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Bristol & Gloucestershire Gliding Club

The Future of Aerotowing at Nympsfield

Final Report

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Owner: BGGC Committee



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BRISTOL G C TUG 15/11/61 – 07/05/73.



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1 Introduction

The club's Pawnee tug is 45 years-old and will require a replacement engine within 2 - 3 years at a cost in the order of £35,000. The aircraft is expensive to operate and investing in an aging airframe may not be the correct decision for the club and its members.

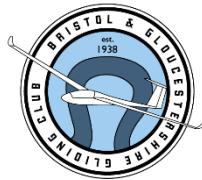
Early in 2018 a sub-committee was formed and asked to examine the club's current and future aerotowing operations. The Terms of Reference were to: *Analyse the club's current and future aerotowing operations and make recommendation(s) for the Short, Medium and Long-term future of aerotowing at Nympsfield. Recommendation(s) were required to be objective, based on verifiable facts and represent the best solution for the club. (See: The Future of Aerotowing at Nympsfield - Terms of Reference. V1.0 March 2018.)*

This report documents the sub-committee's findings.



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2 Aircraft Considered

Three classes of tug were considered: Touring Motor Gliders (TMG), Traditional Light Aircraft (TLA) and Very Light Aircraft (VLA). Although it would be possible to operate a nose wheel type at Nympsfield experience has shown tail draggers to be a more suitable configuration.

2.1 TMG: TMG are more economic to operate than traditional light aircraft and can also be used for field landing, navigation and TMG extension training. As of mid-2018 there were 16 examples in use:

- 12 SF25C
- 3 Dimona variants
- 1 Grob 109

Of these 7 are operated by Military clubs which, although usually small by civilian standards, are very well-funded. Motor glider tugs are expensive when compared to second hand light aircraft of similar towing capability. The design and multiple function of a TMG does not lend itself as a suitable primary tug. If the club ever purchases a motor glider, however, the possibility of towing as a secondary task should be taken into consideration.

2.2 TLA - New: The cost of new light aircraft is considerable. e.g. an American Champion Aircraft Corporation Scout is @\$254,900. Given the high initial outlay and the relatively modest fuel savings over the Pawnee (@ 2 Litres per 2,000' tow) no case can be made for any new aircraft in this class. New TLA are too expensive and not sufficiently more economic to operate to recover their capital cost.

2.3 TLA - Second Hand: Suitable second-hand light aircraft are mostly Lycoming powered and offer little economic advantage over the club's Pawnee. They are also likely to be of a similar design and age to the club's Pawnee and exposed to similar expensive maintenance and increasing spares availability issues, which can lead to delays in return to service when repair is required. Some examples include:

- Pawnee: Available in 235hp or 260hp versions. Both are certified with four bladed propellers and silencers. There are two versions: Early, with its fuel tank in the fuselage and later, with its fuel in wing tanks, the latter being less pleasant to fly. (Currently there are 32 on the UK register, of which one banner tows in the Netherlands, one appears to be owned and presumably based and operated in Italy and at least 3 others are currently unserviceable.)
- Super Cub: Available in 150, 160 & 180 hp variants. 150hp & 160hp variants are not likely to be considered acceptable given the airframe weight. Four bladed propeller and silencer are certified for this aircraft. The 180 hp versions are not a factory standard but are good tugs and would probably be of the order of 2 Litres per tow more fuel efficient than the Pawnee. They are even older than Pawnees with similar maintenance issues.



- **Supermunk:** This has a Lycoming O-360 180 hp engine in a Chipmunk airframe. All Chipmunk airframes are old (production ended in 1956), have potentially high maintenance costs and are comparatively specialist. As a tail dragger it is good for operating out of Nympsfield and pilots like them.

There is little economic advantage in investing in a second-hand alternative to the Pawnee and unless the capital cost savings were to prove considerable it would be better economically to keep the Pawnee.

2.4 VLA: Increasingly large numbers of VLA operate under the UK Light Aircraft Association (LAA) jurisdiction and some are capable of glider towing. Reliable information (Flight Manual data) show four types with permits for towing. All are two-seaters and powered by various versions of the Rotax 900 series engine.

- Aeropro EuroFox
- Aerospool WT9 Dynamic
- Breezer Aircraft Breezer
- Comco Ikarus C42

The American Carbon Cub (Super Cub copy) also falls under LAA jurisdiction. It should make an effective tug being significantly lighter than the original Super Cub and with a 180 PS Continental engine. However, it's expensive – a new kit costs @\$199,500 in the USA. Complete second hand aircraft are advertised from \$160,000 - \$300,000. Although there is interest online in its use as a tug there does not appear to be any in regular operation.

The table overleaf lists the maximum permitted weight each of the four VLA types listed above can tow:

Aircraft:	Max Towed Weight:	Comments:
EuroFox 120 PS	800 kg	
EuroFox 115 PS	800 kg	Turbocharged engine.
EuroFox 100 PS	750 kg	
WT9 Dynamic	750 kg	Single Pilot only whilst towing. (Also available in Europe with a 120 PS engine but it is understood this is not available in the UK.)
Breezer	650 kg	
Ikarus C42	400 to 650 kg	Max towed weight depends on aircraft AUW. 400kg AUW can tow 650 kg, 472.5 kg AUW can tow 400 kg.

The only VLA tug currently owned and operated by gliding clubs in the UK is the EuroFox. Currently there are 102 EuroFox on the UK register of which 27 are equipped as tugs. Some are privately owned and not in routine use as tugs. Excluding ourselves, there are 18 UK clubs (32% of aerotowing clubs) who regularly operate them. Three clubs operate two EuroFox each.



The Black Mountain Club at Talgarth (an aerotow only operation), use a privately-owned example as a backup to their Pawnee.

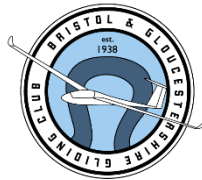
2.5 Conclusion: It is extremely unlikely the club could afford to invest in a new TLA or a Carbon Cub. There are no obvious second hand TLA that have any significant advantage, financially or otherwise, over the Pawnee. VLA however offer a large financial advantage. The only credible ways forward appear to be to continue with the Pawnee accepting its high cost of operation or invest in a EuroFox 120PS.

If the club follows the EuroFox 120PS route it will be investing in a potential two-seat touring aircraft which should retain its value and be easy to sell, should the club wish to change direction in the medium term.



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3 EuroFox Trial

There has been much speculation and uninformed opinion over the capabilities of operating a EuroFox 120PS at Nympsfield. The club was presented with a unique opportunity to evaluate a EuroFox over an extended period from November 2018 to the end of July 2019. A detailed report on the EuroFox Trial is included as Appendix 4. This section is limited to presentation of its outcome.

3.1 Operating Limitations: It was recognised before the trial began that the EuroFox would not be capable of towing some heavy gliders under conditions that are possible with the Pawnee, particularly when towing east to west. It was also acknowledged it would be less capable than the Pawnee in rough conditions. Occasionally these two factors can combine.

There are a small number of days when the winch cannot be used because of an excessive southerly crosswind and aerotowing cannot be supported by the EuroFox. These days tend to offer poor soaring conditions.

The weather conditions that the EuroFox cannot support are relatively uncommon and often associated with little demand for aerotowing. The number of launches required by the heaviest gliders on days when EuroFox cannot launch them is small. In the course of the trial tug pilots declined to launch heavy gliders on 3 occasions and given more experience this would probably have been 2. The bulk of these days retain the option to winch launch. Records indicate that winching has been available on 89% of aerotow days.

3.2 Weather - Absence of Headwind: Any headwind component shortens the take-off run and steepens climb out. Its absence can sometimes prevent the towing of heavy gliders and more often very heavy gliders when operating east to west. The *Meteoblue weather website*¹ suggests that more than 7 kts of headwind can be expected to be available approximately one quarter of the time when operating west to east and one third of the time when operating east to west. Flying records indicate that 65% of gliders are heavy and 3.8% are very heavy². There were days when the Pawnee could have towed but the EuroFox didn't due to the absence of headwind:

- One 'very heavy' two-seater was refused a launch whilst all other gliders were launched.
- On two occasions towing was conducted from the west rather than east end when there was no headwind. (See Section 3.8 Boundary clearance.)
- A tug pilot on another occasion refused to launch the DG505, west to east, despite having already launched a glider of similar weight.

¹ See Appendix 4.

² See Appendix 1 for definition of these terms.



- The most serious loss of launches occurred on a southerly day when the tug pilot was willing to operate west to east, but the instructor felt he couldn't due to the more restrictive crosswind winch limits in that direction. As a result, there was no aerotowing and 5 trial lessons were rescheduled. (See 5.2 Trial Lesson Safety.)

Given the experience gained in the trial and considering the anticipated breakdown of windspeed and direction suggested by the Meteoblue website, the absence of headwind whilst using a EuroFox may cost 2% of the total launches conducted by the Pawnee.

3.3 Weather – Turbulence: Turbulence at Nympsfield presents itself in two forms: General roughness that has little effect on towing performance and turbulence caused by the local geography. The latter results in areas of roughness and sink

General Turbulence: The EuroFox is more affected than the Pawnee but its controls are both quicker and lighter and as long as the pilot is willing and able to 'fly the aeroplane', it handles roughness very well, albeit not as well as the Pawnee. The number of generally turbulent days the EuroFox cannot support compared to the Pawnee is small. It should also be noted that demand for aerotowing in these conditions is limited.

- A day was lost when 4 gliders winch launched on a strong westerly day.
- 2 tows on separate days have been lost.

Experience from the trial suggests that a EuroFox operation would lose approximately 2% of the total launches conducted by the Pawnee due to general turbulence.

Turbulence and Sink: When the wind is between 290° & 330° it can generate curl over at the west end of the airfield. In addition to simple turbulence, descending air can sit in an organised pattern approximately half way across the field width. It is most commonly noticed when there is little headwind component and when the tug pilot proceeds along the middle of the airfield rather than hugging the north boundary where the effect is normally slight or absent.

Given that EuroFox typically crosses the North or West boundaries lower than the Pawnee this effect is of greater significance. In practice these conditions are only an issue in light winds, as stronger winds usually result in significant turbulence that deters tug pilots from operating or glider pilots from aerotowing. In these conditions a winch launch onto the ridge virtually guarantees soaring.

- A day was lost after a tug pilot twice launched the DG505 but wasn't happy with the margin so put the aircraft away and went home. It would have been possible to continue to launch lighter gliders.



Considering the anticipated breakdown of windspeed and direction indicated by the Meteoblue website and experience gained in the trial, it appears that due to this specific turbulence/sink condition a EuroFox operation would lose less than 1% of the total launches conducted by the Pawnee.

3.4 Weather – Crosswind: Nympsfield is fairly well protected from crosswinds by the surrounding trees, albeit at the expense of added turbulence. Strong northerlies invariably generate sufficient curl over and turbulence to make aerotowing difficult for glider and tug. Winch launching is usual in these conditions (see Section 3.3 Turbulence and Sink).

In southerlies where the crosswind is strong enough to prevent winching, it is sometimes possible to aerotow from either end and sometimes from the NE corner. The EuroFox Flight Manual states that the maximum permitted crosswind component is 15 mph (12 kts) but continues to state that: *“The EuroFOX has demonstrated to be able to cope well with crosswinds exceeding this, especially with more experienced pilots.”* The EuroFox has successfully launched in crosswinds in excess of this suggesting that the limit is more likely to be a pilot rather than an aircraft constraint.

Demand for aerotowing in significant southerlies is usually slight. The limiting factor is likely to be a mixture of crosswind and turbulence in the lee of trees. The EuroFox is not as capable as a Pawnee in these conditions.

- The Pawnee was used to launch 5 gliders when these conditions prevailed.

Based on experience gained in the trial, the frequency and severity crosswinds suggested by the Meteoblue website and considering the usually modest demand in these conditions, it is estimated that less than 1.5% of total launches per year will be lost due to crosswinds.

