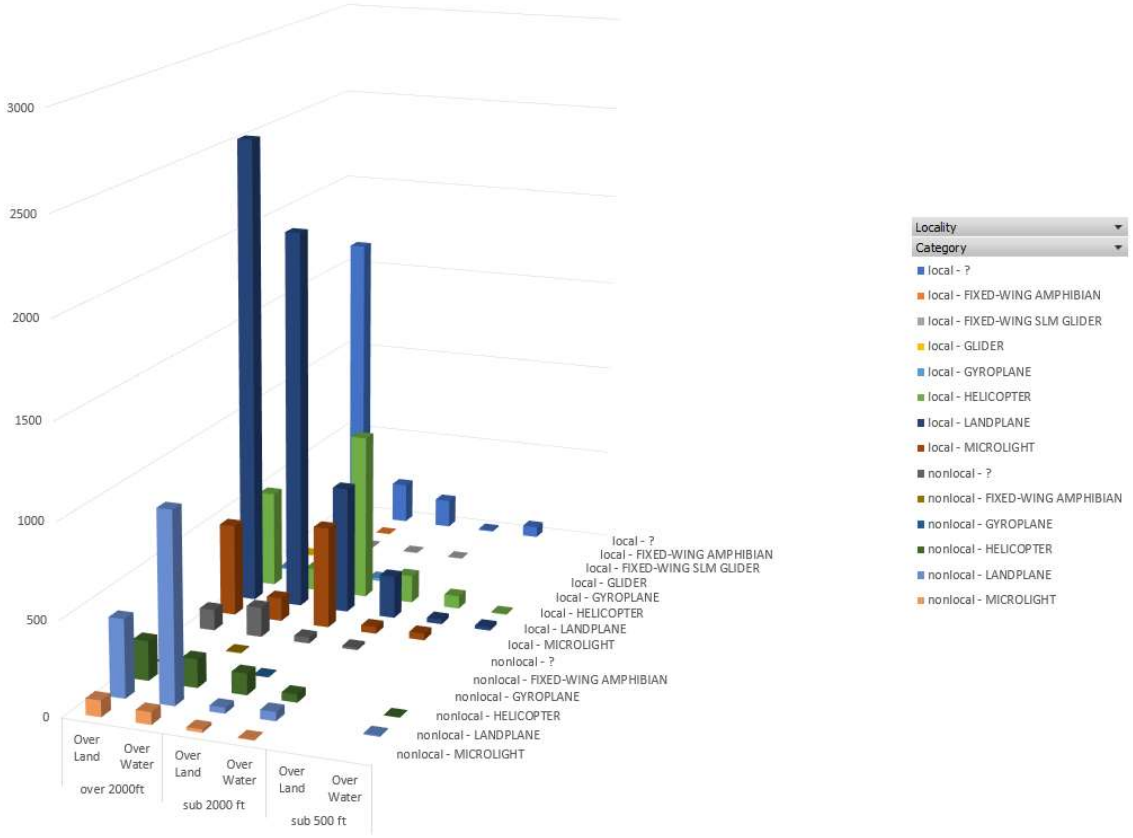
No flights in the top 100 are by craft with a military serial number but there is a reasonable representation of flights between Barrow, Bristol and Farnborough, likely indicative of activity by BAE Systems.

If we shift to looking at flight categorisation of flights that go over the water of Morecambe Bay or not, in low/medium/higher altitude brackets, by category of craft and likely distance being travelled we see a top 40 grid of the following:

Over Water	Height Band	Category	Locality	Counter
No	over 200ft	LANDPLANE	local	2529
Yes	over 200ft	LANDPLANE	local	2053
No	over 200ft	?	local	1631
Yes	over 200ft	LANDPLANE	nonlocal	1011
No	sub 2000 ft	HELICOPTER	local	895
No	sub 2000 ft	LANDPLANE	local	685
No	sub 2000 ft	MICROLIGHT	local	546
No	over 200ft	HELICOPTER	local	519
No	over 200ft	MICROLIGHT	local	496
No	over 200ft	LANDPLANE	nonlocal	417
Yes	sub 2000 ft	LANDPLANE	local	229
Yes	over 200ft	?	local	220
No	over 200ft	HELICOPTER	nonlocal	211
Yes	over 200ft	?	nonlocal	160
No	sub 2000 ft	?	local	155
Yes	over 200ft	HELICOPTER	nonlocal	151
Yes	sub 2000 ft	HELICOPTER	local	149
Yes	over 200ft	MICROLIGHT	local	125
Yes	over 200ft	HELICOPTER	local	119
No	sub 2000 ft	HELICOPTER	nonlocal	114
No	over 200ft	?	nonlocal	112
No	over 200ft	MICROLIGHT	nonlocal	87
No	sub 500 ft	HELICOPTER	local	69
Yes	over 200ft	MICROLIGHT	nonlocal	66
No	sub 500 ft	?	local	58
Yes	sub 2000 ft	LANDPLANE	nonlocal	48
Yes	sub 2000 ft	HELICOPTER	nonlocal	43
Yes	sub 2000 ft	MICROLIGHT	local	37
No	sub 500 ft	MICROLIGHT	local	36
No	over 200ft	FIXED-WING SELF-LAUNCHING MOTOR GLIDER	local	32
No	sub 2000 ft	?	nonlocal	32
No	sub 2000 ft	LANDPLANE	nonlocal	31
No	sub 500 ft	LANDPLANE	local	25
Yes	sub 500 ft	LANDPLANE	local	18
No	sub 2000 ft	MICROLIGHT	nonlocal	17
No	sub 2000 ft	GYROPLANE	local	15
Yes	sub 2000 ft	?	nonlocal	13
Yes	sub 2000 ft	?	local	8
No	over 200ft	GLIDER	local	7
Yes	sub 500 ft	LANDPLANE	nonlocal	6

Top 40 flight level counts of a/c type and extent, with/out over-water components

Due to the variety and number of dimensions, it is best to chart this data 3 dimensionally



Count of flights over varying dimensions.

