Australian Government
Civil Aviation Safety Authority

ANALYSIS OF RESPONSES

Review of RPAS operations

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Contents

1 Executive Summary

Background

This paper analyses responses provided to the Civil Aviation Safety Authority's (CASA) August 2017 discussion paper: *Review of RPAS Operations*. [1]

The purpose of the discussion paper was to seek community and industry views to inform a safety review of approaches to the regulation of Remotely Piloted Aircraft System (RPAS) operations.

The discussion paper sought responses in relation to 5 topics, as well as enabling respondents to provide their views on any other issues or factors they believed should be considered. The 5 topics were:

- registration of RPAS
- training and/or demonstration of proficiency in the safe and lawful operation of RPAS
- geo-fencing
- management of counter-drone technologies
- views on CASA's approach, and what will be required in future

Responses were received through an online questionnaire that enabled respondents to respond through selection of pre-specified response check boxes; provide commentary as free text; and upload a stand-alone submission document.

In total, there were 910 respondents, 81% of whom were individuals, and 19% of whom indicated they were responding on behalf of an organisation. Most respondents use RPAS commercially (~46%) or recreationally (~34%), though a significant number do not use RPAS (~19%).

Key Findings

Some form of registration is supported, with greater support by non-users

Proportionally more non-users advocated mandatory registration of all RPAS, with 36% recommending registration of all RPAS operators. By contrast, recreational and commercial users showed a clear preference for a more targeted approach to registration, with weight of the RPAS the most popular method of determining whether registration is required. ~50% of recreational and 40% of commercial users supported registration of RPAS owners where weight of the RPAS is used to determine whether registration is required.

Training and demonstrated proficiency are broadly supported, particularly for users of large RPAS

Recreational users, commercial users and non-users all indicated a preference for both mandatory training and demonstrated proficiency requirements to be determined by the weight of the RPAS. Notably, there was some divergence in views, with recreation users more likely to advocate no mandatory training or proficiency requirements than commercial and non-users.

Respondents indicated support for free or inexpensive online training to be made available and the need for development of an awareness campaign to help new users learn about the safe and responsible use of RPAS.

Whilst there is broad support for large and small RPAS to be treated differently (for registration, training and demonstrated proficiency) there are divergent views on what size a "small" RPAS is.

[1] Consultation available at https://consultation.casa.gov.au/regulatory-program/dp1708os/

Support for mandatory geo-fencing is divided

There is approximately even support for (47%) and against (53%) the use of geo-fencing technology. Proponents noted it is most useful in situations where increased safety is required (e.g.: airports), whilst detractors believe the technology is ineffective and too costly, especially for recreational users of RPAS. There is clear variation between groups, with 66% of non-users supporting geo-fencing, compared to just 36% of recreational users.

There is broad support for the use of counter-drone technology by law enforcement personnel

The majority of respondents who commented on the use of counter-drone technology supported its use by trained law enforcement personnel where necessary to protect safety and security, especially in controlled airspace.

Radio-frequency counter drone technology was significantly more strongly supported than physical interventions such as nets or trained birds.

There is a wide range of views regarding CASA's approach to regulation

The most common theme to emerge from respondents' in relation to CASA's approach to regulation is that the current rules are sufficient and/or CASA is doing a good job. However, respondents also raised suggestions to amend the rules either to strengthen regulation in areas of perceived greater risk (such as inexperienced recreational operators) or reduce regulation where there is a perception current rules are not keeping pace with technological change (recreational users raised height limits and visual line of sight restrictions in this context).

2 This paper analyses the views of respondents to CASA's discussion paper

This paper analyses responses provided in relation to the Civil Aviation Safety Authority's (CASA) August 2017 discussion paper: *Review of RPAS operations*.

The purpose of this discussion paper was to obtain community and industry views to inform CASA's current aviation safety review in relation to the approaches undertaken by CASA to the regulation of Remotely Piloted Aircraft System (RPAS) operations.

As CASA's regulatory authority extends exclusively to matters of aviation safety, a number of important issues are out of scope of CASA's review. These include security, privacy, importation, insurance and broader social and economic implications. Except where they intersect with matters of aviation safety, these issues were not covered by the terms of reference for the review.

The discussion paper sought responses in relation to five topics (Table 1) as well as enabling respondents to provide their views on any other issues or factors they believed CASA should take into account when considering its approach to the regulation of RPA.

Table 1 | Key questions asked of respondents

Topic #	Questions to consider in discussion paper
1	Should there be some form of mandatory registration of all RPA, RPA owners and/or RPA operators?
2	Should there be some form of mandatory training and/or demonstration of proficiency in, and knowledge about, the safe and lawful operation of RPA before a person is permitted to operate any kind of RPA?
3	Should CASA mandate the introduction of certain kinds of geo-fencing options to limit the operation of RPA in certain areas?
4	CASA seeks your general views on the way in which counter-drone technologies should be managed, and whether there are particular aspects of this technology and its potential uses to which you think CASA should be devoting particular attention.
5	Are we doing enough of the right kinds of things, with a view to current circumstances and what you think we will need to deal with in the future? If not, what should we be doing or doing more of?

Responses to the discussion paper were received through an on-line questionnaire that enabled respondents to:

- indicate their views by selection of pre-specified response check-boxes
- provide additional commentary on each topic as free text
- upload and attach a stand-alone submission document.

This paper presents a synthesis of the responses received. It does not evaluate the relative merit of views provided.

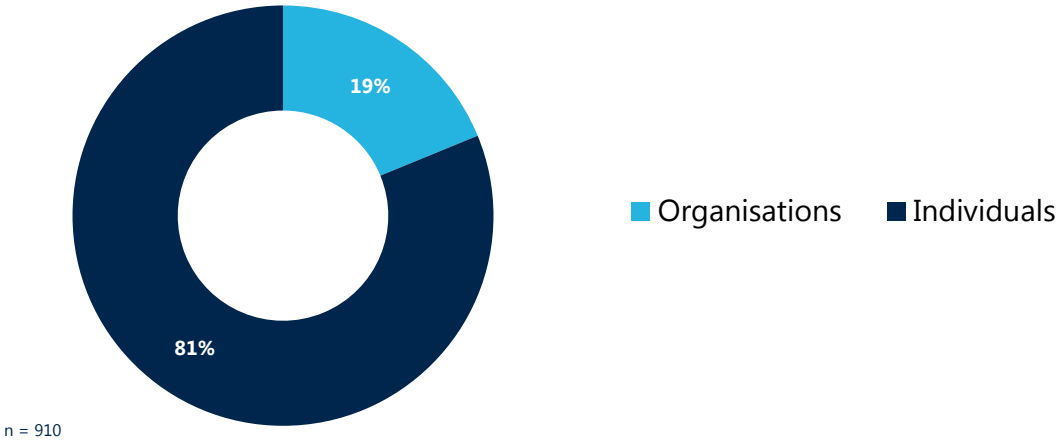
3 Respondents were RPAS users and non-users representing individuals and organisations

The discussion paper received responses from a wide range of individuals and organisations. Details of their characteristics are presented below.

3.1 Feedback was provided by 910 respondents

The discussion paper received 910 responses. Most respondents (81%) represented themselves as individuals. However a significant proportion (19%) indicated their responses represent the position of an organisation (Figure 1).