3.5 Weather – Heat: Increasing temperature reduces the performance of normally aspirated piston engines and requires greater true airspeeds, both resulting in reduced tug performance. Records indicate that on average we can expect the temperature to exceed 20°C on 20.4% of days at Nympsfield. Of these, 14.7% will be less than 25°C, 4.9% will be between 25 & 30°C and just 0.8% will exceed 30°C³.

Fortunately, the highest temperatures are usually associated with high air pressure which provide some mitigation. However, launching very heavy gliders and given the most extreme conditions even heavy gliders may not be possible in the ‘heat of the day’. More probable is the possibility that hot conditions combine with other factors to prevent some launches.

3.6 Operating - Turnaround Time: Turnaround time is influenced by weather and tug pilot technique. The EuroFox does not climb as rapidly as the Pawnee. The average climb rate towing the DG505 913 from a standing start to release, is 3.7 kts and measured in the air is

³ Temperature information taken from ‘meteoblue weather’ website.



4.0 kts. (Unfortunately, there are no comparable figures available for the Pawnee.) A major advantage of Rotax engines is that they are part-liquid cooled, which permits a more rapid descent whilst much reducing the prospect of shock cooling and cracked cylinder heads, common with Lycoming engine aircraft. The trial data, assuming the historic 2,407' average launch height, shows 6.16 launches per logged hour, 86% the rate of the 7.03 launches per logged hour of the Pawnee for the same launch height. These figures suggest that the EuroFox launch rate is almost 12.5% down on the Pawnee. However, in practice the inevitable ground time between launches means that in practice the reduction in launch rate will be less than 10%.

3.7 Operating – Other Items: EuroFox is significantly quieter and far less intrusive to our local neighbours than the Pawnee, even with its four bladed propeller and silencer. The volume is appreciably lower and this must reduce both the level of annoyance and the area covered. This has been noticed by our neighbours and the Chairman has received a letter from a Nympsfield resident noting and appreciating this.

The EuroFox is much easier to manhandle on the ground being less than half the weight of the Pawnee. Two people can remove it from the hangar and one can put it away.

It has simple sight-tube fuel gauges and comparatively large fuel capacity and is both safe and practical to commence operations with less than full fuel. This improves both performance and economy. The D Model of the Pawnee (such as G-NYMF) have unreliable fuel gauge and low fuel warning light systems and it is club policy to commence towing with full tanks to allow calculation of towing endurance.

The EuroFox is vulnerable on the ground in strong wind and gusts which may be a limitation on a few occasions, although it is likely that only a very narrow margin exists where it can operate safely but not be left unattended on the airfield.

Two seats and the ability to train and check tug pilots is a facility the club has missed since it disposed of the Scout G-BGGD in 2014 - the EuroFox trial has brought this to light. Tug Pilot standardisation and conversion requires two seat tugs and can be helpful with ferrying and positioning aircraft.

It is also apparent that as a lighter and lower powered tug than the Pawnee, the EuroFox is less flattering of any deficiency in pilot technique, in particular accurate and appropriate speed control in the transition from ground to climb. Fortunately, problems in this area can be readily addressed given that is a two-seater.

Similarly, if gliders are held on the ground longer than necessary take-off performance is impaired. This is particularly important with nose-wheel two-seaters that keep the nose wheel down and unnecessarily extend the take-off run.



One of the club's existing tug pilots has as yet to find a way of fitting in the aircraft. Lack of leg length being the issue. Addition or removal of cushions permits all the other tug pilots, even the tall ones to fit although one states he isn't comfortable. For those between the extremes of height the aircraft is comfortable and has an effective heater.

3.8 Operating - Boundary Clearance: The most significant issue for EuroFox operation at Nympsfield is boundary clearance at the west end. The assumption has been made that satisfactory performance east to west will ensure satisfactory performance west to east and whilst the data for this launch direction was collected, it is not presented here. Unusually the trial has experienced predominantly easterly winds and only 35.3% of launches have been conducted east to west. A majority of launches east to west would be more representative of typical conditions. Light moderate and heavy gliders are not a problem in the absence of adverse issues. Very heavy gliders need favourable conditions launching east to west. Occasionally days will occur when a true crosswind will permit operating from either end. In this case if aerotowing is to be conducted and winch launching won't be adversely affected, then launching west to east is to be preferred.

Ordnance Survey maps indicate that at its highest the B4066 along the north west boundary of our field is 20 to 25 feet higher than the usual start point for aerotows launching east to west. The trees on the north side of the road to the north east of the large stand of Beech trees just off the west end of the field vary in height, but are not taller than 55 feet. (Based on comparison with a measured tree.) This suggests that 80 feet of height above the usual east end launch point would be sufficient to clear the trees, albeit with no margin.

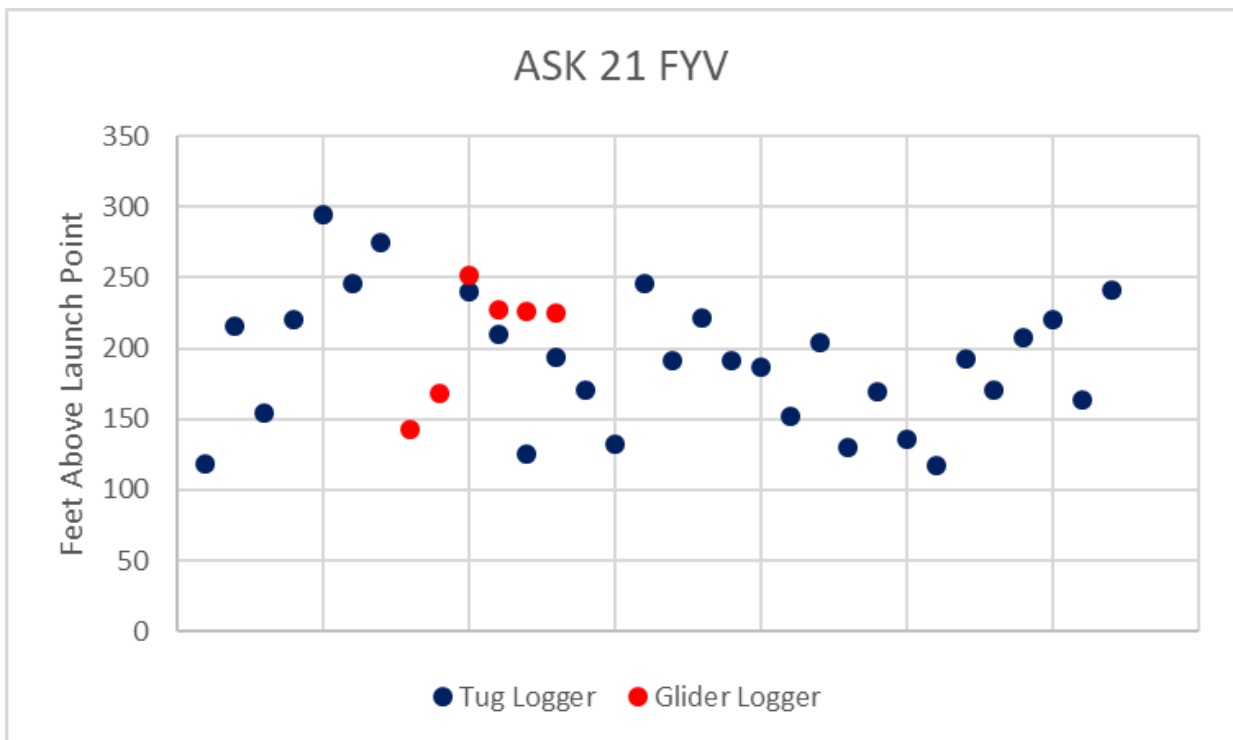
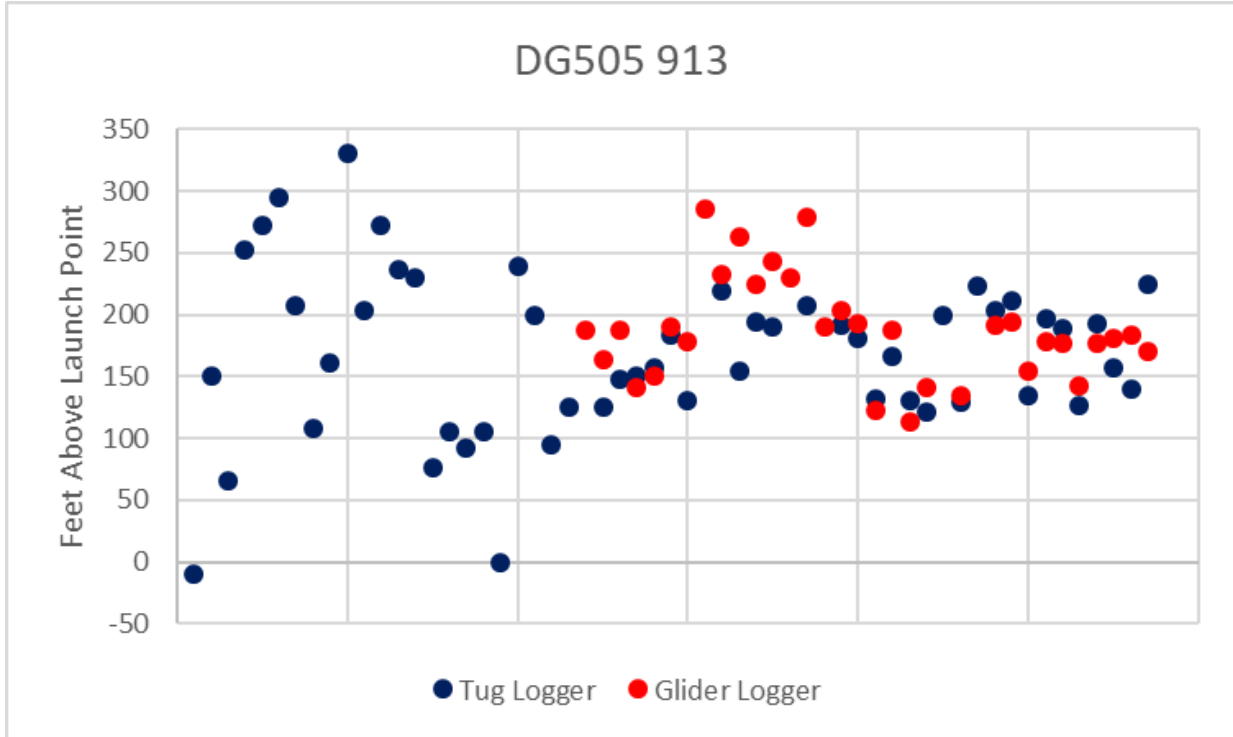
At the outset of the trial the tug was equipped with a logger so that its height over the boundary, climb rate, heights achieved and tow times etc. could be ascertained without the problems associated with human reporting. Inevitably data collection over the trial was incomplete. The tug logger was not connected on some occasions and collection of Flarm Logger data from club two-seaters only commenced in May when it became apparent that the tug logger was not yielding sufficient information.