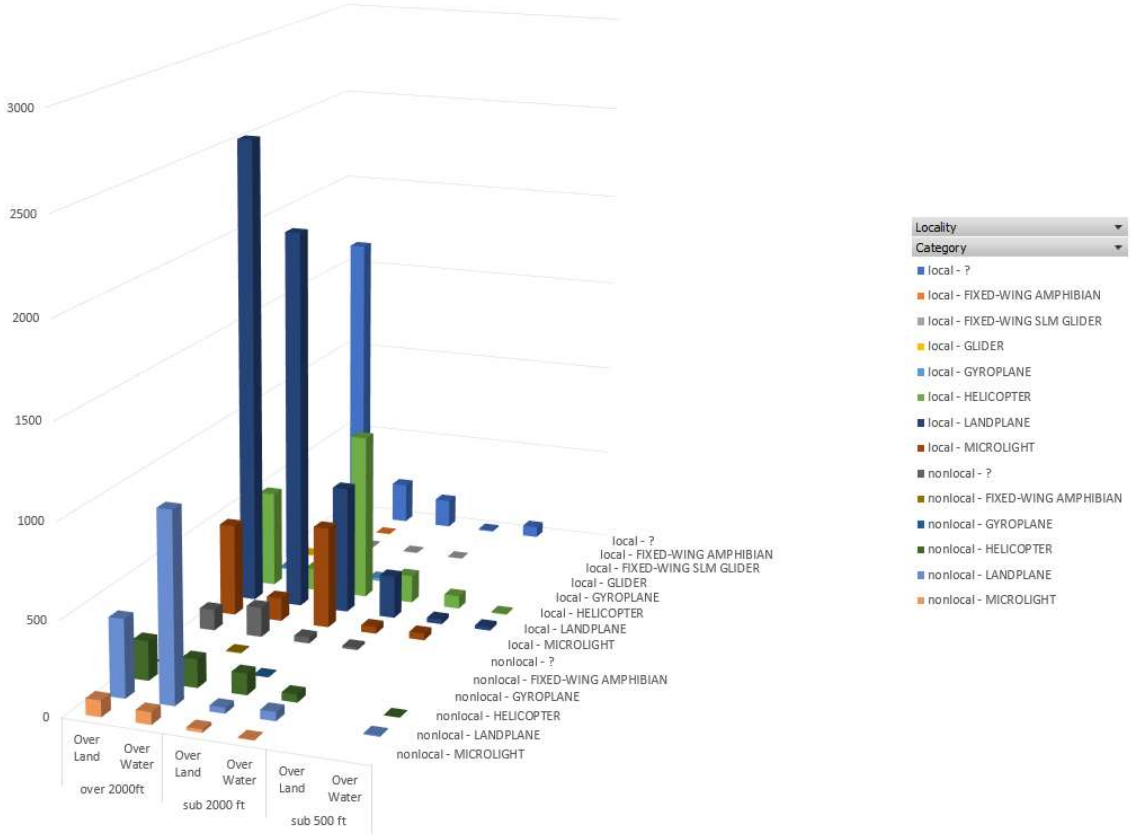
The craft of choice for any locality is a landplane if the flight goes over water.

Microlights are seldom operated over water and when they are it's only in upper altitude brackets

2.3.6b Flight levels breakdown by craft category and extent of flight

From the chart repeated below, the essential take-away from this is that the vast majority of flights occurring over the bay do so above 2000ft, regardless of underlying terrain.

Low flights as a proportion of all flights by the same category of aircraft are much more likely to be executed by microlights and helicopters than other types of craft.



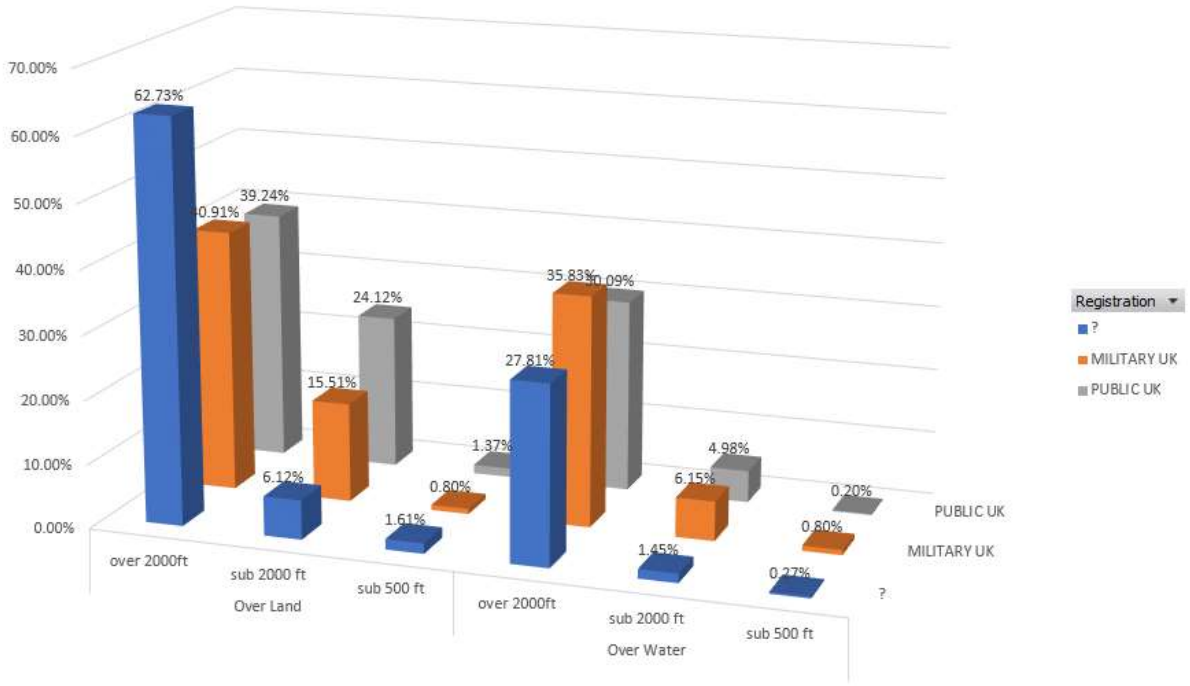
Count of flights over varying dimensions.

2.3.6c Flight levels breakdown by operator type

From the previous chart, low flights, as a proportion of all flights executed by a certain kind of operator, are present in greater proportion over water by military operators and in similar proportion over land by public operators.

In other words; low flights over water are more likely to be military than civilian, whereas over land a low flight is about as equally likely to be military as civilian.

Non-military pilots execute a very small number of low-level flights overall.



Percentage of flights at different levels, factoring terrain type and operator kind

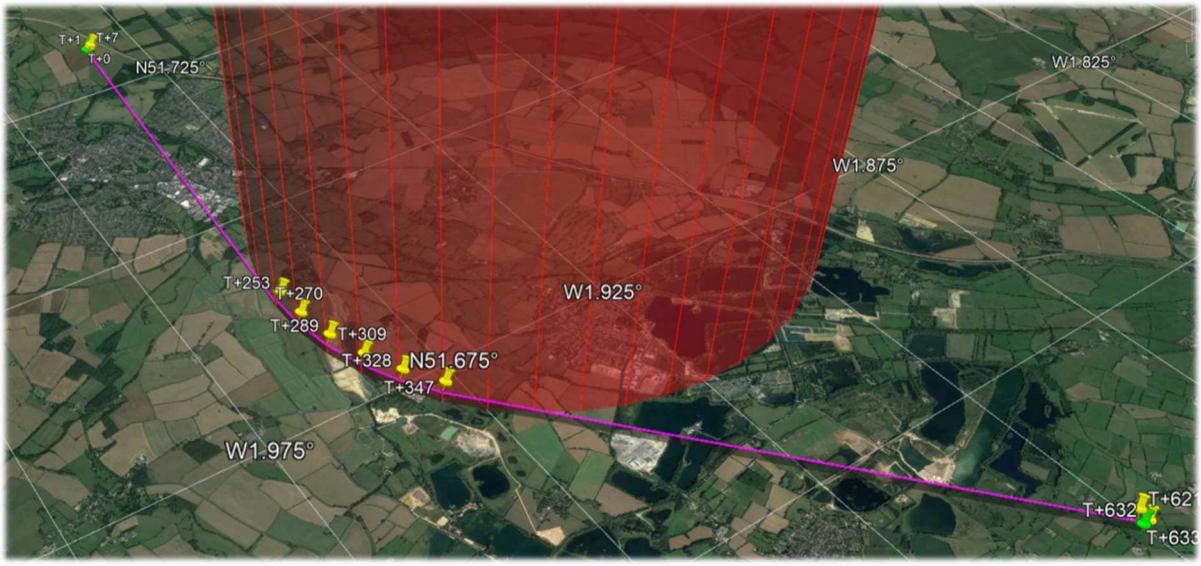
2.3.7 Question 6L Infringement of Restricted Areas

One item of feedback from local microlight groups that we feel compelled to address directly is the claim that Electric Aviation are "planning on infringing R444".