Figure 1 | Representation of respondents



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

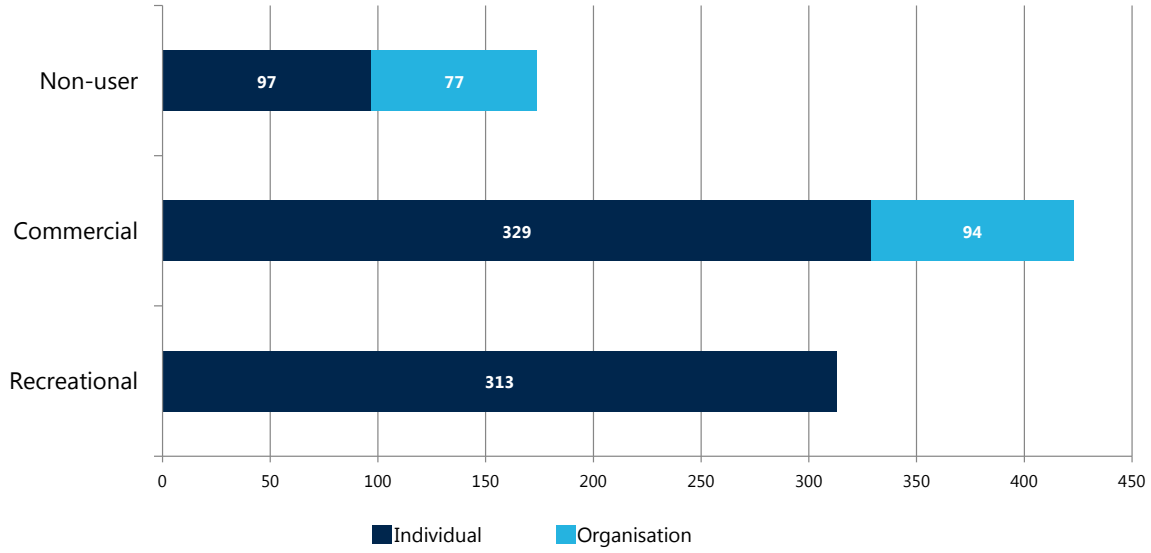
In addition to information received from each respondent through the use of pre-specified responses available in the on-line questionnaire:

- 805 respondents provided 3,725 additional comments across 7 questions
- 40 respondents attached submissions consisting of:
    - two from aerial imaging services
    - eight from aviation related organisations
    - eight from government agencies
    - two from research/education organisations
    - five from RPAS hardware related organisations
    - five from other organisations
    - ten from individuals.

3.2 Most respondents use RPAS, though a significant number of non-users also contributed

Respondents identified if their views represented those of an individual or an organisation. Respondents also identified if they use RPAS recreationally, commercially or not at all. Figure 2 presents an overview of the characteristics of the respondents. Most respondents use RPAS commercially (~46%) or recreationally (~34%), though a significant number do not use RPAS (~19%).

Figure 2 | RPAS usage of respondents (number)



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

While a range of types of organisations provided responses, nearly half were aerial imaging service providers (Table 2). In addition to providing responses through the on-line questionnaire, 30 organisations also provided submissions (and 10 individuals).

Table 2 | Types of organisations that responded

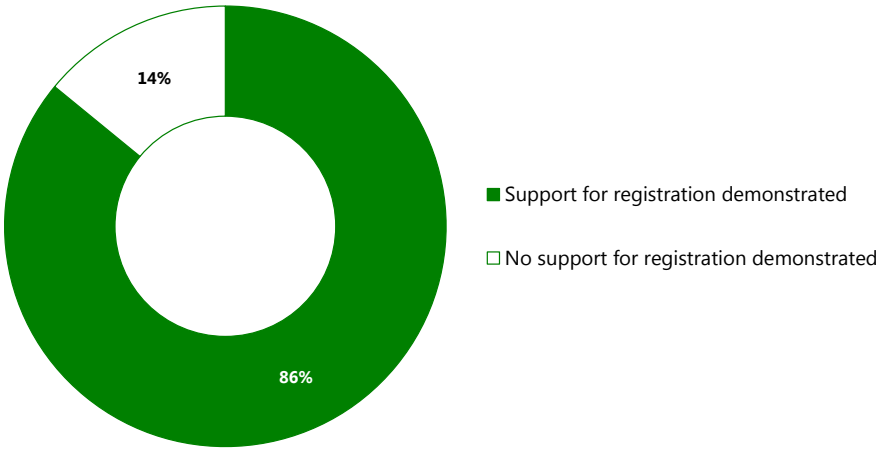
Organisation type	Number of organisations	Number of submissions
Aerial imaging services	80	2
Aviation	22	8
Government	14	8
Research/Education	5	2
RPAS Hardware	15	5
Other*	28	5
Unknown	7	0

*The five submissions from "other" organisations were provided by organisations from telecommunications, aviation, and professional services as well as an industry group, and a law firm.

4 Majority of respondents support some form of registration, with greater support by non-users

The majority of respondents (86%) selected at least one form of registration across all presented options (Figure 3).

Figure 3 | Demonstrated support for registration

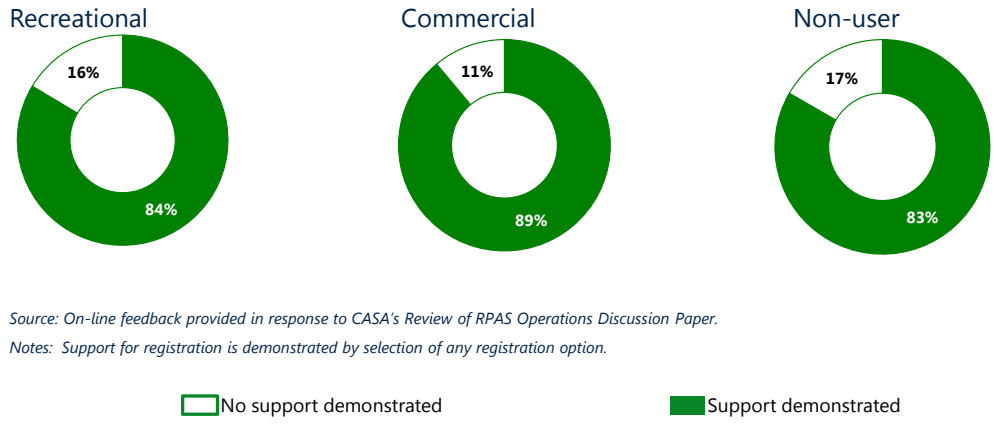


Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper.

Notes: Support for registration is demonstrated by selection of any registration option.

Figure 4 shows some form of registration was supported by the majority of recreational users (84%), commercial users (89%) and non-users (83%).

Figure 4 | Demonstrated support for registration by users and non-users



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper.