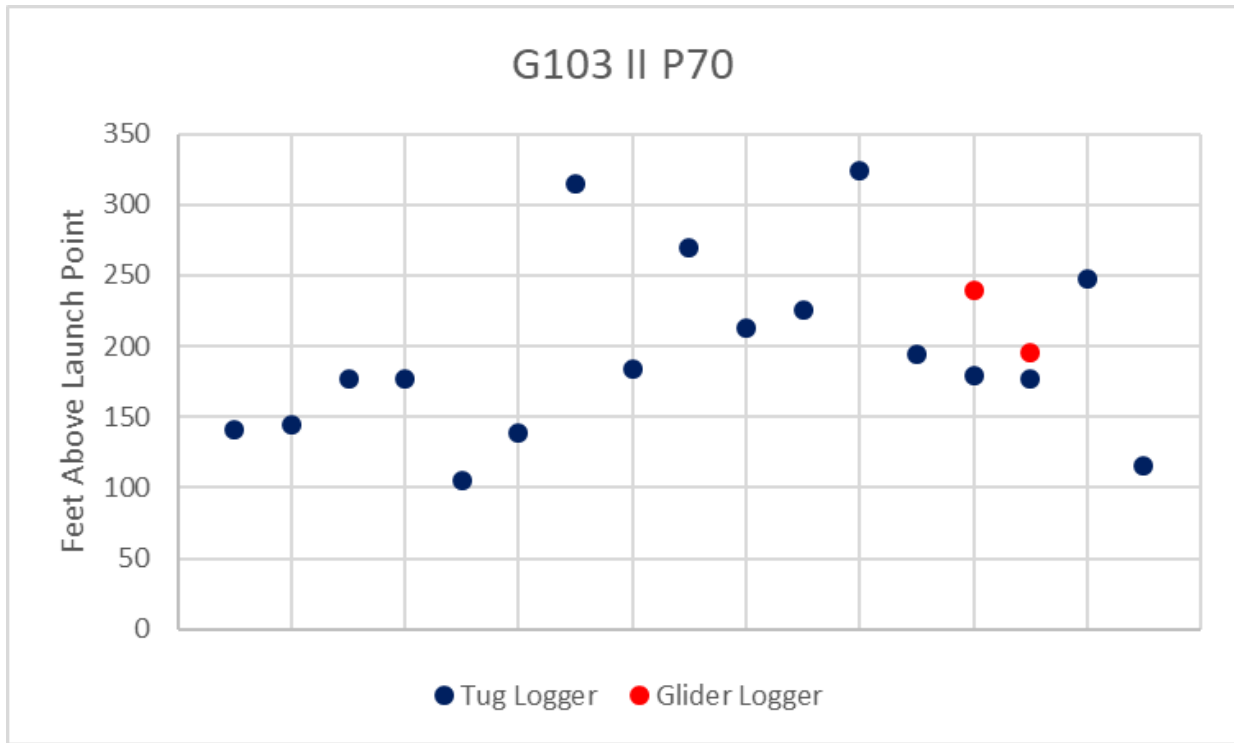
Height from the tug logger is GPS height and from the Flarm logger in the gliders it is barometric height. In the majority of cases there is an encouraging similarity in the figures but it is clear from the plots that some data points from the tug logger must be wrong as they are below the 80 feet discussed earlier, two are below zero. Evidently, in addition to the considerable variation in boundary clearance that might be expected from the wide range of conditions encountered, there is significant 'noise' attached to the data, particularly the tug logger data. Whilst the Barometric Height from the glider loggers should be reasonably free of noise, GPS Altitude from the Tug Logger will be inherently less accurate because the GPS system was never designed to report altitude with the degree of accuracy the trial would like.

Despite the obvious limitations of the data collected the following three plots have been produced. They illustrated the indicated height in feet at the boundary crossed above the point the launch started for east to west launches for the three club two-seaters only. These are the



only types that have conducted sufficiently large numbers of aerotows to meaningfully assess boundary clearance.





The plots indicate that the vast majority of launches were completed comfortably, but the lowest on the Grob II P70, recorded as 105 feet, caused the tug pilot and BI involved some concern. A tow with any combination of aircraft should not be undertaken unless there is believed to be a very high probability of its safe conclusion. Whilst this was achieved on every launch within the trial the margin was felt to be uncomfortably small on a number of occasions. It seems reasonable that we should not be commencing any east to west aerotow unless we expect to be at least 50 feet clear of the trees on the boundary to allow for error and the unforeseen. That suggests being at least 130 feet above the launch point. Also, it is essential, regardless of the site, aircraft or glider that the progress from the start point to a safe height is continuously monitored by both pilots and if the safety margin appears to be in danger of significant erosion, the tow should be aborted in good time.

The average heights above the start point of the launch, in feet, at the boundary for east to west take off for the 3 club two-seaters are indicated in the table below. Logically the Grob 103 II should have a slightly lower average than the K21 given that it is a little heavier, but the small advantage apparent may be due the small sample size for the G103.

	Tug Logger Average (Sample Size)	Glider Flarm Logger Average (Sample Size)
DG505 913	168 (53)	187 (32)
ASK 21 FYV	191 (30)	207 (6)
Grob 103 II P70	196 (17)	218 (2)



3.9 Towing Days Within the Trial: The table below is a very brief resume of the towing conducted, demand for tows and availability within the trial. This has been taken from a very lengthy listing in Appendix 4.

	Days
Trial Duration	248
Maintenance or Repair	17
Holiday/No Attempt to Fly	3
EuroFox Available	228
Flown	84
No Demand	135
Demand but no Pilot	0
Demand & Pilot but not flown	10
Demand & Pilot, Pawnee did or could have, or could have done more than EuroFox.	7

3.10 Conclusions: The pre-trial expectations that the 120 PS EuroFox is not as capable as the Pawnee in rough air or with the heaviest of gliders have been confirmed. Some weather conditions and limitations towing to the west are also a factor. However, based on the trial data and estimates, it can be expected to conduct 93.5% of the aerotows currently provided by the Pawnee.

The EuroFox is not subject to any weather-related difficulties not experienced by other tugs, although it is more sensitive to changes, especially when considering the lower boundary clearance to the west. Whilst all tug and glider pilots need to maintain a careful watch on prevailing conditions, sometimes relatively subtle changes may have effects that are more significant for a EuroFox combination than heavier and more powerful combinations.



4 Financial Case

4.1 Financial Factors: Cost predictions made in this report must be treated with appropriate caution. However, they have been compiled from comprehensive spreadsheet data and employ calculations⁴ that take account of the many factors that distinguish the EuroFox operation from the Pawnee operation. Some factors may change in ways that cannot reasonably be predicted, but the spreadsheet assesses the sensitivity of the calculation to the factors involved. The resulting predictions are robust and insensitive to everything except fuel and maintenance costs. In the case of fuel and maintenance the security of the calculations is only threatened by very large reductions in these costs for the Pawnee and such large changes are not considered credible.

4.2 Fuel Costs: The most significant variable is fuel price. The calculation has assumed a fuel price to the club of £1.335/Litre for 100LL and £1.38/Litre for UL91 including VAT, the latter being the price paid for our most recent delivery early in May. The lower price for 100LL is based on the ratio of 100LL and UL91 prices at the previous delivery time in October 2018.

Lycoming engines can run on either fuel. The EuroFox Rotax engine prefers UL91 or unleaded MoGas. The higher cost of UL91 has been allowed for in the calculation. Should fuel prices rise, for every penny per litre fuel increase approximately £50 per year will be saved. Allowance has been made for the lower overall fuel usage which results in a higher increment per litre being added in order to maintain the fuel installation. (See below.)

4.3 Maintenance: Maintaining LAA aircraft is considerably more economic than maintaining conventional light aircraft, but it is difficult to make a firm prediction regarding unscheduled maintenance. A figure of £3k per year for all maintenance has been assumed which is higher than all the estimates obtained or as a result of the trial. This compares to the £10k plus experienced with the Pawnee.

The trial has used Targett Aviation to service the aircraft, although some maintenance has been completed by experienced members and signed-off by Targett's. Higher savings will be made if the club can operate with an LAA Inspector assisted by suitably capable members. This model works very well at other clubs where maintenance costs are reported to be significantly less than the £3k per annum assumed. However, it is essential maintenance is only conducted by those who are suitably competent and diligent and that they are actively overseen by the LAA inspector signing off the work.

4.4 Pawnee Engine Replacement: An early task completed by the sub-committee was to establish the cost of the replacing the engine in the Pawnee. The quotes following were obtained in April 2018:

⁴ See Appendix 2.



Nicolson McLaren provided a written quote, assuming no major issues are discovered on strip down. An overhaul would mean the club would be without a tug while the work was carried out. An alternative arrangement would be required which would also attract a cost.

- 1) To overhaul our own engine of **£22,665.58 + Test + VAT = £27,396.**

Airparts provided a written quote for:

- 1) A Factory rebuilt engine: **£31,898 + VAT = £38,278**
- 2) A Factory overhauled engine: **£28,119 + VAT = £33,743**

In all cases there will be additional costs for the removal and refitting the engine plus any associated or desirable airframe refurbishment deemed appropriate at the time. A figure in the order of £5,000 should be expected resulting in an **overall budget of at least £35,000.**

(NB. It is probable that at the next annual check it will no longer be able to defer refurbishment of the propeller.)

4.5 Pawnee Disposal: It has been suggested that the club keeps the Pawnee to fly tows that the EuroFox cannot do. It has also been suggested that some members may want to syndicate the Pawnee and operate it as a separate operation. In both cases it would be expensive and cost approximately £7,000 per year to keep it ready, serviceable, insured and available.

If there is a decision to invest in a EuroFox the Pawnee should be sold. A gliding club would be the only potential buyer and it would be more attractive purchase if it can be sold with a useful amount of engine life remaining. (@270 hrs as of mid-June '19.). Waiting until its engine expires is likely to leave the club with an unsaleable airframe.

4.6 EuroFox Engine Fund: Up to June 2019, it was understood that Rotax 900 series engines are limited to 2,000 hours of operation. It is now understood that they will be allowed to continue 'On Condition' past 2,000 hours on a similar basis to Lycoming engines. As this has as yet to be clarified a suitable figure per tow has been calculated on the basis of a fixed 2,000-hour life allowing for the time per tow established in the trial.

4.7 EuroFox Purchase: At the 2018 AGM the Treasurer stated that £30k was 'Ring Fenced' for the Pawnee engine fund. It is assumed that this fund supplemented by money raised by the sale of the Pawnee, commercial loans, member loans, the Phillip Wills Memorial Fund or some combination of them all, will provide the total purchase price. An interest rate of 4% has been used for the calculations but it is expected a lower rate can be achieved.

The Phillip Wills Memorial Fund warrants serious consideration. Its objective is to encourage; "*the promotion of sporting and recreational flying in gliders*". To that end the fund has achieved



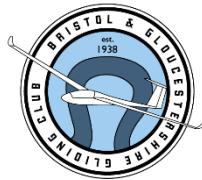
its objectives largely by making loans to BGA clubs at favourable rates to help them with capital projects such as the purchase of land or equipment. So, a substantial change of equipment from Pawnee to EuroFox should form a good case for a loan. Traditionally loans made by the fund are at considerably lower rates than those available commercially.

4.8 Conclusion: Assuming current costs and the club continuing to do a similar amount of tows, a EuroFox, will save more than £15 in fuel and maintenance costs per average tow. Even after more expensive insurance and a slightly higher engine fund a significant reduction in the price of aerotows to members and a larger profit margin for the club will be possible.



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5 Safety

5.1 Type Safety: When Barry Walker originally proposed bringing a EuroFox on site in 2013 and again over the duration of the trial assertions have been made that; 'EuroFox is an unsafe tug'. Every aerotow undertaken unavoidably involves some risk and this must be managed by the pilots to ensure the risk is minimised. A tow with any combination of aircraft should not be undertaken unless there is believed to be a very high probability of its safe conclusion. However, engines can fail, glider pilots can leave their brakes open and misjudgements can and do occur. It is the pilots' responsibility to monitor the progress of every tow regardless of the tug and glider in use and if safety is about to be compromised to terminate the tow before either aircraft is threatened. Aerotowing with a EuroFox will not require any change of approach from a safety point of view although the lower average boundary clearance heights must not be forgotten. A summary of AIB and BGA Accident reports is provided below.

AIB Reports: Since 01/01/2000 6 AIB Reports have featured EuroFox aircraft:

Reg	Description	Location	Owner	Date
G-CIPS	Hit livestock,	Cobbs Cross Airstrip, Worcestershire	<i>Privately owned BMAA⁵.</i>	16/9/17
G-ONIK	Struck obstacle during go around	Cobbs Cross Airstrip, Worcestershire	<i>Privately owned, LAA, non- tug</i>	16/6/17
G-ODGC	R/H Landing Gear Bolt Failure	Eyres Field, Dorset	<i>Dorset Gliding Club owned tug, LAA taildragger</i>	15/10/16.
G-ODGC	Engine Failure	Near Puddletown, Dorset	<i>Dorset Gliding Club owned tug, LAA taildragger</i>	28/5/17
G-CHUP	Runway excursion on landing	Near Hay-on-Wye	<i>Privately owned LAA, taildragger tug.</i>	2/9/14
G-CHUP	Right main landing gear leg failed during landing roll	Shobdon	<i>Privately owned LAA, taildragger tug.</i>	31/3/16

⁵ British Microlight Aircraft Association.