Part of the work Electric Aviation are engaged in with regards to developing bespoke route planning and monitoring software specifically considers flight zones of all classifications across the UK and we can demonstrate that the software actively routes around restricted zones and danger areas.

Drones fly under supervision of qualified human pilots with continuous position assist from GPS and other instrumentation, to a prescribed route planned by software and executed by computer hardware.

An example calculated route rest with the instruction "fly from 51.731,-1.958 to 51.634 -1.900, avoiding any restricted airspace on the way by 10 metres" produced the following route around South Cerney dropzone:



Planned route with automatic avoidance of a dropzone

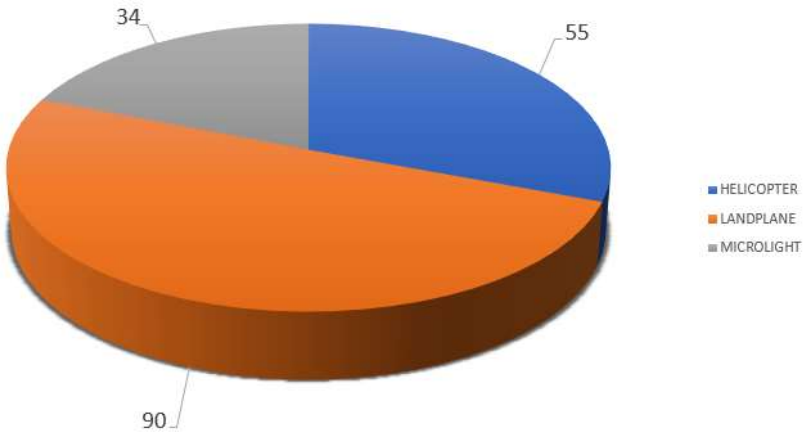
The software will plan, and the drones will execute, routes that know the exact extents of R444 and what is needed to avoid them.

In support of the notion that computers make such routing errors considerably less often than human operators do we asked Miralis to examine the data for statistics on potential infringements of R444 and also the Gas Venting Stations at Nether Kellet and Barrow.

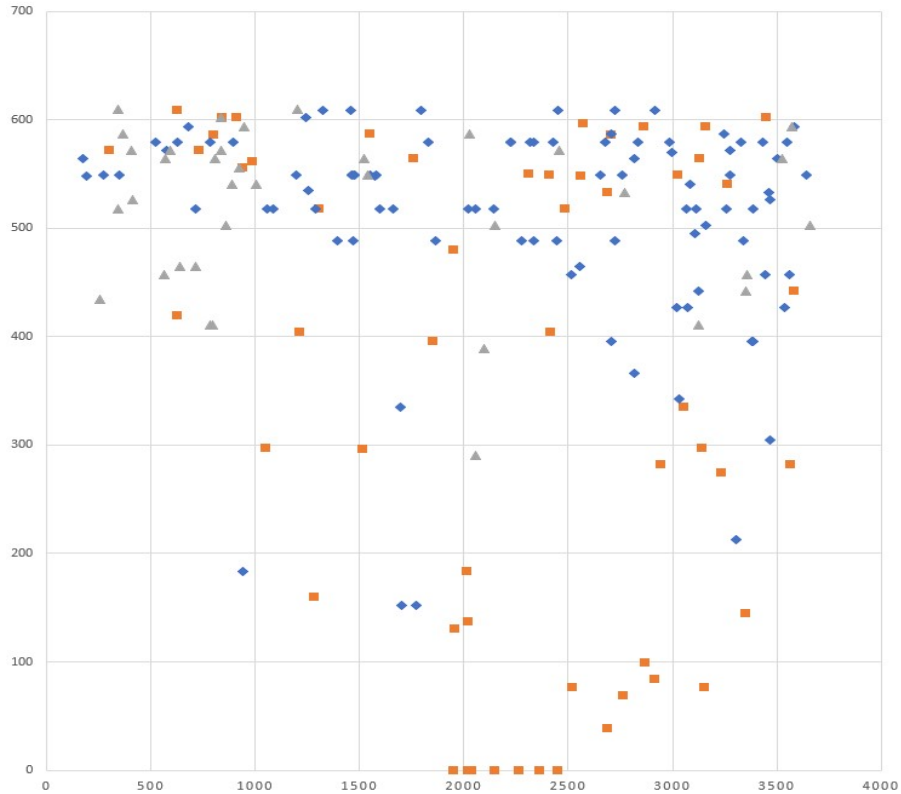
2.3.7a Infringement of R444

R444 is a restriction around a nuclear power generation facility in Heysham. The restriction is a cylinder of radius 3704m (2NM) around coordinates 54.029716,-2.91444 that extends to a true altitude of 609m (2000') AMSL.

Around half of all 179 infringements in the year are from planes, with the remaining half being split roughly 2 microlights per 3 helicopters. Helicopters may have valid permissions to enter the area.