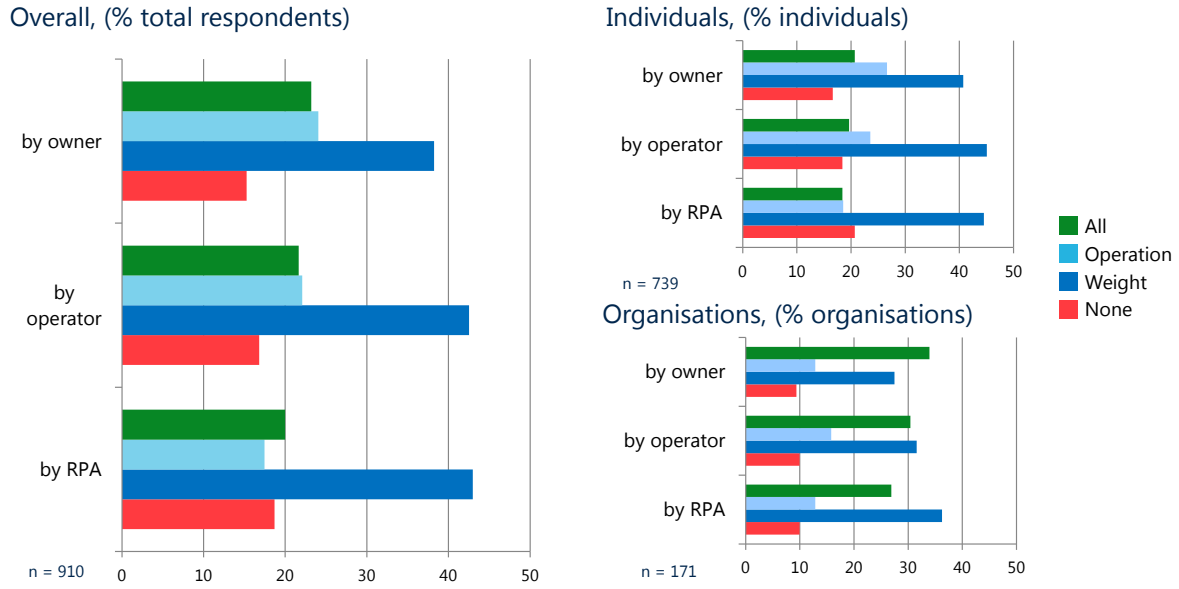
Notes: Support for registration is demonstrated by selection of any registration option.

Proportionally more non-users of RPAS advocated mandatory registration than users of RPAS. Many non-users recommended registration due to safety and accountability concerns. Recreational and commercial RPAS users called for a targeted registration system that would be achievable, enforceable, effective, efficient and adaptive. The conflicting opinions of non-users and users signal the contested nature of the issue of registration. These views are discussed in further detail below.

4.1 Registration of RPAS is contested, though weight of the RPAS is consistently seen as the most important factor

The registration of RPAS is contested with no clear preferred registration option other than by the weight of the RPAS. Overall, respondents supported the registration of RPAS based on its weight. Of all respondents, for registration by weight of the RPAS: 38% supported registration of the owner; 43% of the operator; and 43% of the RPAS itself (Figure 5 Left). The preference for registration by weight is highest among those who responded as individuals. Of these, 45% chose registration by weight for both registration of the operator and the RPAS itself (Figure 5 Top Right). However, organisations show slightly lower support for registration by weight: 27% for registration of the owner, 32% for registration of the operator and 36% for registration of the RPAS. Organisations demonstrated greater support for registration of all RPAS (34% of organisations) compared to individuals (21% of individuals). Individual respondents were more than twice as likely to advocate no mandatory registration compared to organisations (21% and 10% respectively).

Figure 5 | Preferred registration options



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

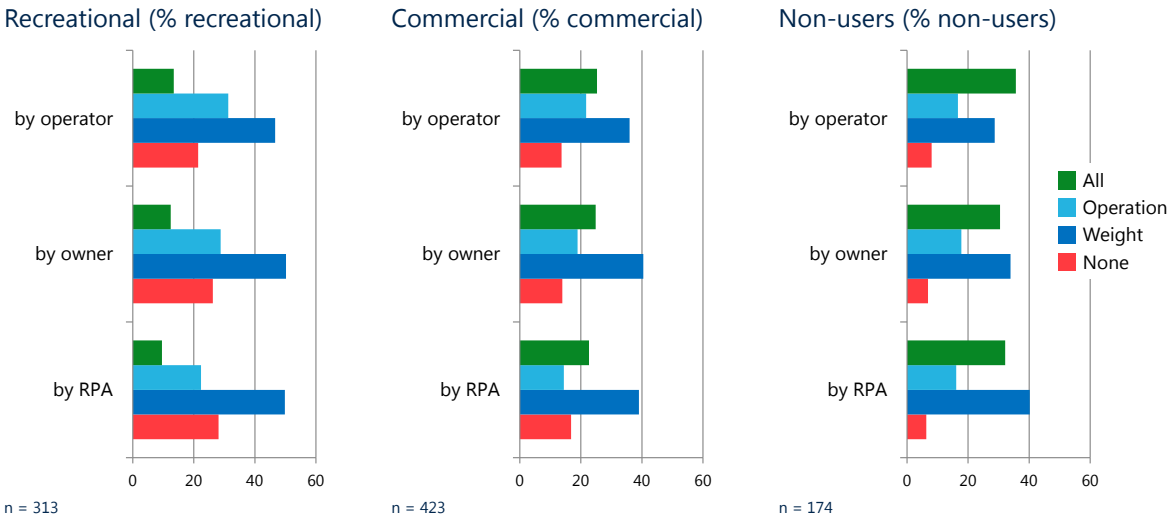
Notes: Percentages may not sum to 100 as respondents may select multiple options

4.2 Non-users support broad registration while recreational and commercial users prefer a targeted approach

Of the non-users of RPAS that responded, 36% recommended registration of all RPAS operators (Figure 6 Right). In their online responses, non-users emphasised the collection of identifiable information of owner, operator and RPAS to ensure that the risks associated with operating an RPAS are mitigated. By contrast, recreational users supported a targeted approach to registration. Of the recreational users that responded, only 13% recommended mandatory registration of all RPAS. Almost half of recreational users supported registration of RPAS owners (50%), operators (47%) or individual RPAS (50%) by weight (Figure 6 Left). Registration by type of operation was less supported by recreational users being noted by between 22% and 31% of recreational users (for registration by RPAS and by operator respectively). Recreational users supported no mandatory registration at all more often than registration of all operators, owners, or RPAS.

Commercial users of RPAS likewise supported a targeted approach for registration. Registration based on the weight of the RPAS was again the preferred characteristic for this group. Within this, a slight preference for registration of owners was presented (selected by 40% of commercial users). Comments included in commercial users' responses indicate that this is often due to commercial users having many RPAS within the one organisation. A notable point of difference between commercial and recreational users is that 23% of the former support registration of all RPAS compared to only 10% of the latter. A significant percentage of commercial users supported registration by weight of the RPAS with 40% supporting by owner, 39% by RPA, and 38% by operator. Less than 18% of commercial users supported no registration at all.