BGA Accident Reports: From 01/10/15 to 30/09/18, the following tugging accidents and incidents were reported to the BGA, these include the two accidents to G-ODGC listed above:

No.	Type	Accident
18	Supermunk	Nose over
110	Pawnee	Upset
116	Citabra	Through hedge on take-off.
120	Pawnee	Mogas vapour lock problem.
7	EuroFox	U/C Bolt failure, one leg folded after T/O. A/C damaged on landing.
61	Pawnee	Restriction of rudder movement due to failed tailwheel landing spring.
86	EuroFox	Engine stopped at 300' on climb (engine subsequently worked)
88	EuroFox	Propeller picked up winch cable as it was taxied over.
111	Robin DR400	Taxied with tow bar attached, prop strike.
116	Robin DR400	Wheel spat fire.
133	Unknown	Tug couldn't stay below glider 60kt max aerotow speed. Glider lost control and diverged,
138	Chipmunk	Engine failure, No. 4 cylinder head broke off.
147	Super Cub	Aborted launch, due to park brake left or kicked on.
158	Robin	Tug upset; glider also had brakes open
164	Supermunk	Partial engine failure, cracked cylinder head.
168	Super Cub	Tail rose, prop strike.
21	Supermunk	Partial engine failure
39	Unknown	Tug Upset
40	EuroFox	Unintended take-off!
46	Chipmunk	Rudder Lock left on, fell off before flight.
60	EuroFox	Engine not developing full power glider waved off. Clogged fuel filter & faulty throttle position indicator.
69	Pawnee	Clipped fence on take-off.
72	EuroFox	Smoke seen coming from Tug. Was actually coolant, radiator cap not refitted correctly.
82	DR400	Collision with K21.
96	Unknown	Propeller touched runway on go around.
127	Robin	Rope dragged through cockpit of airborne glider.
129	Supermunk	Tug shed its spinner on tow.
140	EuroFox	Rope hit parked glider. Pilot forgot to retract rope
159	Pawnee	Tug upset at safe height.
167	EuroFox	Tug Pilot wanted to release but couldn't see the release behind the throttle. Glider had released by the time he found it.

Tugs are all too often involved in accidents and incidents. Given that there are now over 100 EuroFox aircraft on the CAA register of which 27 are tugs, it is clear that EuroFox does not have an unusual safety record.



5.2 Trial Lessons: Trial lessons are made aware their flight is weather dependant. The club will not fly them if the conditions are unsuitable for a first flight, typically; strong winds, low cloud or poor visibility. The duty instructor, BI and tug pilot are responsible for deciding if the weather is suitable. Mid-week trial lessons are instructed to contact the office the morning of their flight to check if the weather is suitable. Weekend trial lessons are contacted by the duty BI the morning of their flight. Operating a EuroFox will be no different to current practice.

5.3 Weak Links: For decades Nympsfield and many other clubs have used 'Mity Links' in their aerotow ropes. This system provides two differing weak links. At the tug end it is nominally 1,100 lbf and at the glider 900 lbf, 499 kgf and 408 kgf respectively. The EuroFox airframe is limited to a maximum 300 kgf weak link and Tost 300 kgf weak links are used at the tug end of the rope. That is 73.5% as strong as our traditional links. To protect against 'fatigue failures' of the weak link the Tost Reserve system is employed where two weak links both of 300 kgf breaking strain are housed in parallel. In effect one is slightly longer than the other and only comes into play should the first fail.

In practice, because EuroFox is typically half the weight of the Pawnee, the probability of a weak link failure is no greater. There has been no indication from the trial that the lower strength weak link is a problem. One set of links was broken in the course of a rather vigorous out of position demonstration by a club two-seater. The two-seater retained the rope which, once the rings and weak link carrier were recovered from the tug, was repaired and returned to service.

There have been a couple of cases of the rope being used the wrong way around, with the weak link at the glider end. Whilst this doesn't hazard the glider, it could result in excessive loads on the tug in the unlikely event of the trailing rope catching in an obstruction.

5.4 Tug Upset: On the 28th of June 2019 a type of 'Tug Upset' occurred. During a BI Course the DG505 was flown well out to the right and into a high position. The position was sufficiently extreme that the EuroFox was slowed down and turned away from the glider. As the glider did not attempt to follow the tug, inevitably, the two aircraft diverged and the glider released. This was intentionally repeated / demonstrated on a second tow. Both occurrences were at a safe height. Clearly if a glider gets far enough out of position this can happen with any tug, but is obviously more likely with heavy gliders and light tugs. There have been no difficulties reported from instructors or tug pilots when the usual out of position training exercises have been conducted.

It should be noted that this particular type of upset is caused by a glider being flown, under control, into an extreme position. It should not be confused with the 'usual' type of Tug Upset where the glider pilot loses control in pitch and effectively 'winch launches' behind the tug. This much more dangerous occurrence happens very rapidly, quickly slows the tug and pulls the tail upwards. Historically this has resulted in tug pilot fatalities in a range of tugs. Whilst lightweight tugs must be more vulnerable to upset, the speed and rapidity of divergence suggests that should the loss of control in pitch type of upset occur any type of tug will be upset.



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6 120 PS EuroFOX Acquisition

6.1 Obtaining a 120 PS EuroFox: There are a number of ways to obtain a suitable aircraft. They are listed below in order of implementation speed:

1. Purchase G-CHUP, if it becomes available at a suitable price.
2. Purchase another 120 PS EuroFox, should one become available.
3. Purchase an existing LAA EuroFox and convert it to 120 PS tug standard.
4. EuroFox are now advertising 100% factory built BMAA 120 PS tugs available as of mid-2019.
5. Build from a new kit to the required standard.
6. Build from a new kit to the required standard and lease G-CHUP during the build period.

Option 1

If the option becomes available it would be the easiest route to take. The price is unknown, but presumably somewhat less than a new example. It is insured @ £80,000 for the trial period.

Option 2

This could also be a quick route, but it is unlikely that such an aircraft would be become available in the short-term.

Option 3

This may or may not be time or cost effective.

Option 4

This would also be an easy course to take, but although an identical tug, the aircraft is a microlight BMAA aircraft and not an LAA aircraft. However, BMAA flight times do not count towards PPL renewal and the full implications of this are not yet understood. Depending on the exact specification the price is £85k to £90k including VAT.

Option 5

This would provide the best standard of aircraft required and form a team of individuals who would hopefully be minded to maintain it into the future. Unfortunately, it seems unlikely that from receipt of the kit to release to service would be less than a year, more probably 18 months. The price of the kit is the same as the Ready Built microlight tug as noted above £85k to £90k including VAT depending on specification. Delivery time is 15 to 16 months.



Option 6

Lease (or buy) G-CHUP. Place an order and build a new kit. Terminate (or sell) G-CHUP lease when the new aircraft is brought into service. Leasing would provide a cost-effective approach and provide the benefits of option 5.

The swiftest route, if it becomes available, would be to buy G-CHUP. The slowest route to build a new aircraft in kit form. Introducing the aircraft to club use in as short a period as possible has the merit of retaining the highest value in the Pawnee and commencing a substantially more economic aerotow operation sooner rather than later.

6.2 Timing of the Change: A prompt decision on what course to take is advisable. Delaying will inevitably result in an increase in costs for all options. EuroFox prices can only increase and the Pawnee will attract a higher resale value with a useful number of engine hours remaining.



7 Conclusions and Recommendations

The primary question the sub-committee asked itself was; “*Was it appropriate to continue aerotowing at Nympsfield?*” The answer was a unanimous Yes. The sub-committee also recommended that the club should take advantage of Barry Walker’s offer to use his 120 PS EuroFox to conduct an extended evaluation compared with the Pawnee. After analysing the trial and financial data and the potential effect of external threats the sub-committee conclude:

Club membership is declining and the demand for aerotows decreasing. As at July 2019 Club records show 129 paid-up members, which represents approximately 78 actual flying members (See Appendix 5.) The average number of aerotows for 2015 - 2017 calendar years was 1,007, although this increased to 1,236 in 2018. Over the 2015 – 2017 period an average of 348 Trial Lessons a year were flown and these members purchased on average a further 37 aerotows per year.

The club is facing increased competition from its closest neighbour, the Cotswold Club at Aston Down. Until recent years this was a winch only operation, but they now operate a privately owned EuroFox tug with another planned to join next year. Aston Down already provides aerotow launches more cheaply than the BGGC and also advertise aerotow trial lessons at a significantly lower price than the BGGC⁶. They flew 512 aerotows in the 2016/17 BGA year and due to a successful competition, 796 in the 2017/18 year. Any previous advantage the BGGC had with its ‘exclusive’ aerotow operation has passed. The club must be able to compete financially or risk further decline.

Whilst a 120 PS EuroFox is not capable of providing all the launches a Pawnee can, it is capable of meeting the vast majority of demand at a significant saving in both fuel and maintenance costs. A 120 PS EuroFox has an overwhelming financial advantage which can deliver lower cost launches for members and trial lessons and a higher profit margin for the club.

Operating a EuroFox may change the nature of aerotowing and it will be necessary to monitor the effect on both winch and aerotow launching, although it is not anticipated that significant changes will occur. It should also be acknowledged that an increasing demand for LAA and Rotax engine aircraft should result in improved variants or new types in the future. The suitability of EuroFox should be kept under review to ensure that as changes occur within the club or to the regulatory environment the club responds promptly and appropriately.

Given the clear economic advantages of operating a 120 PS EuroFox the Club must decide if it is acceptable to lose 6.5% of tows in exchange for the considerable financial benefit to the club and the membership as a whole. Whilst 6.5% is a modest loss it is regrettable that most

⁶ The Cotswold GC pay the private owner of a 120 PS EuroFox £18 for a 2k’ tow and charge their members £24. They advertise aerotow trial lessons at £85 against our charge of £109.



of the loss will affect just a few types and hence a few members. rather than the membership as a whole.

Even the proposal to conduct a EuroFox trial attracted some localised criticism. If the committee support the Short-term recommendation, all valid concerns will need to be addressed and a clear case for the recommendation made. The short and longer terms recommendations are:

- 1. In the Short-term:** The club should acquire a 120 PS EuroFox and as soon as possible and dispose of the Pawnee whilst it has engine time remaining.
- 2. In the Medium-term:** The club should carefully monitor any changes in the volume or nature of aerotowing and winch launching, either as a result of the short-term recommendation or otherwise and respond appropriately in good time and in the best interests of both membership and club. Additionally, it should ensure that an 'Airframe Fund' in addition to an 'Engine Fund' is operated to facilitate future requirements.
- 3. In the Longer-term:** The club should monitor ongoing technical improvements in aircraft or equipment that develop and any regulatory changes that may prove advantageous to our aerotowing operation.

The short-term recommendation proposes a significant change for the club. The medium and long-term recommendations can be regarded as advice to apply common sense and good practice. The remainder of this report contains the detail of sub-committee's work and **must** be considered concurrently with the previous summary sections and conclusions. The sub-committee is unanimous in its conclusions and subsequent recommendations.



Appendix 1: Previous Years Flying

Background: It was necessary to understand what aerotows the club was providing to whom, in what aircraft and when, in order to assess what changes might result from any recommendations made. Thorough understanding of our aerotow operation is also an essential pre-requisite to any costing exercise.

Data: The tables below illustrate the state of our aerotowing operation over several years immediately prior to commencement of the Future Aerotowing Sub-Committee.

Total Aerotows Provided - 01/01/15 to 31/12/17:

	2017	2016	2015	Average 2015-2017
Tows	1,001	994	930	975
Max height	6,000	7,500	5,000	
Min height	600	700	450	
Average height ft	2,428	2,452	2,340	2408

Aerotow Payees: The tables below indicate who the customers for aerotows in 2015, 2016 and 2017 were. The largest customer by far being the club itself in providing Trial Lessons and aerotows to Solo & Beyond members. 'Trial Members' are temporary members flying on Trial Lesson membership, either on their initial flight, or subsequently.