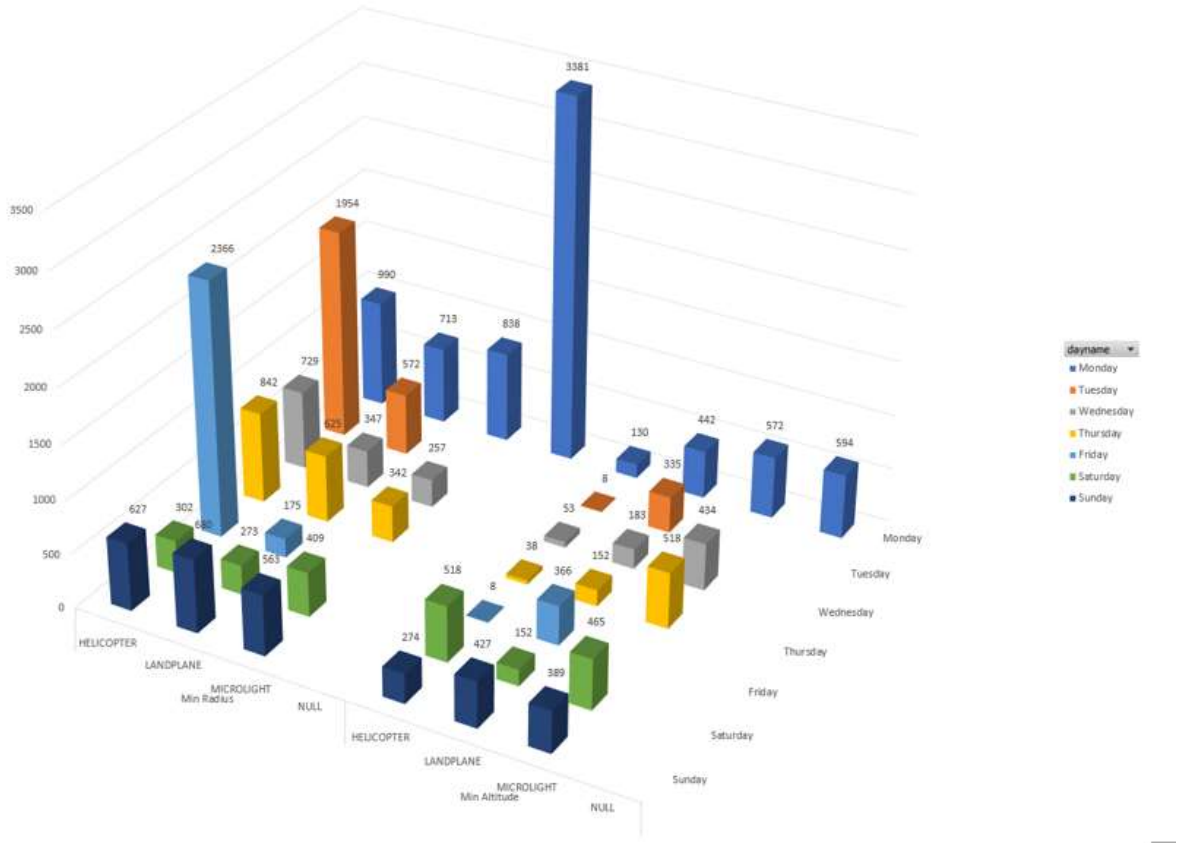


Count of infringements of R444 by craft type



179 flights, minimum observed horizontal and vertical distances(metres)
Planes: blue diamond, Helicopters: orange square, Microlights: grey triangle

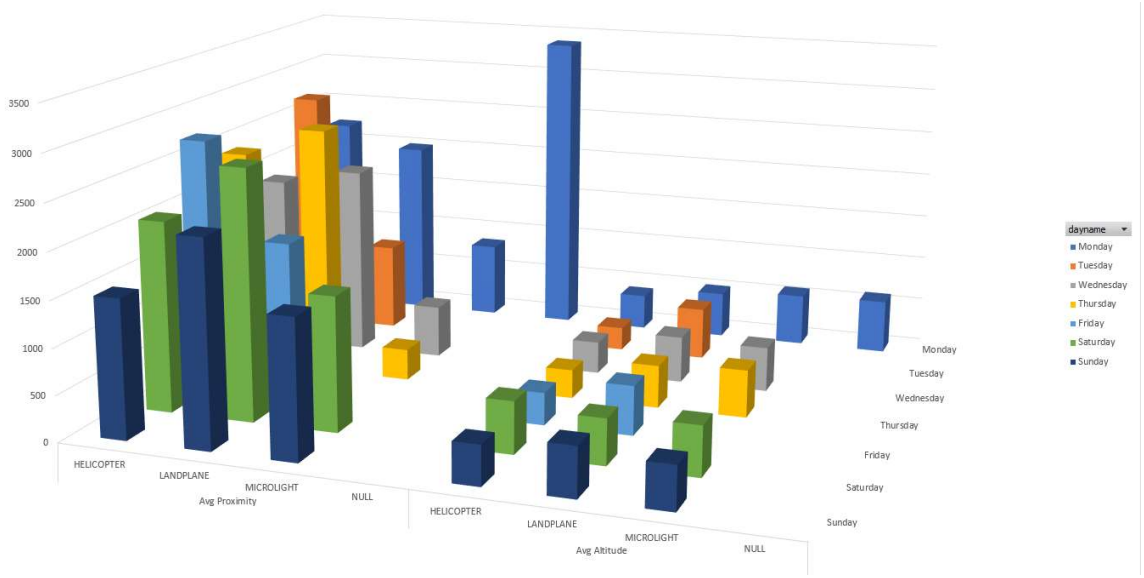
Plotting the minimum observed horizontal and vertical distances on an XY graph helps visualise how close flights get to the nuclear facility in R444. The facility is effectively at 0,0 on the graph with R444 extending out 3704m and vertically up to 609m. Please note the main building infrastructure extending out to approximately 500m horizontally!



Smallest radius from centre and lowest observed altitudes
(Heights in metres; R444 is 609m high and has a radius of 3704m).

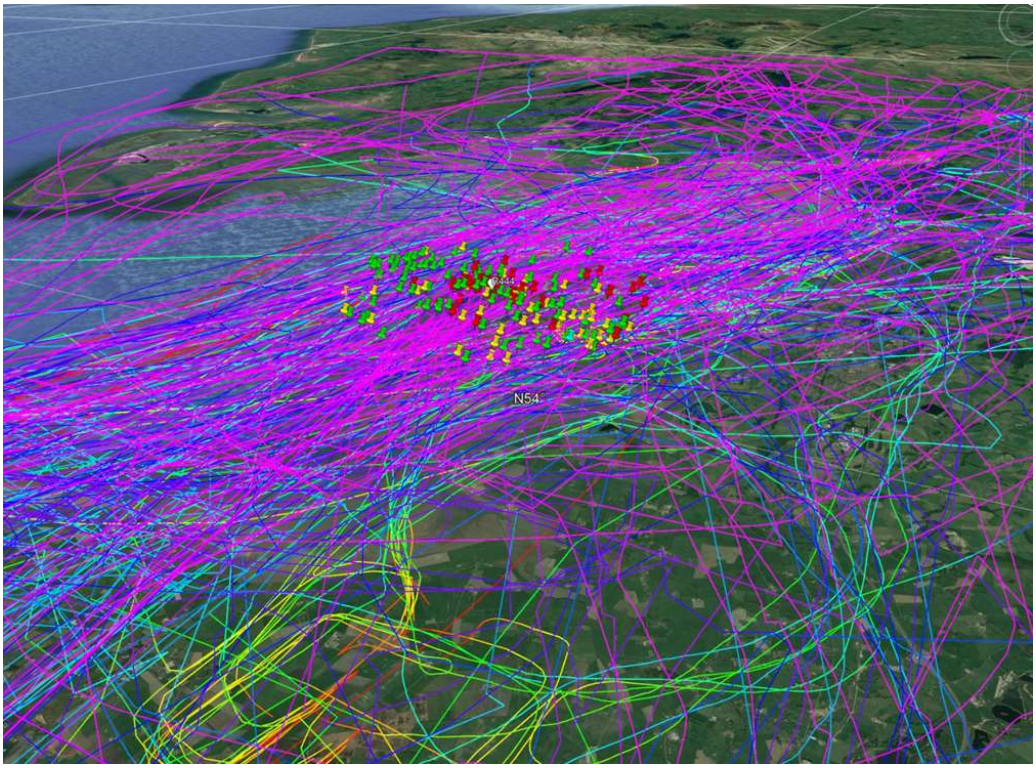
- Helicopter altitudes during weekdays indicate routine authorised entry.
- Planes vary their infringements in the horizontal and vertical quite considerably.
- Microlights generally keep to higher altitudes but stray closer to the centre.