Figure 6 | Preferred registration options of recreational, commercial and non-users



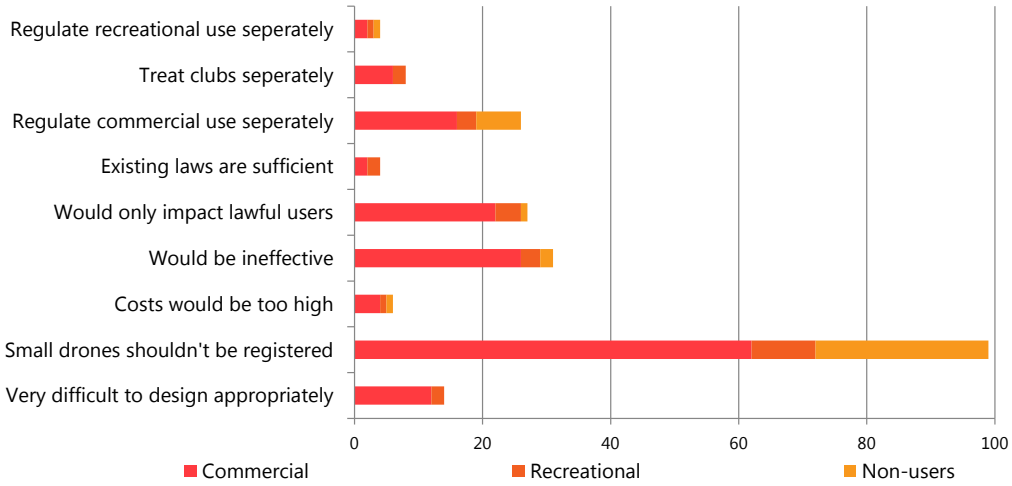
Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

Notes: Percentages may not sum to 100 as respondents may select multiple options

4.3 Respondents' comments indicated the complexity of designing and implementing an RPAS registration system

Additional commentary provided by respondents further illustrates the complexity of designing and implementing a registration system that would effectively and efficiently manage RPAS now and into the future. Figure 7 presents the key themes that emerged from analysis of comments provided by respondents.

Figure 7 | Themes of comments provided in relation to the question of registration



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

That small RPAS should not need to be registered was the most commonly mentioned theme. What constitutes "small" differed across respondents with weights in the range of 100g to 2kg often mentioned. A weight of 250g was the most commonly cited cut-off for what constitutes a small RPAS. Of the respondents that commented, 62 commercial users, 10 recreational users and 27 non-users indicated their preference that small drones should not be registered. Reasons cited included issues with enforceability, overburdening the registration process, and creating barriers to entry to the use of RPAS as a hobby.

Only four users of RPAS commented that existing laws are sufficient to regulate the RPAS industry (two commercial users and two recreational users). On a similar issue 12 commercial users and 2 recreational users indicated that it would be very difficult to design an appropriate registration system. Respondents noted 31 times that it would be ineffective to register RPAS (26 commercial users, three recreational users and two non-users). The uncertainty regarding the issue of registration was also prevalent when 22 commercial respondents said that it would adversely impact lawful users. Recreational users noted this four times and non-users twice.

Some supporters of a mandatory registration system argued that the risk of inexperienced, uninformed and reckless RPAS operators justified universal registration. Helicopter pilots often noted concern of such risks citing the critical structural damage a sub 2kg RPAS could cause upon collision. Multiple helicopter pilots demonstrated concerns quite strongly:

> *"No registration means no way of investigating incidents with drones unless you catch violators in the act. We had an incident yesterday involving a near miss between a drone and one of our EMS helicopters with a crew of 4 and a patient on board. The drone passed within 100ft of the aircraft. The near miss occurred by night at 3000ft AMSL in the vicinity of Moruya. If all RPA operators (say above 250g similar to what the FAA have mandated) were registered, it would be easier to identify local drone operators who may be able to assist with the investigation"*
>
> - employee of Toll Helicopters

> *"I'm a fire fighting helicopter pilot and I am very concerned about low level operations due to the increase in drones in the last few years"*
>
> - emergency services helicopter pilot

A number of respondents noted that clubs could be leveraged to address the issue of inexperienced operators and should be treated as a separate category for registration. Multiple respondents noted that

clubs could be leveraged to promote the safe use of RPAS, deliver education, and provide an environment where RPAS owners and/or operators could pursue their sport safely (much like controlled racing circuits for high performance cars and motorbikes). They also suggested that clubs could be used as a channel to increase registration numbers especially among the younger demographic and should not be subjected to onerous regulation. For example, drone racing is fast becoming a popular hobby and if it is conducted in a club environment, operators would pose no risk to others and safely increase their skills. As such, the sport has the likelihood of encouraging the responsible use of RPAS according to a number of respondents.

Much of the commentary in relation to RPAS registration focused on issues of concern in populous areas. A number of respondents indicated that RPAS are very useful in regional and remote setting and indicated their desire that their use not be unnecessarily impeded:

> *"As a farmer flying over my own property this is a time saving and animals [sic] welfare tool that has saved lives of livestock and animals on farm no other licensed [sic] requirements should be needed*."
>
> - a farmer

The submissions provided in relation to the discussion paper demonstrated that a cross-section of responders agreed that some form of a registration system is required for recreational and commercial RPAS operators. Submissions from private citizens, local councils, state and commonwealth agencies, airlines and airports, and private entities all indicated this view. However, submissions differed on whether operators of all RPAS, irrespective of their weight, should be required to register. Seven submissions in favour of mandatory registration of all RPAS were provided by: a local city council; an aviation interest group; an association of RPAS users; a state and a commonwealth government agency; and two private citizens. These submissions argued that all RPAS should be registered to an owner and that registration should require the collection of personal information including the owner's name, official ID, email and physical address. The submissions indicated that collection of personal information would ensure that the risks associated with operating an RPAS are mitigated:

- *"All RPAS should be registered and should require an ID to purchase, and registration should be applied retrospectively."* In Motion Aero

A government agency's submission advanced the view that all RPAS operators must hold a CASA remote pilot licence (RePL) even if operating RPAS that weigh less than 250g.

By contrast, 15 submissions recommended that RPAS under a certain weight be excluded from mandatory registration. The weight range itself was a matter of discussion as at least six submissions by private organisations, including commercial airlines, noted that only RPAS above 250g should be registered in order to align with the U.S. and European regulations. At least two submissions noted that other criteria should also be considered in the future. Relevant criteria identified were: aircraft design and components as well as capabilities such as speed, ceiling height and transmitting power. The rationale for not limiting the regulation of RPAS by weight was that as drone technology advances, RPAS will become lighter and more capable and as such, regulating registration requirements (as well as training and knowledge) across certain weight classes may quickly become out-dated. With respect to the weight class, two submissions recommended that RPAS above 2kgs should be registered and added that their operators should be licenced before first flight. Three other submissions noted the difficulty in implementing a broad registration system due to the challenges of enforcing RPAS registration.