	Trial Members	Initial T/L	Average Height ft.
2017	372	332	2,573
	37.2%	33.2%	
2016	387	360	2,522
	38.9%	36.2%	
2015	397	352	2,391
	42.7%	37.8%	
Total for 2015 – 2017	1,156	1,044	2,494
	39.5%	35.7%	



	Temp Members	Average Height ft
2017	101	2,071
	10.1%	
2016	97	2,063
	9.8%	
2015	41	2,429
	4.4%	
Total for 2015-2017	239	2,130
	8.2%	

	Private	Average Height ft
2017	274	2,214
	27.4%	
2016	222	2,246
	22.3%	
2015	210	1,972
	22.6%	
Totals for 2015-2017	706	2,152
	24.1%	

	Club 2-Seat Non-trial or Temp	Average Height ft
2017	205	2,678
	20.5%	
2016	252	2,716
	25.4%	
2015	260	2,554
	28.0%	
Totals for 2015-2017	717	2,646
	24.5%	



	Club Single Seaters	Average Height ft
2017	49	2,229
	4.9%	
2016	36	2,161
	3.6%	
2015	22	2,232
	3.7%	
Totals for 2015-2017	107	2,207
	3.7%	

Types by Weight: The list of different types towed is lengthy. In view of the high significance of weight, the types flown over the 2015 – 2017 period have instead been grouped by weight.

The following (arbitrary) groupings by typical launch weight have been made:

	kgs	lbs
Very Heavy	>675	>1488
Heavy	550>675	1213>1488
Moderate	425>550	937>1213
Light	<425	<937

‘Typical Launch Weight’ is empty weight plus 90 kg per pilot plus 10 kg fuel where appropriate. In other words, it is the typical dry launch weight for the type. Three of the four club two-seaters employed over this period have no ballast facility. The fourth, the DG505 which is equipped for ballast in practice only uses tail ballast. Most single seaters can carry ballast, which typically may move them up a weight group, but the vast majority of launches, even in good conditions, are dry. The launches provided over the 01/01/15 to 31/12/17 period break down as below:

Very Heavy	3.8%
Heavy	64.7%
Moderate	8.3%
Light	22.2%
Unknown	1.1%

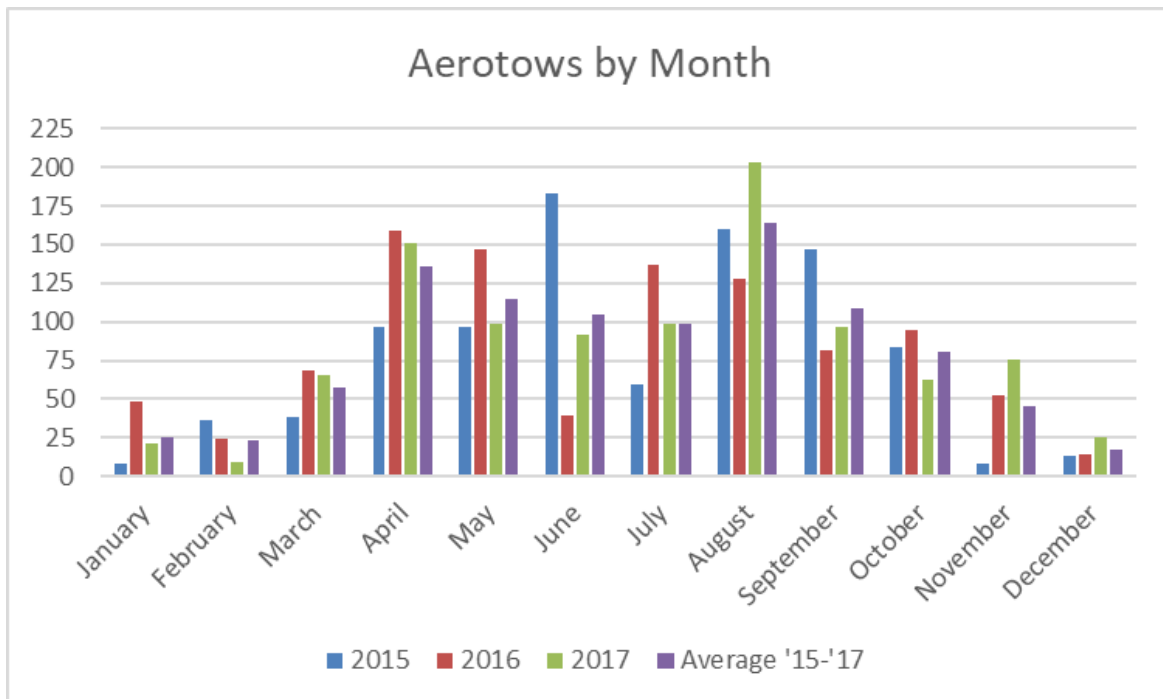
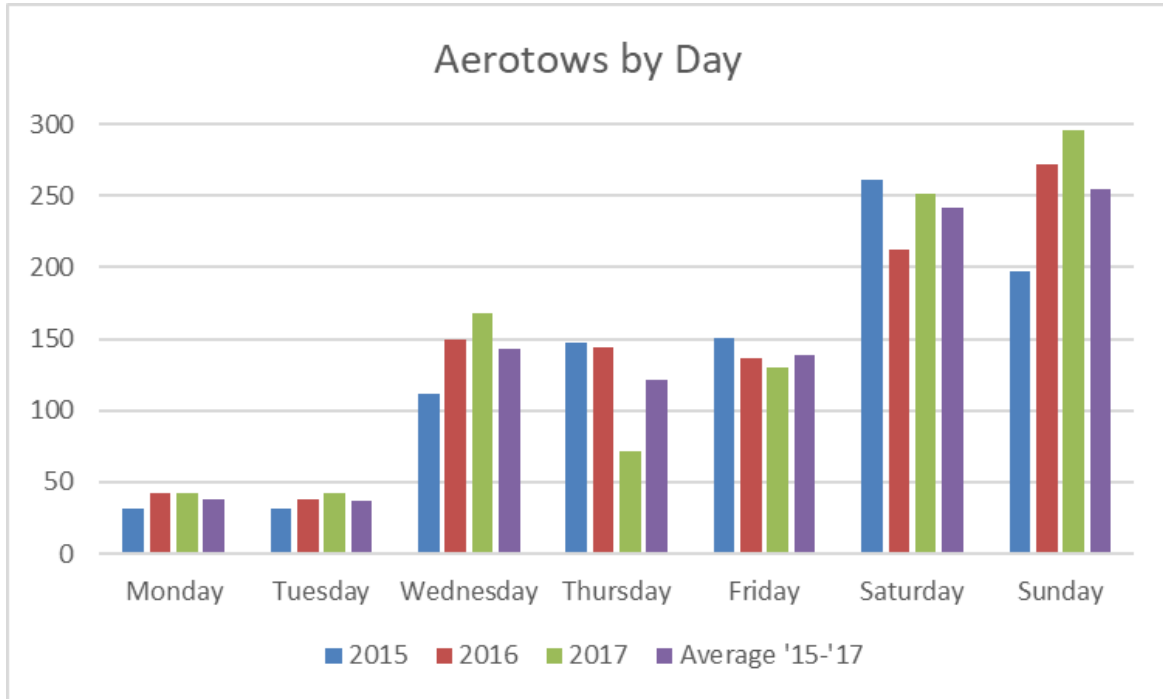
Of the four private two-seaters on site over the 2015/2017 period, three, the Arcus T, Arcus M⁷ and Nimbus 3Dt fall into the Very Heavy Class and took 3.8% of aerotows. The Duo Discus

⁷ The Arcus M is no longer on site and the Duo Discus on site has been replaced by a Duo Discus T which is ‘Very Heavy’.



are in the Heavy group and took a further 1.8% of the launches. Therefore, privately owned 2-seaters took 5.6% of the aerotows.

When We Aerotow: The two plots below indicate aerotows by day and month.





Launch Availability: The availability of launches, both aerotow and winch for a 4-year period, 2013 to 2016.

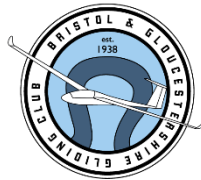
	Aerotow Days	Winch Days	Both Days
01/01/13 - 31/12/16	567	791	506
2013	147	201	130
2014	145	193	128
2015	120	183	108
2016	155	214	140
Average per Annum	142	195	126

Winch launching was conducted on 89% of aerotowing days and aerotowing on 64% of winching days.



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Appendix 2: EuroFox 120 PS – Pawnee Financial Comparison

Objective: This Appendix lays out the financial case for operating a 120 PS EuroFox compared to our current Pawnee. It does not attempt to debate the desirability of employing a EuroFox from a practical or performance point of view, these matters being dealt with elsewhere in this document.

The financial differences between Pawnee and EuroFox operations are examined to ensure that the full financial implications of the Short-term Recommendation can be understood. Except where stated all costs are those current including VAT, no attempt having been made to allow for the effect of future inflation.

Background: Traditionally the provision of aerotowing has been an expensive matter. Historically the BGGC operated two tugs and often made use of others, either from outside the club or aircraft based on site and at its peak in the '80's & early '90's provided more than 6,000 launches in some years. With the introduction of a modern winch and modern winching practices in the early '90's and a long slow reduction in membership, the demand for aerotows has dropped considerably and in the latter years of the current decade has settled at approximately 1,000 launches per year. This lower level of activity has resulted in the club operating just one tug from 2014, but despite that the modest number of launches required still results in considerable fixed cost attached to each launch.

The Future Aerotowing Subcommittee was formed in early 2018 prompted by the knowledge that the clubs current tug, Pawnee G-NYMF, was running out of engine hours and would require a new or refurbished engine in a few years which was clearly going to be a very expensive exercise. If this or any other course is to be taken it is essential that it is correct for the club and as far as is possible, all its members.

Financial Factors Considered

Aerotows Provided per year: The number of aerotows per year has a direct effect on the significance of fixed costs, which with aerotowing tend to be high. The more tows that can be conducted the lower the cost per tow.

Trial Lessons per year: The number of trial lessons conducted per year is significant. Over a third of aerotows are purchased by the club itself to support trial lessons. This means that any lowering of the price to members, as is anticipated with a EuroFox operation, will be considerably less costly to the club than it would be if all the tows provided were to members.

Solo & Beyond Membership: Provision of this class of membership will, assuming the member takes all their included flying, cost approximately £70 less for the club to provide. As of mid-June, '19 there were 10 Solo & Beyond Members and all were active.



Fuel Consumption: The club's existing Pawnee uses, on average 8.320 Litres of fuel per 2,000 feet of height towed. The trial has indicated that a 120 PS EuroFox uses on average 3.353 Litres of fuel per 2,000 feet of height towed. 2,000 feet is usually considered a normal tow, however, the average tow height provided over the years 2015, '16 & '17 was 2,407 ft. In the trial it was 2,373 ft. As a result, the fuel used for an average tow of 2,407 ft is 10.013 L for the Pawnee and 4.035 L for the EuroFox.

Fuel Cost: Fuel is the most expensive item in the aerotow budget. The club's most recent Avgas UL91 delivery in May 2019 cost £1-38 per litre including VAT. Both the Pawnee and EuroFox can run on UL91 but the Pawnee could also run on 100LL Avgas (Leaded fuel) which is slightly cheaper. The equivalent current cost of 100LL Avgas, using the October 2018 UL91/100LL Avgas ratio, is £1-33.5 per litre. Turbo Gliders (Solo engines), Rotax-engine aircraft, the club's golf buggies and most Lycoming engines operate best on unleaded fuel (UL91).

Cost of Fuel Installation: It has been assumed that if the club did not have an aerotow operation it would not operate an Avgas facility. Therefore, the costs of the fuel installation need to be recouped from fuel users and a cost per litre of Avgas has been calculated for both Pawnee and EuroFox operations. Perversely, because a Pawnee operation would use nearly 6,000 litres of fuel more per year, the uplift per litre is significantly lower.