This chart includes one flight of unknown category excluded from the pie chart



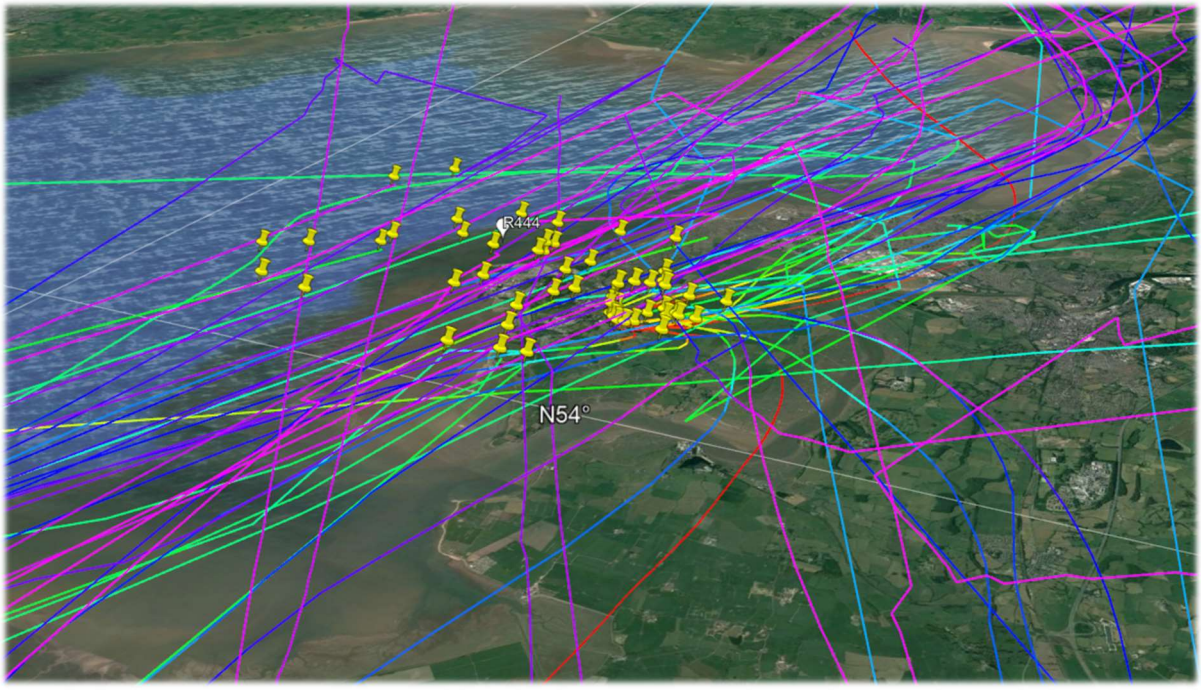
Average heights graph (altitudes in metres; R444 is 609m high)

Landplanes typically stay further away and higher up implying that plane behaviour is varied (minimum deviates more from the average). Microlight behaviour is more consistent but the averages indicates they're more likely to fly closer to the centre of R444 and lower over it.



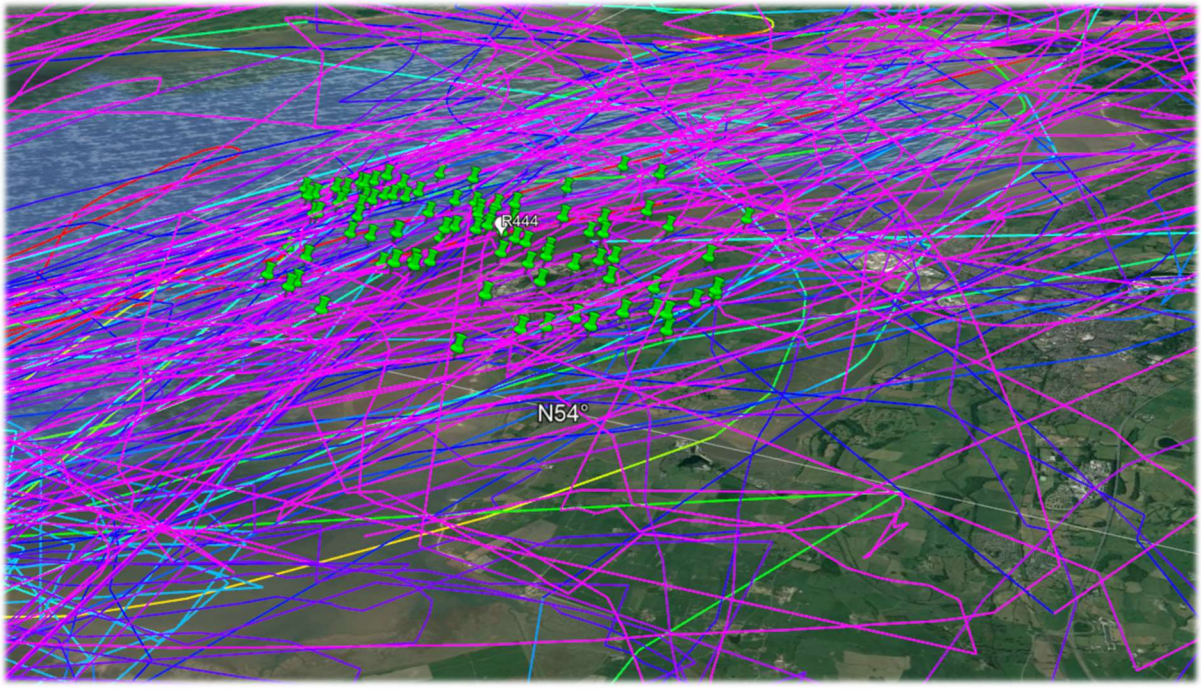
180 infringements of R444; track with rainbow altitudes (red: 0m to pink: 609m+)
Pushpin defines point of closest proximity w.r.t horizontal and vertical distance
Pushpin colour defines a/c type (red: microlight, green: plane, yellow: helicopter)

The combined image shows R444 as reasonably often transited, generally in a southwest to northeast direction.