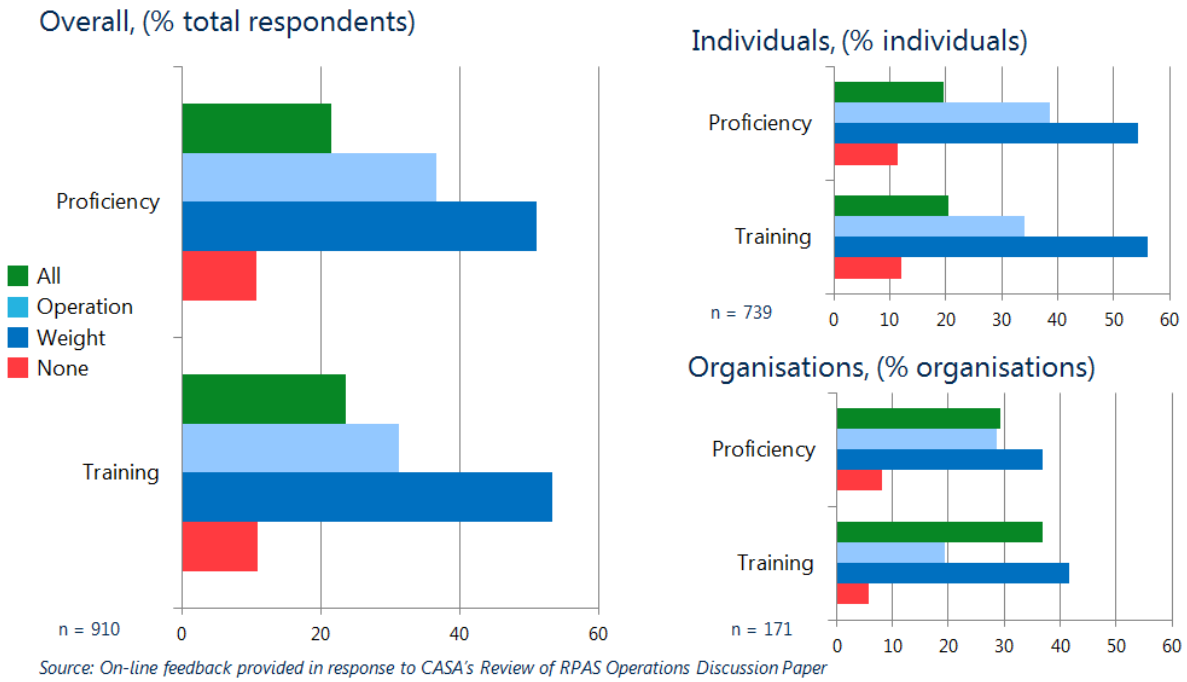
5 Training and demonstrated proficiency are broadly supported, particularly for users of larger RPAS

Views on mandatory training and demonstrated proficiency are broadly consistent across recreational users, commercial users and non-users. Many respondents noted that operators of RPAS must demonstrate proficiency and should undergo some form of training and education to ensure that they are aware of relevant regulations, risks and their responsibilities. Individuals supported proficiency and training more than organisations but both called for the development of free and user-friendly education on the safe operation of RPAS. Easy to use e-learning platforms were often noted as valuable, provided they are regularly updated to meet industry and technological developments.

5.1 Training and proficiency have broadly similar support

Overall, respondents broadly supported mandatory proficiency and training for at least some users operating RPAS. The support for mandatory training was approximately equivalent to the support for demonstrated proficiency. Of all respondents, over 50% agreed that both proficiency and/or training should be required taking the weight of the RPAS into account (Figure 8 Left). Respondents overall had less support for demonstrated proficiency based on the operation of the RPAS (37%) and similarly for training based on operation (31%). 21% of respondents said that proficiency and/or training should be required for all RPAS. 11% of respondents indicated that no proficiency or training was required.

Figure 8 | Preferred training/proficiency options overall and for individuals and organisations



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

Notes: Percentages may not sum to 100 as respondents may select multiple options

Over half of individual respondents expressed a preference for proficiency and/or training based on the weight of the RPAS (Figure 8 Above Right). Individuals supported demonstrated proficiency based on the type of operation 39% of the time and training 34%. 20% of individuals indicated all RPAS use should

require mandatory proficiency and/or training whereas only 12% indicated no proficiency/or training should be mandatory.

42% of organisations indicated training should be required based on the weight of the RPAS and 37% indicated proficiency should be demonstrated. Mandatory training and proficiency based on operations was less supported (19% and 29% or organisations respectively). The support for training and proficiency requirements based on operation and/or weight of RPAS was lower than that indicated by individuals. However, proportionally more organisations support training and proficiency for all RPAS than that demonstrated by individuals. 37% of organisations supported mandatory training for all RPAS (vs 20% of individuals) and 29% supported proficiency (vs 20% of individuals). Only 6% of organisations indicated that no mandatory training should be required and 8% that no demonstrated proficiency should be required.

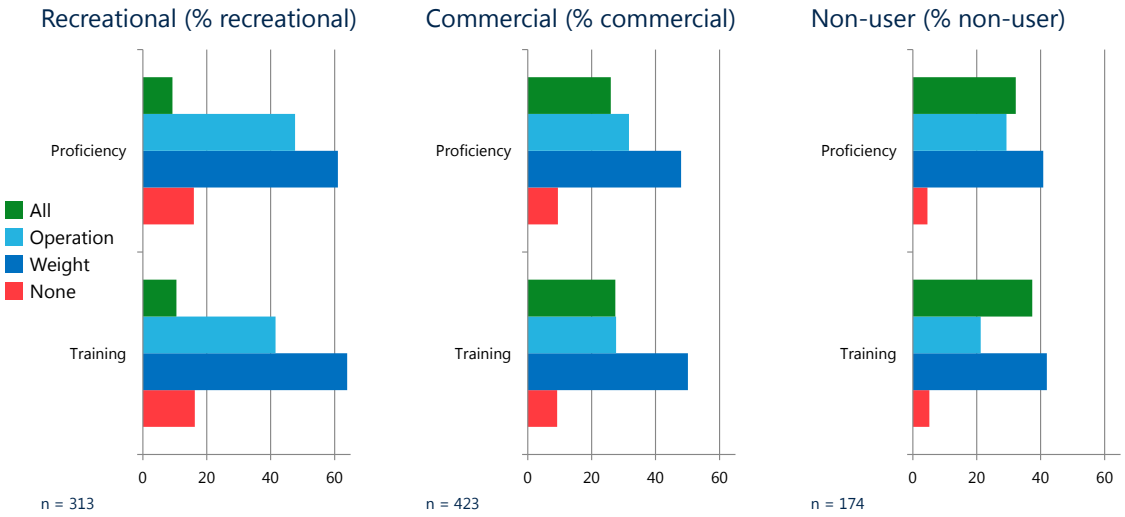
5.2 There is common support that operators of larger RPAS should be trained and proficient

Recreational, commercial and non-users of RPAS all indicated support for mandatory training and demonstrated proficiency based on the weight of the RPAS being used. The proportion of recreational users supporting training and/or proficiency by weight was the largest of the three groups at over 60% (Figure 8 Left). Recreational users also recorded the highest support by type of operations with 48% supporting proficiency and 42% supporting mandatory training. However:

- commercial and non-users indicated proportionally more support for mandatory training and/or demonstrated proficiency of all RPAS users (over 25% of commercial users and over 30% of non-users)
- proportionally more recreational users are in favour of no requirements for proficiency or training than other groups (16% of recreational users, 9% of commercial and 5% of non-users).

The higher support for no mandatory training and/or demonstrated proficiency by recreational users aligns to commentary provided by them that expressed concerns that proficiency and/or training requirements could be a precursor to the introduction of a licensing regime that would create barriers to entry to the hobby. Such views are not only held by recreational users. Some individuals and organisations involved in the commercial use of RPAS noted that blanket proficiency and training requirements could create the conditions that would stifle innovation and growth in the sector.