The trial period fuel logs show a large proportion of Avgas is used by other users - Targett Aviation aircraft, club Turbo gliders, retrieve vehicles and visiting aircraft. Fuel usage over the trial period was as follows:

User	Fuel Used
EuroFox	58.3%
Targett Aviation	14.2%
Buggies	12.0%
Other	15.5%

Fuel purchased for anything other than club use is surcharged at @20p/litre.

Aircraft Maintenance: The club has excellent records for the cost of Pawnee maintenance. Over its last 10 years of operation (making allowance for inflation) it has cost £10,478 per year. This includes all scheduled and unscheduled maintenance and the EASA Tug BGA Airworthiness Support Fee. The 8-month trial period was not sufficient to establish an accurate long-term figure for EuroFox maintenance, although it has provided a sound understanding of potential costs.

EuroFox scheduled checks, eg. 50-hour, 100-hour etc. are considerably cheaper than similar checks on EASA aircraft. Unscheduled maintenance also appears to be significantly lower,



although given that by definition it is unpredictable in nature, it is not possible to be certain in this area. Unscheduled repairs completed during the trial support the EuroFox low maintenance overhead forecast, even the unfortunate nose over in January resulted in a bill of less than £3,700 and just 11 days out of service. An average annual maintenance budget of less than £3,000 should comfortably address the scale of the club's aerotow operation @1,000 tows-per-year, although unusual unscheduled events could make individual years more expensive.

Under limitations applicable to the trial there was a limit to how much maintenance the club was allowed to do. LAA aircraft have an owner's maintenance schedule which allow the owner to complete and sign-off specific and itemised maintenance tasks. Tasks which fall outside this remit must to be signed-off by an LAA inspector. As owners, more will be possible and this will further assist in reducing maintenance costs. However, it must be stressed that all maintenance must only be conducted by competent and diligent individuals and always with the agreement and oversight of an LAA Inspector.

BGA & LAA Annual Charges: Any club operating an EASA tug, such as the Pawnee must pay a BGA EASA Tug BGA Airworthiness Support Fee, currently £162 per annum. A Club operating an LAA tug must pay a Corporate Membership Fee of £150 and a Permit to Fly renewal Fee of £200 per year.

Replacement Engine Costs: In 2018 the cost of replacing the Pawnee's engine were investigated and it was established that a refurbished 'Zero Timed' engine would cost not less than £27,396. Further costs associated with removing the existing engine, re-fitting the new engine and associated costs would likely result in a total bill of at least £35,000.

Currently the modified Rotax fitted to G-CHUP would cost £30,000 to replace and there would be some further cost associated with the physical exchange of powerplants, but these would be significantly less than those associated with changing a Lycoming engine. £2,000 has been assumed.

Engine Life: The nominal life of Lycoming engines is 2,000 hours but they can continue 'On Condition'. This involves a decrease in the service interval and regular compression checks. In practice there can be a large difference in how long engines continue 'On Condition'. Most problems can still be repaired, but at some point, further repairs become uneconomic. A further 200 hours may be regarded as typical, but it might be significantly more or less.

The nominal life of modified Rotax engines was understood to be 2,000 hours when it would need to be replaced, but it now appears that it is possible to continue 'On Condition' in a similar fashion to Lycoming engines. However, the conditions imposed and the desirability and practicality of life extension for a tug engine is as yet unknown. Therefore, for the purpose of costing, a 2,000-hour life has been assumed.



Airframe Depreciation: In order to replace major equipment within the club it is usual to make a 'depreciation' charge in order to build up a replacement fund. This is based on the value of the equipment and its anticipated life. In the case of EuroFox it is suggested that the airframe, not including engine, is valued at £50,000 with an anticipated life of 20 years. It is suggested that money accrued by depreciation of significant assets such as tugs (winches & gliders etc.) should be subject to 'Ring Fencing' in the fashion of 'Tug Engine Funds' to ensure its availability at the appropriate time.

Insurance: The most recent insurance bill for the Pawnee was £2,000 for a year. The EuroFox cost £2,000 to insure for the trial, but that covered from the 26th of November '18 to 30th of September '19. An annual rate of £2,363.

Loan Interest Rate: Given the current lack of a tug replacement fund it appears possible that a loan may be required to purchase a EuroFox. It is assumed that a mixture of Members and Bank Loans will be obtained. However, it is strongly recommended that a Phillip Wills Memorial Fund Loan be investigated. This type of project fits very well into their objectives and a loan from them is likely to be at rate lower than commercially available.

Residual Value of the Pawnee: It is very difficult to know what the club's Pawnee will be worth when the time comes for its disposal. In practice it is likely to be worth value of the remaining life of its engine plus whatever its airframe is worth. It will be a more attractive aircraft to purchase if it remains a 'Going Concern', i.e. with a useful amount of engine life remaining. It should currently be worth not less than £6,000 and hopefully more than £10,000.

Residual Value of 120 PS EuroFox: In the unlikely event that the club find, that after a year or two's experience, it would prefer another type of tug, it is probable that a 120 PS EuroFox would prove easy to sell. It is likely to remain an attractive proposition for any club still operating traditional light aircraft tugs which are more expensive to operate or to the general aviation community as an economic 2-seat tourer.

Engine Fund: An engine fund has been maintained for replacement of the Pawnee's engine and as of the 2018 AGM stood at £30,000. It is assumed that this sum will be transferred toward purchasing a EuroFox.

For comparison with EuroFox operation a calculation has been made as to how much each tug should recover from each launch to accurately maintain an engine fund. Taken into consideration is engine life and the time taken to conduct a tow. In the case of the Pawnee it is known that it can do 7.21 average launches per engine hour of logged towing time. (Based on 7.86 2,267 ft launches per logged hour.) If an engine life of 2,200 hours is assumed then a new engine will be required every 15.7 years.

A condition of the EuroFox trial was to record service to tachometer time and not flying time (as used by the Pawnee). The tachometer in G-CHUP records flight time from engine start to engine shutdown. Flying time records take-off to landing time. Recording tachometer time in



this form results in regular checks being conducted more frequently and it also returns less than 4 average launches per tachometer hour. Measured by the usual method it completes 6.25 average launches per hour so, allowing for the average tow height an engine life of 2,000 hours and 1,000 tows-per-year a new engine will be required every 12.5 years.

If the club were to operate a EuroFox the tachometer should be reset to record engine time in the usual accepted aviation fashion. The time recorded being directly proportional to the number of revolutions the engine has made.

Significance of Financial Factors

Fuel: Is the largest cost of providing an aerotow with a Pawnee or EuroFox. Fuel consumption is as follows:

	'Standard' Tow 2,000 ft	Long-term Average Tow 2,407 ft
Pawnee	8.320 L	10.013 L
EuroFox 120 PS	3.353 L	4.035 L

The cost of the above based on May 2019 fuel cost is:

	'Standard' Tow 2,000 ft	Long-term Average Tow 2,407 ft
Pawnee UL91	£11.48	£13.82
Pawnee 100LL	£11.11	£13.37
EuroFox 120 PS	£4.63	£5.57

As noted above EuroFox needs UL91, the Pawnee can run on 100LL which is slightly cheaper. Allowing for the slightly cheaper fuel the Pawnee might use, EuroFox is £6.48 cheaper to fuel for a 2,000-foot tow and £7.80 cheaper for an average tow. Given an annual average of 1,000 tows £7,800 would be saved on fuel if the Pawnee were operated on 100LL Avgas or £8,250 if on UL91.

Aircraft Maintenance: Aircraft maintenance is the second most expensive item in aerotowing. Records indicate that over the last 10 years the average cost of maintaining the Pawnee has been £10,478⁸. As previously noted, the trial did not establish annual maintenance figures. However, a good understanding has been gained and Appendix 2 details the logic behind an estimated figure of an average £3,000 per year. On that basis operating a 120 PS EuroFox rather than a Pawnee would save £7,478 annually.

Replacement Engine Funds: Appropriate funds to replace each engine at the end of its life have been calculated. The EuroFox requiring that an extra £353 per year is set aside due

⁸ In view of the lengthy period over which Pawnee maintenance records are available the average of CPI & RPI inflation has been factored in. Without that factor the average was £8,418.



to it doing slightly less tows-per-hour and the assumption being made that its engine will not continue 'On Condition'.

Fuel Installation Charges: Recent Electrical Testing cost £264 and is required annually. Pressure Testing is required bi-annually and cost £588 in July 19. The club should be aware that its fuel installation is old and will require replacing, likely as a result of a pressure test failure. It must manage this event and contribute to a replacement 'Tank Fund' and £1k per year would seem a sensible minimum. The Petroleum Storage Certificate costs £60 per annum. A total of £1,618 per annum. A calculation has been made to recover these costs from the fuel dispensed. Fuel logs were collected throughout the trial to establish how much fuel went where. Due to the significantly lower volume of fuel consumed by a EuroFox operation it contributes more per litre, but less overall.



Aerotow Cost: The table below indicates the best understanding of the cost of providing aerotows with the Pawnee or a 120 PS EuroFox. It is taken from a spreadsheet: BGGC Aerotow Cost.xlsx

B&GGC Pawnee & 120PS EuroFox Aerotow Costs

Tows/yr:	1,000
Average Tow Height kft:	2.407
UL91 £/L:	£1,380
Fuel Installation/yr:	£1,618
Non-Towing Fuel L/yr:	2,550

	Pawnee	120PS EuroFox	Difference	Saving/Yr
Average Tow Cost:	£31.13	£17.31	£13.82	£13,822
2k' Tow Cost:	£25.87	£14.39	£11.48	

Pawnee L/2k Tow:	8.320
EuroFox L/2k Tow:	3.353

Fuel Installation Charge £/L:	£0.13
Fuel Instalation Charge £/L:	£0.25

Pawnee Annual Maintenance:	£10,478
EuroFox Annual Maintenance:	£3,000

Pawnee Insurance:	£2,000
EuroFox Insurance:	£2,362

EASA Tug BGA Airw'iness Support:	£162
Annual LAA Corporate Memb'ship:	£150

Pawnee Engine Replacement:	£35,000
Pawnee Average Tows/Engine Hour:	7.2
Lycoming Life Yrs:	15.9
EuroFox Engine Replacement:	£32,000
EuroFox Average Tows/Engine Hour:	6.25
Rotax Life Yrs:	12.5

Pawnee Airframe Value:	£20,000
Pawnee Airframe Depreciation:	5%
EuroFox Airframe Value:	£50,000
EuroFox Airframe Depreciation:	5%

Rope & Weak Link Costs/yr:	£180
----------------------------	------

£13.82
£5.57
£1.29
£0.99
£10.48
£3.00
£2.00
£2.36
£0.16
£0.15
£2.21
£2.56
£1.00
£2.50
£0.18
£0.18

The costs are based on use of UL91 by both tugs and compares 'like for like'. An allowance has been made for airframe replacement in both cases. This has not in fact been the practice with the Pawnee. However, it is strongly recommended that it should be henceforth.

The spreadsheet indicates that the provision of aerotows by a 120PS EuroFox compared to the club's Pawnee will save £11.48 for a 2k' tow and £13.82 for an average tow of 2,407kft.



Further, it must be remembered that any reduction in the price of launches made to members as a result of these savings only applies to the approximately 60% of launches not used by the club to provide Trial Lessons and Solo & Beyond memberships.

Financial Conclusion: Changing to a 120 PS EuroFox operation will make it possible to offer members aerotows at a significantly lower cost than with the Pawnee whilst also allowing a higher profit margin for the club.



Appendix 3: EuroFox 120 PS Annual Maintenance Estimate

Scheduled Maintenance: It is anticipated that the tows required annually can be completed in less than 175 flying hours. The following maintenance is scheduled:

- 50-hour checks
- 100-hour checks
- 200-hour checks
- Annual Check
- Gearbox Check – Required at 600 hours. (Interval unclear, may be 1,000 hours.)
- Propeller Check – Required at 800 hours.
- Undercarriage Securing Bolts Replacement - At every 500 hours or 1000 landings. (Suggest every 500 landings.)