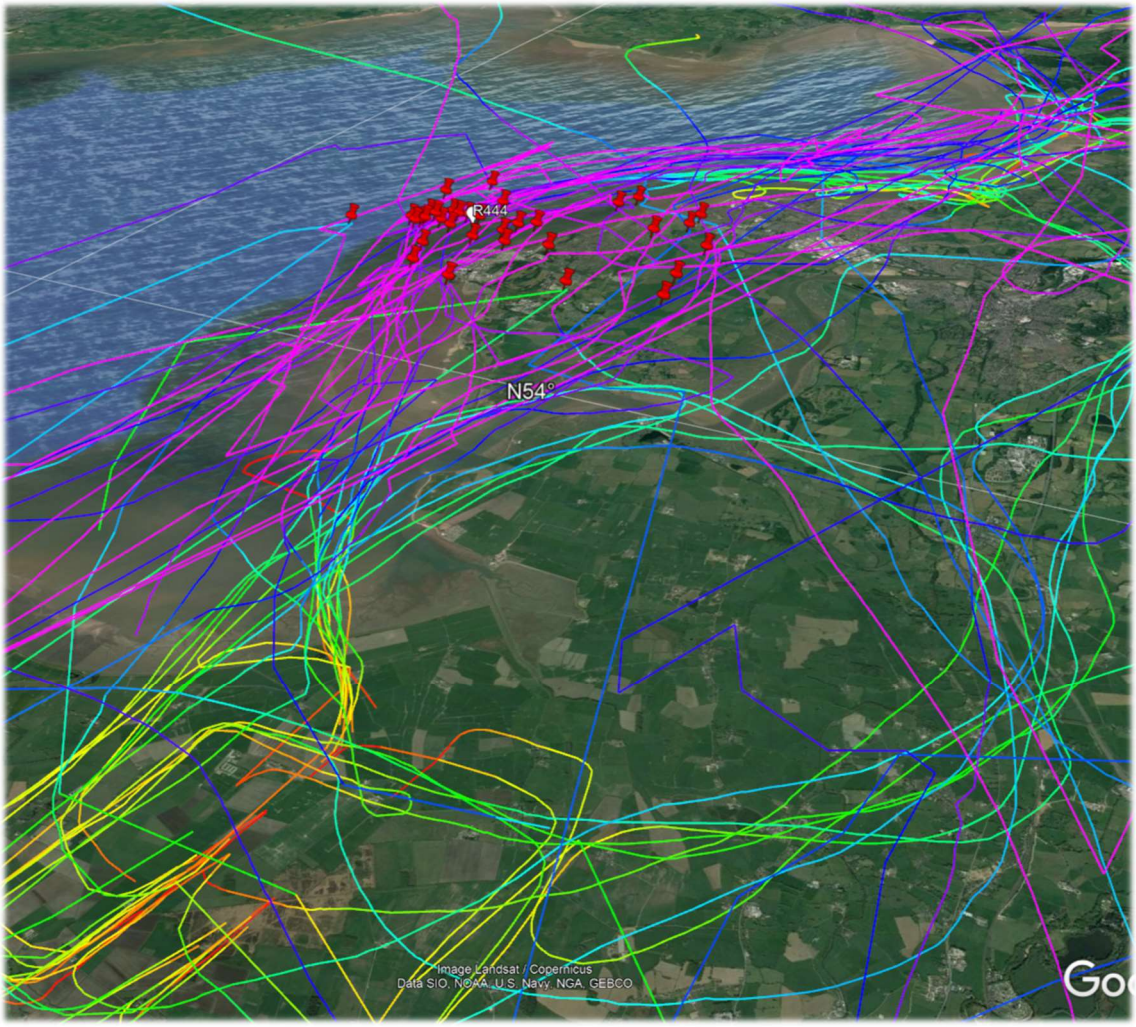
Helicopter operations through R444

The cluster of green-to-orange-to-red curved lines and pins indicate final approach to landing/climb path after take-off. Blues and pinks are transiting flights at approximately 450m to 600m; the upper extents of the restriction.



Landplane (including ultralight) operations through R444

Planes are generally transiting over at a consistent altitude that they reached elsewhere.

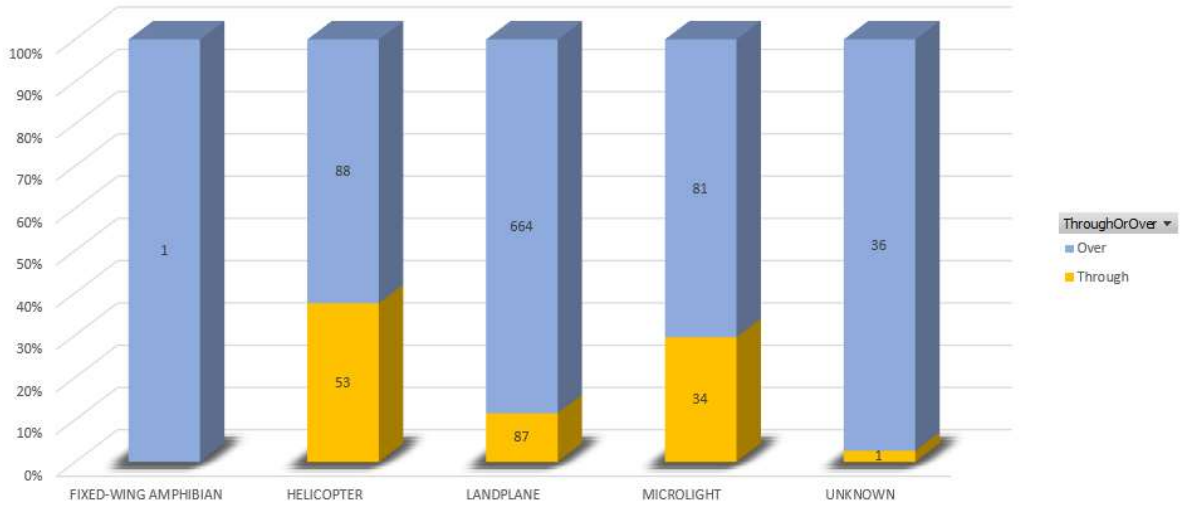


Microlight operations in R444
(red 0', yellow: 400', green: 1200', cyan: 1200', blue: 1600', pink: 2000'+)

The microlight visualisation is interesting; it appears that microlights seem to be aware of the location of R444 and climb (flightpath fades from greens through blues to pinks) to try and avoid it then drop down on the other side. Avoidance isn't always successful.

The total count of flights passing over the surface-circle of R444 is 1045.

The breakdown of whether the craft successfully flew over R444 (min altitude of 2000') or through it is:



Over/through R444 percentage graph. Numbers on bars represent count of flights

It can be seen that the Microlight community have the largest percentage of flights over R444 that actually infringed the airspace (34/81) 41.97% out of all user groups, when Helicopters are discounted as they may be permitted to enter the restricted area. Landplanes infringed 13.10% as a comparison.