Figure 9 | Preferred training/proficiency options of recreational, commercial and non-users



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

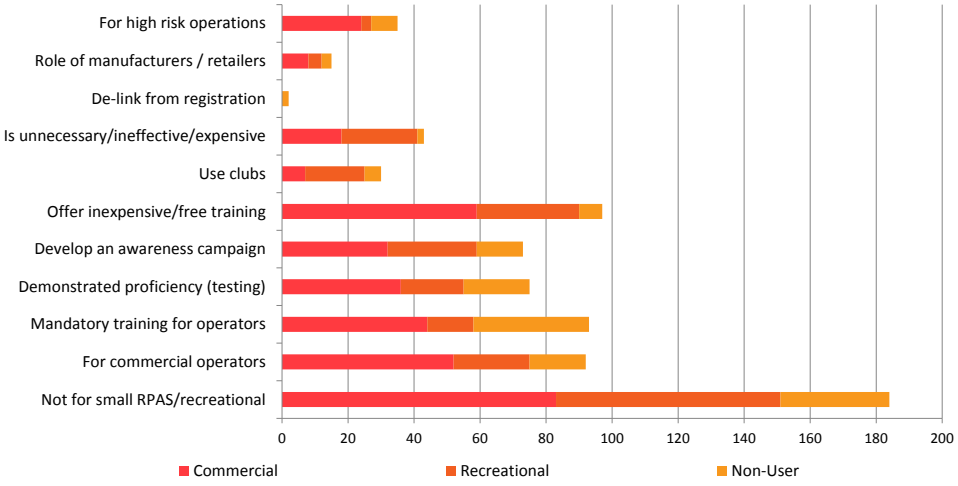
Notes: Percentages may not sum to 100 as respondents may select multiple options

5.3 There is broad support for proficiency and training requirements but divergences still exist

Additional commentary provided by respondents in relation to mandatory training and demonstrated proficiency indicates broad support for both while providing more insight into how respondents' views diverge.

Figure 10 presents the key themes contained within comments provided by respondents within the online questionnaire and shows significant variation across groups.

Figure 10 | Key themes of comments in relation to training/proficiency



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

Both commercial users and non-users indicated support for training and proficiency requirements more often than recreational users. All three groups noted often that such requirements should not be put in place for small RPAS. Recreational users often mentioned that any such requirements would impede

hobbyists from taking part. Commercial operators were the most likely to note that mandatory training and demonstrated proficiency should be required for commercial operations.

A number of recreational users indicated support for access to free or inexpensive training. These respondents often commented that this would help to cultivate an interest in the use of RPAS and provide the necessary support for hobbyists to operate RPAS appropriately. Commercial users also indicated support for this idea. Non-users did not provide many comments in relation to inexpensive/free training though some did note that public resources should be used to subsidize the training costs for RPAS users, particularly commercial operators. Commercial users indicated support for inexpensive or free training more often than recreational users. However, both user groups commented a number of times that compulsory training is unnecessary, would be ineffective, and too expensive. By contrast, only a handful of non-users opposed compulsory training.

Comments indicated that recreational respondents are concerned that a registration system that includes mandatory proficiency and training elements for all RPAS irrespective of weight or capabilities would unnecessarily prevent hobbyists from taking part in RPAS use. Both recreational and commercial users advanced the view that any proficiency and training requirements should be practical, cost-effective, and updated regularly to keep up with industry changes and technological advancements. Both recreational and commercial users also noted that the regulatory framework should be responsive and flexible and that it be designed to attract users and not bar them from entry.

A number of RPAS users commented that clubs could be used well for training and proficiency demonstration purposes. Many of these comments noted that clubs are avenues for learning, promoting safety, and providing a safe environment for users to operate RPAS in a controlled environment with minimal risks to the general public and property.

> *"An alternate to this would be compulsory member [sic] of a model flying club. The majority of these clubs insist members show a proficiency of the models they fly before being allowed to fly at the club. It would also ensure they are covered with public liability insurance through the MAAA."*
>
> - a recreational RPAS operator

RPAS users and non-users both provided comments that government authorities should develop an awareness campaign as this would help new users understand about the safe and responsible use of RPAS. These comments often noted that this would also help dispel uncertainties in the general public regarding RPAS use.

Of the submissions provided in relation to the discussion paper, 30 recommended that operators of RPAS should have to undergo some form of optional or mandatory training, education and/or testing. Submissions that recommended mandatory training for RPAS operators totalled 10 and came from private citizens, aviation organisations, telecommunications service providers, local councils and other private organisations. However, four responders from this group of 10 excluded mandatory training requirements for RPAS below 250g.

Of the 20 submissions that recommended training, education or testing, but did not specify that this should be mandatory, some areas of commonality included:

- developing a sustained awareness campaign targeted at recreational users of RPAS to ensure operators are aware of relevant regulations, risks and their responsibilities
- delivering free and user-friendly education on the safe operation of RPAS via e-learning platforms that are continuously updated to meet industry and technological developments
- linking the level of training for operators to the weight and/or performance of the RPAS.

Some areas of contrast across these remaining 20 submissions included what categories of RPAS operators should be trained, what type of training should be required and whether training should be linked to a formal testing and licencing process. The main areas of divergence centred on the following issues:

- Whether operators of RPAS above 250g should be required to undertake a formal registration and/or a testing process that would grant or deny an operator a licence to fly their RPAS.
- Whether training should include formalised testing as well as defining the scope of the testing element. Options included online testing only, online testing and/or a demonstration of skills (similar to that of the theory and practical tests for motor vehicle operation).
- Whether refresher training and/or testing for operators of RPAS above 250g should be mandated to ensure that operators are up to date with the latest regulations and can comply with restrictions for safety.

Some submissions noted that a blanket approach to training, whether linked to a formal testing element or not, requires further dialogue due to the challenges of enforcing mandatory training. Others advanced the view that any mandatory training should be delinked from the registration process of RPAS.

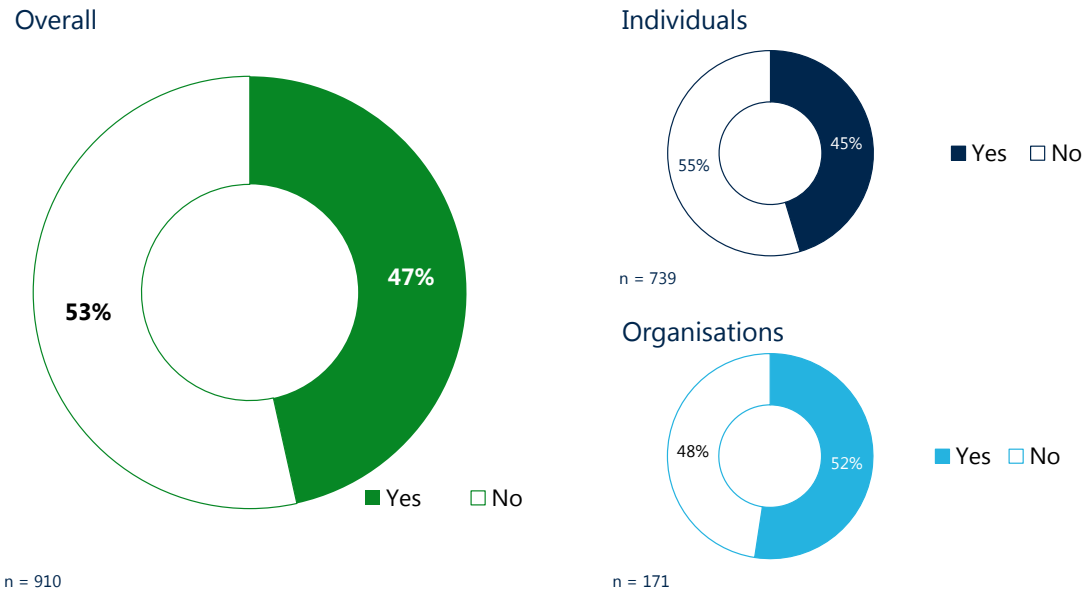
6 Support for mandatory geo-fencing is divided

Views on geo-fencing are split with even support for and against the use of the technology. Many respondents noted that it should be used in situations where increased safety is required (e.g. airports). However, many other respondents noted that the technology is not effective and would be too costly, particularly for recreational users of RPAS. These matters are discussed in further detail below.