The box below has been taken from the Eccleston Aviation's⁹ website on the 18/04/19 and gives a good indication of what engine servicing should cost. (Targett Aviation currently charge £45 per hour + VAT). Engine servicing should average less than £700 per annum including a gearbox check every third year.

Additionally, the Airframe requires inspection at the same intervals. If the four checks per year take 5 hours at £45 per hour plus VAT then a further £1,080 would be required.

EuroFox UK have stated that the cost of the propeller check is “*No charge except freight to France and any tidying up needed.*” In January '19 shipping a replacement propeller cost £40, so an estimate of £200 has been assumed. Less than £50 per year.

Replacing the undercarriage bolts should not take more than an hour, so a further £65 twice a year should cover this task.

The total of the above scheduled maintenance averages less than £2,000 per annum.

The above assumes that all maintenance is conducted professionally, but in practice some of the above, routine 50-hour and possibly all or part of the 100-hour checks and changing undercarriage bolts could be accomplished by suitably competent and diligent members under the guidance and supervision of an LAA Inspector.

⁹ Rotax & Edge Performance Agents.



Eccleston Aviation LTD

Prices (18/04/19)

Rotax 912 Servicing

Typical fixed wing inc. Vat

25hr £200

100hr £200

200hr £250

Prices Include: Oils, Oil filter, consumables, Labour, Spark plugs as required by maintenance manual.

Labour rate is £42 + vat (£50.40)

Rotax 912 Series Gearbox servicing inc. Vat

Gearbox Servicing Pricing (may be more if parts are req.)

Rotax 912uls with slipper clutch 1000hours £160

Rotax 912uls with slipper clutch 600hours £140

Unscheduled Maintenance: By definition Unscheduled Maintenance is hard to quantify, at best only an educated estimate can be made. Discussion with tug pilots including the tug master at the Yorkshire Gliding Club, who have by far the most EuroFox experience, indicate remarkably little has been required there. Within the trial four unscheduled matters arose. By far the most serious was a nose over on the 4th of January. Also, there was an issue with the Coolant Temperature gauge, a failed rudder cable required replacement at the first 50-hour check and at the 100-hour check a cracked seat pan required repair. It is hoped that the nose over proves to be an extremely rare occurrence. There is no reason to suppose that EuroFox even in its most powerful form is prone to this sort of accident. The total cost of the repair following the nose over was £3,651.49 of which the club paid £750 (the 'insurance excess'). The rudder cable repair cost £152. The repair of the cracked seat pan cost £141.

Trial Maintenance Cost: Five invoices have been received from Targett Aviation:

- | | | |
|--|-----------|---------------------|
| 1. 25 hr Check: | £75.92 | |
| 2. Repair following Nose Over accident: | £3,651.49 | (£750 paid by club) |
| 3. 50 hr Check & rudder cable replacement: | £521.64 | |



- | | |
|--|---------|
| 4. 100 hr Check, repair of cracked seat pan & adjustment of Flaperon bushes on one wing: | £709.20 |
| 5. 50 hr Check: | £347.70 |

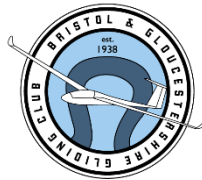
Amounts of coolant and oil employed to top up during the trial have been extremely small, in contrast to the sizeable quantities of oil required by Lycoming engine aircraft.

Annual Maintenance Cost: Only long-term operation can give a true measure of maintenance costs, but it would seem reasonable based on the above to budget for an average of £3,000 per annum. (NB. That is an average, there will no doubt be good and bad years.)



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Appendix 4: EuroFox 120 PS Trial – Final Report

Launches Conducted: The trial commenced on the 26th of November 2018 with the first tow on the 30th of November and terminated on the 31st of July. Of 248 days, the club made no attempt to operate on 3 days, the aircraft was undergoing maintenance on 17 days and available 228 days. 546 launches and 6 aerotow retrieves were conducted on 84 days.

Total Tows:	546	
Tows East to West:	193	
Tows West to East:	353	
Club Two-Seater Tows:	301	
DG505:	178	
K21:	82	
Grob G103 II:	41	
Tows heavier than the DG505:	14	
Tows lighter than the DG505:	354	
Trial Average launch height from Tug Logs:	2,373 ft.	
Average Fuel per Average Trial Launch:	3.978 L	
Fuel Cost per Trial Average Launch:	£5.49	UL91 Avgas at £1-38/L
Average Fuel per 2k' launch:	3.353 L	
Fuel Cost per 2k' launch:	£4.63	UL91 Avgas at £1-38/L
Average Flight Time per average Launch:	9 mins 36 secs.	
Average Time per 2k' launch:	8 mins 6 secs.	

In addition to the launches within the Trial listed above, the aircraft has conducted 6 aerotow retrieves, a number of post check and propeller setting up flights and numerous familiarisation flights, but they total less than 8.3 hours flying.

For comparison the figures below relate to the Pawnee G-NYMF.

Average launch height from Tug Logs:	2,407 ft	
Average Fuel per Launch:	10.01 L	
Fuel Cost per Average Launch:	£13.37	100LL Avgas at £1-33.5/L
Fuel per Trial Average Launch:	9.87 L	
Fuel Cost per Trial Average Launch:	£13.17	100LL Avgas at £1-33.5/L
Average Fuel per 2k' Launch:	8.32 L	
Fuel Cost per 2k' Launch:	£11.11	100LL Avgas at £1-33.5/L
Average Flight Time per Launch:	8 mins 32 secs.	
Flight Time per Trial Average Launch:	8 mins 17 secs.	
Average Time per 2k' launch:	7 mins 6 secs.	



Aerotow Payees: The table below indicates the payees for the launches provided in the trial. Also, 5 aerotow retrieves were supplied to privately owned single seaters and 1 to a private two-seater.

Club Gliders	330	60.4%	Includes BUGC Astir.
Club Two-seaters	299	54.8%	
Club Single Seaters	31	5.7%	Includes BUGC Astir.
Non-Club Gliders	216	39.6%	
Non-Club Two-seaters	13	2.4%	
Non-Club Single Seaters	203	37.2%	

Fuel Consumption: Within the trial a careful record of all the flying conducted was kept by reference to the Tug Logs and the fuel consumed by reference to the Fuel Logs. The club charges for aerotows by height as recorded on the Tug Logs and these demonstrate an excellent correlation with logger records, significant differences being rare. Fuel consumption was calculated by dividing the total fuel used providing launches by the total height provided. As some non-launching flying was conducted, conversion, aerotow retrieves etc., an allowance for this was made. This was based on the Flight Manual fuel consumption figures for the 100 PS Fuel injection Rotax EuroFox increased by 20%. (In line with the increased power of the modified engine.) As non-launching flying amounted to less than 9.1% of the total flying hours the resulting fuel consumption figures are dependable. Compared to providing the same flying with our Pawnee approximately £4,650 in fuel was saved over the duration of the trial.

Notable Trial Events:

Date:	Event:
26/11/18	First Day of Trial.
30/11/18	First tows of trial conducted.
07/12/18	Tug pilot declined to use EuroFox due to blustery conditions.
21/12/18	Tug pilot declined to use EuroFox due to high winds. Probably OK for Pawnee. Gliders winch launched.
24-25/12/18	No flying attempted.
04/01/19	Tug nosed over on start up.
13/01/19	Super Cub flown. EuroFox would have coped with flying, but may have been an issue taxiing down/cross wind. 3 tows.
15/01/19	Tug returned to service. 25 hr check completed whilst aircraft under repair.
21/01/19	Coolant Gauge U/S.
01-03/02/19	Much lying snow on airfield, no aerotowing.
17/03/19	Tug Pilot unfamiliar with EuroFox, would have used Pawnee, too rough for either later.
25/03/19	First tow of Nimbus 3 dt.
30/03/19	Tug out of hours.
01/04/19	Tug to Targett Aviation for 50 hr check. Rudder cable discovered U/S.
02/04/19	Tug returned to service.



Date:	Event:
05/04/19	Strong southerly, Pawnee used. Pilot not cleared for EuroFox. EuroFox could have been used later in day.
12/04/19	Temperature Sender changed. Duo Discus t retrieved from Enstone.
21/04/19	Glider retrieved from Ledbury.
28/04/19	Tug put away after 2 tows due to insufficient margin at west end of field. Could have continued with lighter gliders. Correct technique, staying to N. side of field may have helped.
05/05/19	A noteworthy low exit over the NW boundary reported by tug pilot & BI in the Grob 103 II P70.
11/05/19	Tug Pilot refused to tow east to west. Refused to tow Duo Discus t.
20/05/19	Tug to Targett Aviation for 100 hr check.
22/05/19	Tug returned to service after 100 hr check and repair of cracked seat pan.
23/05/19	Low clearance towing Ventus 2 cxt at 75 kts. (Unnecessarily fast & pilot was using an alternative, inaccurate, ASI resulting in even greater speed.)
01/06/19	Tug Pilot wanted to operate W to E. But given southerly instructor deemed it inappropriate for winching. No aerotowing, 5 trial lessons postponed. Wind veered later, would have been OK from usual E launch point & certainly from NE corner.
18/06/19	Propeller reset. (This proved inappropriate and it was subsequently reset to its original position.)
22/06/19	20 gliders launched West to East including Nimbus 3t, but pilot declined to launch DG505.
27/06/19	Gliders despatched to Black Mountains and 2 later retrieved from Usk.
03/07/19	Duo Discus t refused a tow west to east.
05/07/19	ASI comparison flight made. Conventional ASI as per flight Manual, Dynon under reading.
09/07/19	50 hr check.
12/07/19	Aerotow retrieve from Rendcomb.
16/07/19	K8 & 'Plate' retrieved from Lasham.
21/07/19	Change from DG505 to K21 made as conditions became more difficult.
23/07/19	Strong southerly. No winching, 7 aerotows.
31/07/19	Last day of trial.

Towing Days Within the Trial: The lengthy list below outlines the demand for tows, pilot availability and when EuroFox towing took place. It also indicates when the Pawnee did, or could have done something the EuroFox couldn't have done. An absence of demand indicates that no one required a tow. This may have been just that, no one wanted a tow, or on many occasions weather prevented aerotowing or in some cases any flying.

Date	Demand	Pilot	Flown	Pawnee	Comments
26/11/18	No				
27/11/18	No				
28/11/18	No				
29/11/18	No				
30/11/18	Yes				
01/12/18	No				



Date	Demand	Pilot	Flown	Pawnee	Comments
02/12/18	No				
03/12/18	No				
04/12/18	No				
05/12/18	No				
06/12/18	No				
07/12/18	Yes				1 Tow Requested. Pawnee perhaps.
08/12/18	No				
09/12/18	No				
10/12/18	No				
11/12/18	No				
12/12/18	No				
13/12/18	No				
14/12/18	Yes				
15/12/18	No				
16/12/18	Yes				
17/12/18	No				
18/12/18	No				
19/12/18	No				
20/12/18	No				
21/12/18	No				Very Rough.
22/12/18	Yes				
23/12/18	No				
24/12/18					No Flying - No Rota
25/12/18					No Flying - No Rota
26/12/18					No Flying - No Rota
27/12/18	No				
28/12/18	No				
29/12/18	No				
30/12/18	No				
31/12/18	No				
01/01/19	No				
02/01/19	No				
03/01/19	No				
04/01/19	X	X	X		Aircraft Damaged
05/01/19	X	X	X		Aircraft under repair
06/01/19	X	X	X		Aircraft under repair
07/01/19	X	X	X		Aircraft under repair
08/01/19	X	X	X		Aircraft under repair
09/01/19	X	X	X		Aircraft under repair



Date	Demand	Pilot	Flown	Pawnee	Comments
10/01/19	X	X	X		Aircraft under repair
11/01/19	X	X	X		Aircraft under repair
12/01/19	X	X	X		Aircraft under repair
13/01/19	Yes				Super Cub flown. EuroFox would have coped with flying, but may have been an issue taxiing down/cross wind.
14/01/19	X	X	X		Aircraft under repair
15/01/19	No				
16/01/19	No				
17/01/19	No				
18/01/19	No				
19/01/19	No				
20/01/19	Yes				
21/01/19	No				
22/01/19	No				
23/01/19	No				
24/01/19	No				
25/01/19	Yes				
26/01/19	No				
27/01/19	No				
28/01/19	No				
29/01/19	No				
30/01/19	Yes				
31/01/19	No				
01/02/19	No				Lying snow
02/02/19	No				4 - 5" of lying fluffy snow. Tug operation thought too risky.
03/02/19	No				Snow on airfield, No Aerotows
04/02/19	No				
05/02/19	No				
06/02/19	Yes				
07/02/19	No				
08/02/19	No				
09/02/19	No				
10/02/19	Yes				
11/02/19	No				
12/02/19	No				
13/02/19	Yes				Tows completed from the NE corner. A set of weak links was broken.