2.3.7b Kellet and Barrow GVS

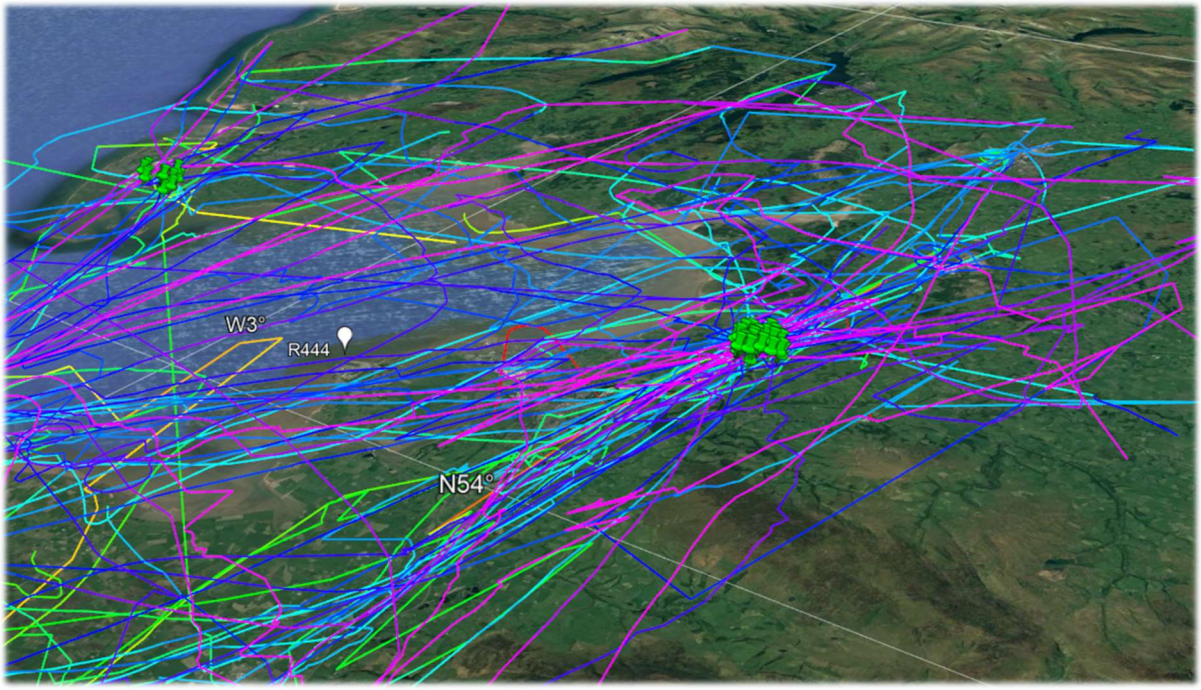
Gas venting sites at Barrow and Nether Kellet are a local feature that present potential danger to aircraft. They're located at 54.093056,-3.180278 and 54.101944,-2.737778 respectively, both have a radius of 926m and extend up to 1097m and 853m respectively.

We charted flights and found evidence that awareness of their existence, or appreciation of the danger they represent is much lower than R444.

A considerable number of flights passing through are made by helicopter and there's a clear pattern of one particular type of craft (Robinson R44 – green lines below).

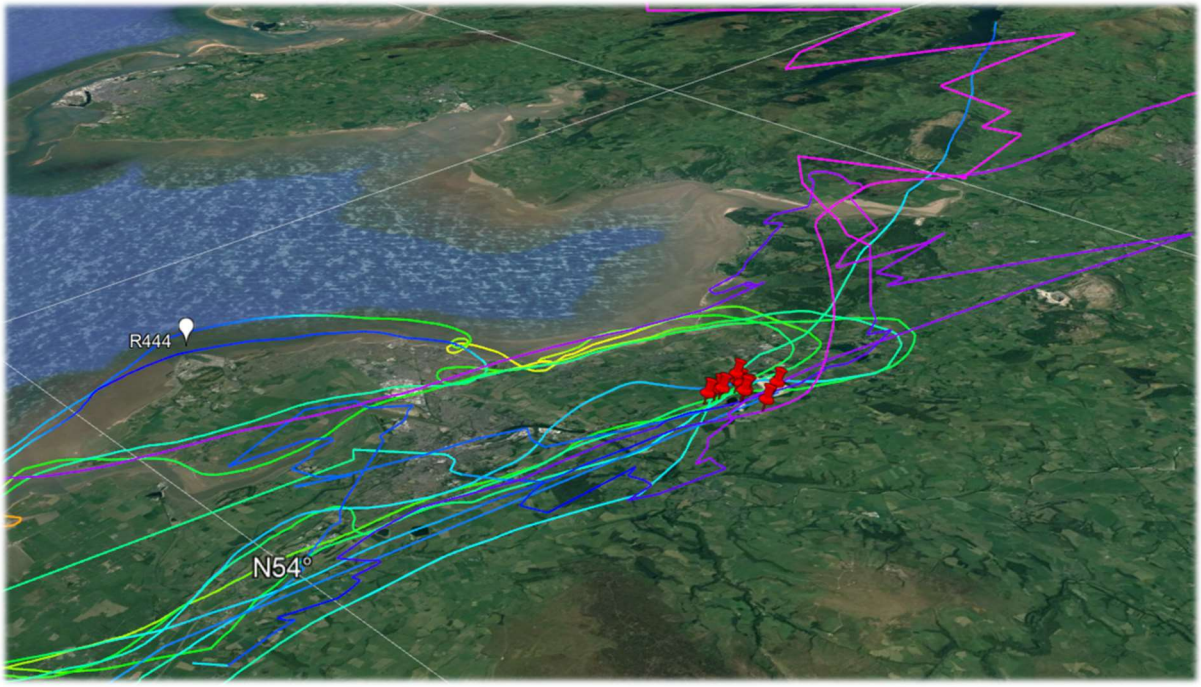
These flights follow a very accurate track and visit both sites, likely as a professional pipeline survey operation.

s



Landplane infringements of the two GVS

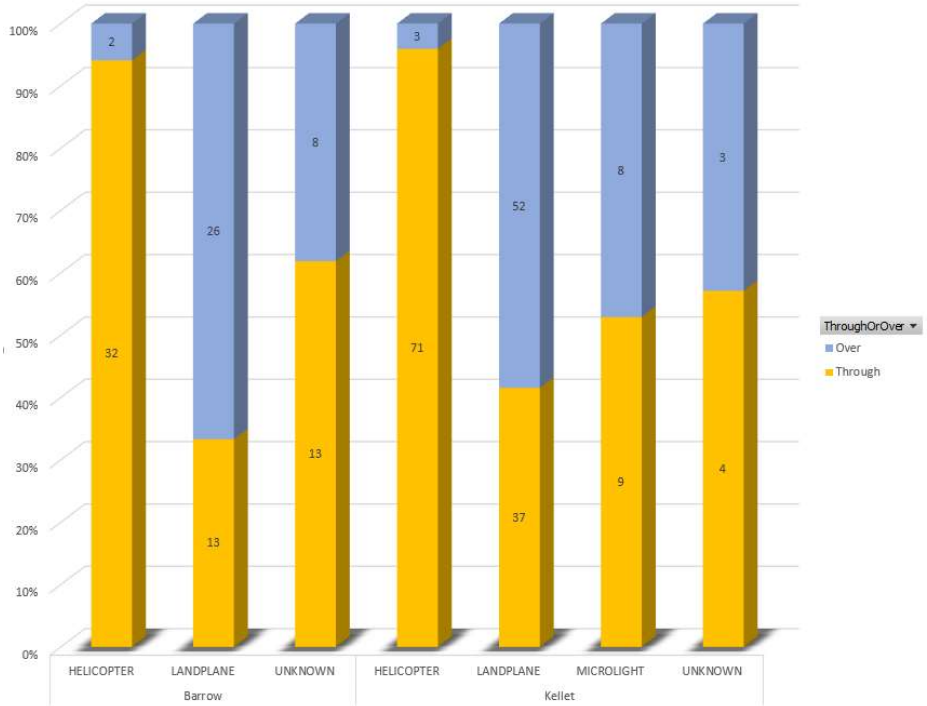
Planes don't appear to exhibit any particular behaviour near either GVS.



Microlight infringements of the two GVS

Microlight behaviour is similarly unchanged in the region of the GVS; flights typically seem to be a "there and back" operation out of Rossall Field and St Michael's with an altitude track that follows the general ground levels without particularly different treatment of the Nether Kellet GVS.