6.1 Organisations and individuals' support for mandatory geo-fencing is split

Overall, views on geo-fencing are close to evenly divided. Of all respondents, 47% support geo-fencing while 53% to do not (Figure 11). This pattern follows for individual respondents as well, however organisations show slightly more support with 52% in favour.

Figure 11 | Respondent's support of mandatory geo-fencing

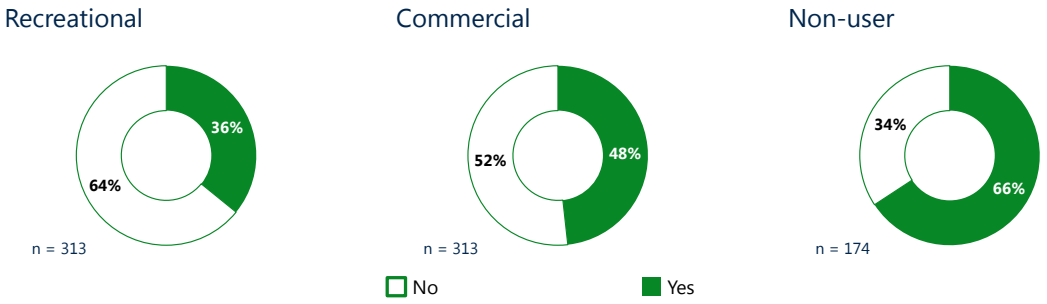


Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

6.2 Non-users support geo-fencing more than recreational users

Views on geo-fencing are more distinct between users and non-users of RPAS. Of the recreational users that responded to the discussion paper, 64% were against geo-fencing. This compares to 66% of non-users in support of the technology (Figure 12). Commercial RPAS users demonstrate the same divide as respondents overall with 48% in support and 52% against.

Figure 12 | Respondent's support of mandatory geo-fencing

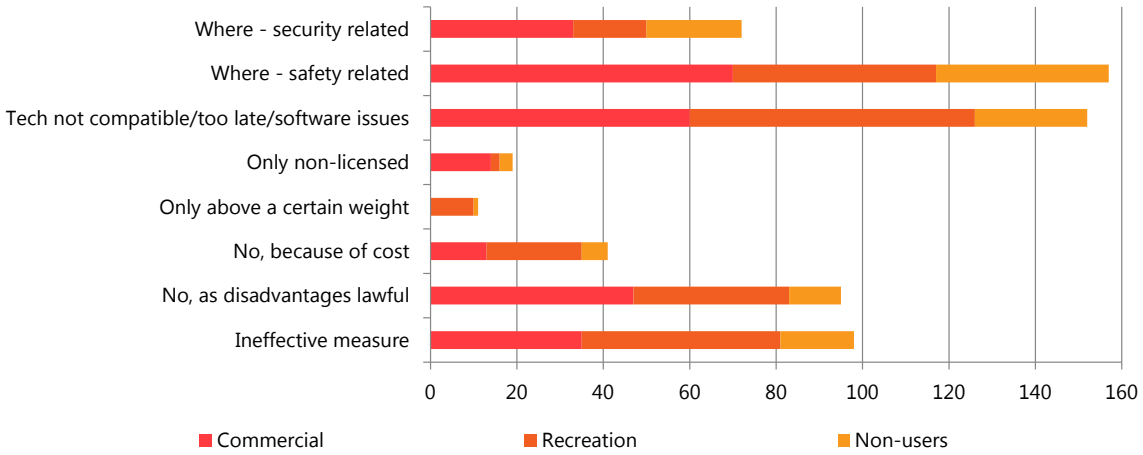


Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

6.3 There is support for geo-fencing to increase safety but many respondents see it as ineffective

Additional comments provided by respondents in relation to geo-fencing further show the strong split of views in relation to its use. The most commented theme was that geo-fencing should be used in areas where increased safety is a key concern (e.g. airports), however, a similar number of comments indicated that the technology is not able to be appropriately implemented with many indicating it would be ineffective (Figure 13). Geo-fencing is also viewed as ineffective due to concerns that operators who wished to could simply circumvent it. Another key theme was that geo-fencing should be used to enhance security. Some respondents who do not support geo-fencing noted the costs involved would be too great, particularly for recreational users of RPAS.

Figure 13 | Key themes of comments in relation to geo-fencing



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

Submissions provided in response to the discussion paper identified similar concerns and split of views. Of the 21 submissions that related to geo-fencing, matters raised included:

- recognition of its potential but also its current limitations (11 submissions)
- clear opposition to geo-fencing as a solution (5 submissions)
- clear support for mandatory geo-fencing (4 submissions)
- a view that pre-loaded software on RPAS already functioned as an effective geo-fence (1 submission).

The 11 submissions that recognised geo-fencing's potential but also its limitations were provided by: emergency services; an airport; commercial airlines; a telecommunications service provider and a technology company; RPAS operators; and an RPAS manufacturer. Some of the potential benefits of geo-fencing that were articulated in these submissions included its application in determining long term no-fly-zones around aerodromes, preventing RPAS from entering heavily populated or restricted areas, and protecting high value assets on the ground. However, the same submissions presented concerns that the deployment of geo-fencing could have unintended consequences, or impose blanket restrictions, such as:

- the risk that geo-fencing could compromise the flight control system of an RPAS which could endanger lives and/or property on the ground
- whether geo-fencing would prevent authorised users from operating RPAS in restricted areas
- possible interference with manned aircraft navigation and communications systems and air traffic controller systems
- whether the static application of geo-fencing would become out-dated due to dynamic changes of areas over time
- the extent to which geo-fencing could prevent the legitimate use of RPAS.

Some of these submissions also cautioned against relying on a single technology as a solution to prevent unauthorised, faulty, accidental or malicious RPAS from entering into restricted air space. For instance, a defence industry entity advocated for the introduction of an RPAS Unmanned Traffic Management (UTM) system which could handle the notification and approval of RPAS for a particular flight. The same entity projected that UTMs would enable large volumes of RPAS to use designated air corridors thus improving regulation, safety and accountability, which would integrate RPAS into the airspace with manned aircraft. A number of other organisations also noted the potential benefit of UTM. Another entity, a technology services firm, advocated against any regulation that would mandate geo-fencing retrospectively due to the cost and impact on RPAS currently operating.

Five submissions were opposed to geo-fencing for various reasons. Among them, one aviation services entity argued that mandatory geo-fencing is unviable due to technological differences and a lack of universal standards. Another argued that geo-fencing technology would be challenging to mandate and roll out widely. Similarly, a submission from an airport did not support geo-fencing as a solution due to claims the technology is unreliable and the risks it could pose to navigational and communications systems of manned aircraft.

Four submissions advocated mandatory geo-fencing. These were provided from: an RPAS service; an airport; a local council; and an aviation sector industry body. The general consensus across these submissions was that geo-fencing should be employed around populous areas such as stadiums and public events as well as around aerodromes.