Date	Demand	Pilot	Flown	Pawnee	Comments
14/02/19	No				
15/02/19	No				
16/02/19	No				
17/02/19	No				
18/02/19	No				
19/02/19	No				
20/02/19	No				
21/02/19	Yes				
22/02/19	Yes				
23/02/19	Yes				
24/02/19	Yes				
25/02/19	No				
26/02/19	Yes				
27/02/19	Yes				
28/02/19	No				
01/03/19	No				
02/03/19	Yes				
03/03/19	No				
04/03/19	No				
05/03/19	No				
06/03/19	No				
07/03/19	No				
08/03/19	No				
09/03/19	No				
10/03/19	No				
11/03/19	No				
12/03/19	No				
13/03/19	No				
14/03/19	No				
15/03/19	No				
16/03/19	No				
17/03/19	Yes				Pilot unfamiliar with EuroFox, would have used Pawnee. Too rough for either later.
18/03/19	Yes				Cloud too low for club checks
19/03/19	No				
20/03/19	No				
21/03/19	No				
22/03/19	Yes				
23/03/19	Yes				



Date	Demand	Pilot	Flown	Pawnee	Comments
24/03/19	Yes				
25/03/19	Yes				
26/03/19	Yes				
27/03/19	Yes				
28/03/19	Yes				
29/03/19	Yes				
30/03/19	X	X	X		EuroFox out of hours
31/03/19	X	X	X		EuroFox out of hours
01/04/19	X	X	X		EuroFox out of hours
02/04/19	No				
03/04/19	Yes				
04/04/19	No				
05/04/19	Yes				Unflyable until 16:00 when Pawnee flew.
06/04/19	Yes				
07/04/19	No				
08/04/19	No				
09/04/19	No				
10/04/19	Yes				
11/04/19	Yes				
12/04/19	Yes				60 Minute retrieve from Enstone.
13/04/19	Yes				
14/04/19	Yes				
15/04/19	No				
16/04/19	No				
17/04/19	Yes				Not suitable for towing - bad visibility
18/04/19	Yes				Not suitable for towing - bad visibility
19/04/19	Yes				
20/04/19	Yes				
21/04/19	Yes				OK from West end, but unlikely from East with heavies. Retrieve from Ledbury.
22/04/19	Yes				
23/04/19	No				
24/04/19	No				
25/04/19	No				
26/04/19	No				
27/04/19	No				
28/04/19	Yes				Tug put away due to insufficient margin towing DG505 to west. Could have continued towing lighter gliders.
29/04/19	Yes				
30/04/19	No				



Date	Demand	Pilot	Flown	Pawnee	Comments
01/05/19	No				
02/05/19	Yes				
03/05/19	Yes				
04/05/19	Yes				
05/05/19	Yes				
06/05/19	No				
07/05/19	Yes				
08/05/19	No				
09/05/19	No				
10/05/19	Yes				
11/05/19	Yes				Declined to launch Duo Discus T with two on board.
12/05/19	Yes				
13/05/19	Yes				
14/05/19	Yes				
15/05/19	Yes				
16/05/19	Yes				
17/05/19	Yes				Low cloud and rain.
18/05/19	No				
19/05/19	Yes				
20/05/19	X	X	X		Unavailable - 100-hour Check
21/05/19	X	X	X		Unavailable - 100-hour Check
22/05/19	Yes				
23/05/19	Yes				
24/05/19	Yes				
25/05/19	Yes				
26/05/19	No				
27/05/19	Yes				
28/05/19	No				
29/05/19	No				
30/05/19	No				
31/05/19	No				
01/06/19	Yes				Southerly. Tug pilot wanted to operate W to E, instructor didn't due to winch crosswind limits. No aerotowing. Wind veered later, would have been OK from usual E launch point or from NE corner.
02/06/19	No				
03/06/19	Yes				
04/06/19	No				
05/06/19	Yes				



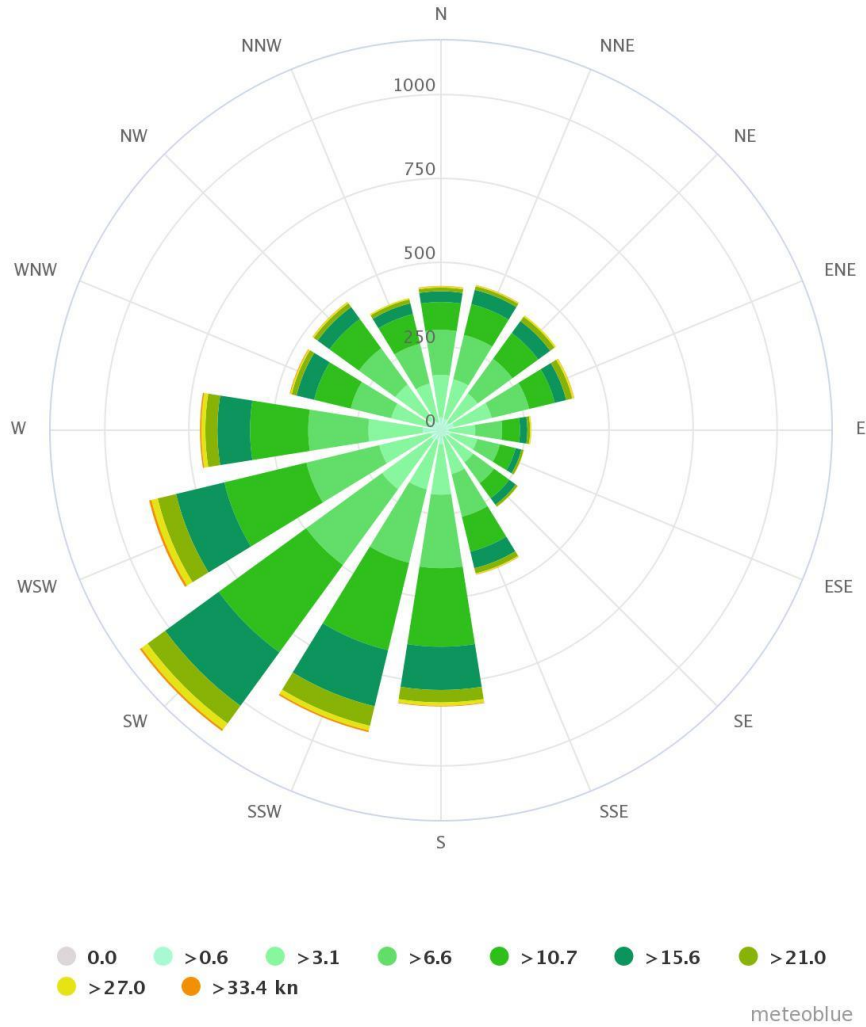
Date	Demand	Pilot	Flown	Pawnee	Comments
06/06/19	No				
07/06/19	No				
08/06/19	No				
09/06/19	Yes				
10/06/19	No				
11/06/19	No				
12/06/19	No				
13/06/19	No				
14/06/19	No				
15/06/19	No				
16/06/19	No				
17/06/19	Yes				
18/06/19	No				
19/06/19	No				
20/06/19	Yes				
21/06/19	Yes				
22/06/19	Yes				
23/06/19	Yes				
24/06/19	Yes				
25/06/19	No				
26/06/19	No				
27/06/19	Yes				2 aerotow retrieves from Usk.
28/06/19	Yes				
29/06/19	Yes				
30/06/19	Yes				
01/07/19	No				
02/07/19	Yes				
03/07/19	Yes				
04/07/19	Yes				
05/07/19	Yes				
06/07/19	Yes				Launched with no headwind from the east, changed ends when wind became Northerly 2 kts.
07/07/19	Yes				
08/07/19	No				
09/07/19	X	X	X		50hr Check
10/07/19	Yes				
11/07/19	No				
12/07/19	Yes				Retrieve from Rendcomb.
13/07/19	Yes				



Date	Demand	Pilot	Flown	Pawnee	Comments
14/07/19	Yes				
15/07/19	Yes				
16/07/19	No				Retrieve from Lasham.
17/07/19	No				
18/07/19	No				
19/07/19	No				
20/07/19	No				
21/07/19	Yes				
22/07/19	No				
23/07/19	Yes				No winching due to southerly.
24/07/19	Yes				
25/07/19	No				No winching due to southerly.
26/07/19	Yes				
27/07/19	No				
28/07/19	Yes				
29/07/19	No				
30/07/19	No				
31/07/19	No				

Trial Weather: Unfortunately, over the period of the trial the weather was atypical in that it included an unusually large number of days operating west to east. No less than 64.7% of the total aerotows on 51% of aerotow days has been west to east. The Wind Rose for Nympsfield overleaf suggests that we can ordinarily expect to aerotow in that direction at most about 35% of days. Also, June 2019 was an unusually poor month with little flying and this has resulted in less towing than might have been expected over the trial period.

Wind at Nympsfield: The archive Wind Rose below and the table overleaf have been taken from the 'meteoblue weather' website and have been used to assist in assessment of the frequency and hence significance of various weather conditions at Nympsfield as seen in the trial. The Wind Rose illustrates Wind strength, direction and duration in hours for 1 year at Nympsfield:



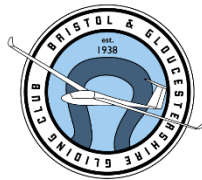
Wind at Nympsfield in days per year:

kts	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0
>0.6	1.5	1.4	1.2	1.6	1.0	1.3	1.0	0.8	1.5	1.3	1.5	1.3	2.2	1.5	1.6	1.0
>3.1	5.3	5.0	4.4	4.8	3.3	3.3	4.0	4.8	6.3	6.3	7.5	6.6	6.8	4.8	5.3	4.9
>6.6	5.6	5.7	5.3	4.8	3.3	2.9	3.2	5.5	9.1	9.4	11.6	9.3	7.5	5.2	5.6	5.1
>10.7	3.5	3.9	4.0	3.3	2.2	2.0	2.3	4.5	9.8	11.2	13.4	10.5	7.2	4.7	4.5	3.8
>15.6	1.3	1.8	1.8	1.5	0.9	0.8	1.0	2.1	5.4	7.2	8.2	6.2	4.0	2.3	1.8	1.4
>21.0	0.5	0.5	0.7	0.8	0.3	0.3	0.3	0.7	1.5	2.5	2.7	2.3	1.5	0.6	0.6	0.5
>27.0	0.2	0.1	0.2	0.2	0.2	0.0	0.0	0.1	0.4	0.6	0.9	0.8	0.5	0.2	0.2	0.2
>33.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3	0.2	0.1	0.0	0.0



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Appendix 5: State of Membership

Members & Active Members: The table below illustrates the state of membership as of July 2019:

Membership Class	Number	Number Who Fly
Adult	38	35
Family	8	8
Country	2	2
Retired	26	17
Solo & Beyond	8	8
Cadets	12	6
Student	2	2
Associate	33	0
Total	129	78

At its peak, in the early '90's, the club had nearly twice the current number of members. Also, whilst there isn't data to define it, there is a perception that the 'demographic' has changed. We have more cadets, more retired members but fewer 25 to 55 year olds.



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