We did not observe any infringements of Barrow GVS by microlights, but in total 281 flights infringe the GVS zones, with Kellet infringements/flyovers occurring around twice as often as Barrow.



Percentage breakdown of flights below(through)/above the top of the danger area
Numbers on bars are count of flights

2.3.8 Conclusions from ADS-B Analysis

Our analysis of the year's Flight Radar 24 data for the Morecambe Bay Area, conducted by external consultants, Miralis Data Limited, shows that there were:

- 13,215 flights between 1st of August 2020 and 31st of July 2021
- Flights are at their lowest over the winter months
- The majority of aircraft operate above 1000'.
- Winter microlight use fell to around 10% of summer levels.

- There were only 61 microlight flights where part of the flight was sub 500'
- There were only 18 microlight flights where the whole of the flight was made sub 500'
- There were 266 Landplane flights where part of the flight was sub 500'
- There were only 19 Landplane flights where the whole of the flight was made sub 500'
- There were only 15 Helicopter flights where part of the flight was sub 500'
- There were only 24 Helicopter flights where the whole of the flight was made sub 50'

- 390 flights (2.95%) featured any component below 500ft.
- 63 flights (0.47%) operated entirely below 500ft

- Microlight aircraft do land on the sands at Morecambe bay, but this activity is limited to Piling Sands, well to the south of the planned Airspace Change, with one incident of a microlight landing at Bolton Le Sands.
- Microlights do not have the land-owners permissions to land on the sands.
- This activity has triggered SAR response needlessly

- The majority of flights analysed are "Local Flights" starting/ending at local airfields.
- The largest proportion of flights over the bay are Blackpool to Blackpool land planes.
- The next largest group of flights are North/South routes from out of area airfields.

- Microlights seldom operate over water, but do so in upper altitude brackets
- The vast majority of flights occurring over the bay do so above 2000ft
- The largest deployment of flights sub 500ft over the water are military.

- R444 was infringed 174 times in the year, 90 times landplane, 34 times Microlight.
- The majority of infringements are cause by height not distance being adhered to.
- Weekend infringement is the most common.
- 42% of microlight flights that plan to overfly R444 fail and infringe.
- 13.1% of landplanes attempting overflights of R444 fail and infringe.

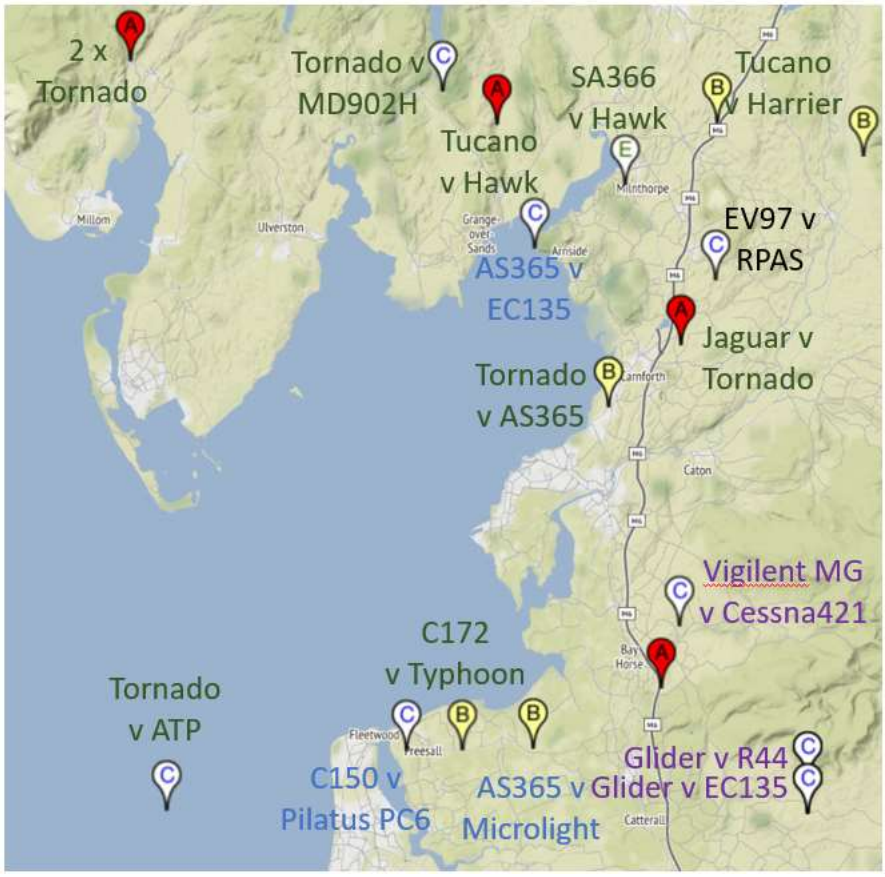
- Microlight aircraft regularly infringe the Gas Venting Site at Nether Kellet.

2.4 Lessons from Airprox

A review of the Airprox incidents for the period 2000-Current day was conducted. Using the excellent GIS interactive Map of UK Airprox Locations, provided by one of the Airprox board members.

Electric Aviation were able to identify historic Airprox incidents in the Morecambe Bay Area.

This analysis is presented below.



It can be seen from the above graphic that the majority of historic Airprox incidents involve the military within the Morecambe Bay Area, with only one civilian Airprox incident at the top of the bay at Arnside, the entrance to the Kent estuary, where the proposed TDA will operate.

Reviewing the military response to the Airspace Change Proposal (See section 1.16) which detailed:

Military airspace users raised concern that if there is no DACS/DAAIS available, blanket NOTAM application would effectively prevent other airspace users from utilising the airspace, which is not in accordance with flexible use principles.

Thus we conclude that having reviewed the previous Airprox information, we believe the provision of DACS/DAAIS to be of critical importance for this Airspace Change Proposal, to provide critical separation for the RPAS when operating across the bay and to provide maximum access for the military to operate in the same airspace.

2.5 Conclusions

Electric Aviation believe that the claims of the microlight fraternity are grossly exaggerated.

Practice Forced Landings should be made overland and not over the bay area, either over water nor sand, which may be quicksand.

Low level flight may be practised over the bay, but in reality this is an exceptionally hazardous activity and whilst potentially can be achieved within the realms of SERA5005/ORSA1496 probably cannot be done without breaching ANO Article 240 and SERA3101. It is unlikely a microlight's insurers would honour a claim in such circumstance.

The microlight fraternity's activities are causing needless false call outs to the Search and Rescue and Emergency Services in the region.

With only 61 microlight flights where part of the flight was sub 500' out of 13,215 flights recorded in a year by Flight Radar24, we believe that the microlight case for low flying and landing on Morecambe Bay is grossly over stated and misrepresentative of reality.

From the feedback from the Ministry of Defence and from anecdotal evidence from BAe Warton the greater risk lies with military aircraft transiting the Bay area at low level. This is confirmed by the historical evidence of AIRPROX's analysed.

Thus we conclude that a DACS service is essential in providing the military their levels of re-assurance such that this Airspace Change Proposal will not affect their planned operations as well as providing access for microlights with appropriate radio telephony equipment.