7 Respondents are generally supportive of counter-drone technology, with caveats

Respondents provided significant commentary in relation to the use of counter-drone technology with over 670 providing comments within the on-line questionnaire and 17 attaching separate submissions. The majority of respondents were supportive of the use of counter-drone technology by trained law enforcement personnel where necessary to protect safety and security. This is discussed in further detail below.

7.1 Respondents are most supportive counter-drone activities by appropriately authorised personnel

The majority of respondents who provided a comment regarding who should be able to use counter-drone technology stated it should be accessed and used by trained and authorised personnel, such as the police, airport authorities and the military (Figure 14). Many stated explicitly that the technology should not be made available to the general public:

> *'It should be used to counter the threat and unlawful use of RPAs, I would be more than happy for the enforcement body, police or emergency services for example, to possess it. But not publicly available.'*
>
> - a recreational RPAS pilot

- *'Should only be made available for use by trained, licensed and authorised people. The last thing you want is counter drone technology in the hands of untrained general public. Should only be used in situations where the safety of others is in jeopardy or to prevent flying of RPAs in restricted zones.'*

-

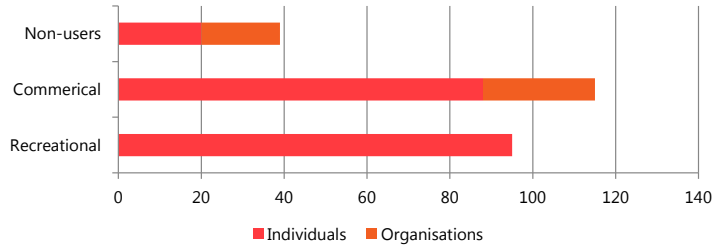
- a commercial RPAS pilot.

Figure 14 | Views on who should be able to use counter-drone technology (number of comments)

Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

Support for counter-drone technology being utilised by law enforcement personnel is strong across users of RPAS as well as non-users (Figure 15).

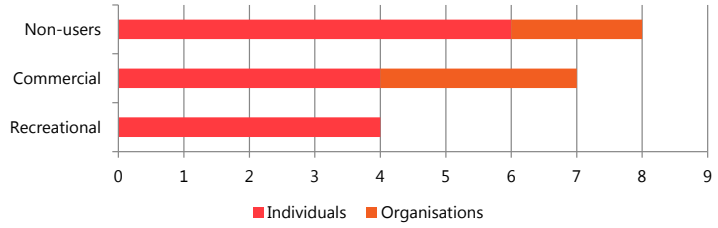
Figure 15 | Support for counter-drone technology use by law enforcement (number of comments)



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

A much smaller number of respondents (19) expressed support for the technology being made available to the public and commercial users (Figure 16). The majority of these are non-RPAS users. As the number of non-RPAS users responding to the discussion paper is much less than the number of users, this indicates a relatively strong response. These respondents' comments also indicated the need for licencing and registration arrangements for the use of counter-drone technology by non-law enforcement personnel.

Figure 16 | Support for public/commercial use of counter-drone technology (number of comments)

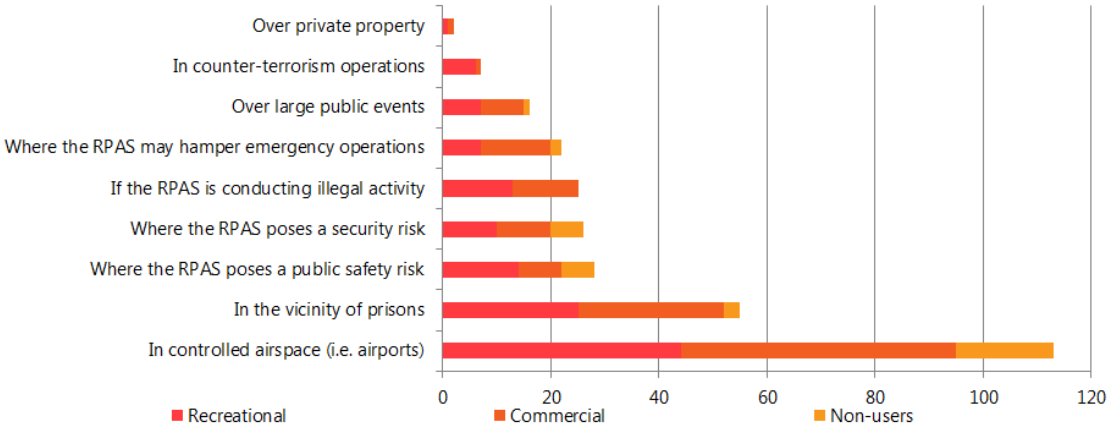


Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

7.2 Use of counter-drone technology in controlled airspace has the strongest support

Respondents provided a range of views regarding the appropriate circumstances for the use of counter-drone technology. Figure 17 shows that the strongest support was for the use in controlled airspace (around airports), followed by use in the vicinity of prisons and where the RPAS may cause a safety or security risk. Only a very small number (two respondents) were in favour of the use of counter-drone technology on private property.

Figure 17 | Views on circumstances for the use of counter-drone technology (number of comments)



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

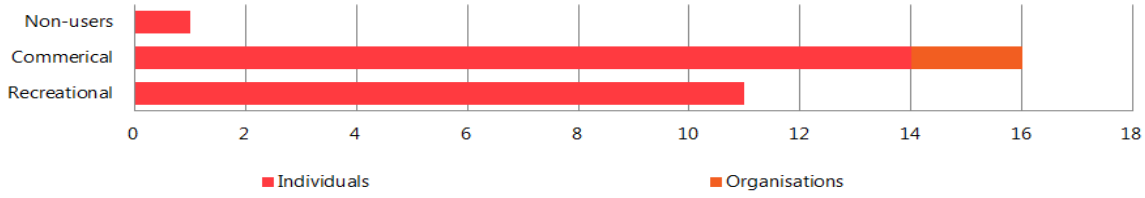
A theme that was present among recreational and commercial RPAS users, but not present for non-users, was that the RPAS must be conducting illegal activity to initiate the use of counter-drone technology. These respondents expressed concern that the technology may be used inappropriately against their RPAS:

> *'When a drone is being used to carry out intention [sic] illegal actions then it is required. Someone flying in the wrong area but not hurting anyone shouldn't have there [sic] property destroyed.'*
>
> \- A recreational RPAS user

7.3 A few respondents disagree with development and use of counter-drone technology

Of the 670 respondents who provided a comment on the use and management of counter-drone technologies, 28 were explicitly against their use. Figure 18 shows users of RPAS, both commercial and recreational, more often indicated they were against the use of counter-drone technology than non-users.

Figure 18 | Views against the use of counter-drone technology (number of comments)



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

The reasons stated for not agreeing with the use of counter-drone technology included concerns for safety if RPAS were to become uncontrolled or fall and the likelihood the technology would enable 'vigilantism' causing RPAS to be damaged unlawfully. Comments provided also suggested that counter-drone technology is not required at this point in time, as the threat of RPAS conducting illegal activities is viewed as overinflated. This group of respondents suggested greater effort should be placed in registration and tracking systems, pilot education and enforcing existing laws through the police.

> *"There should be a total ban on counter-drone technology that removes a drone from the air in an uncontrolled or dangerous way. A drone falling from the sky in an uncontrolled manner poses*

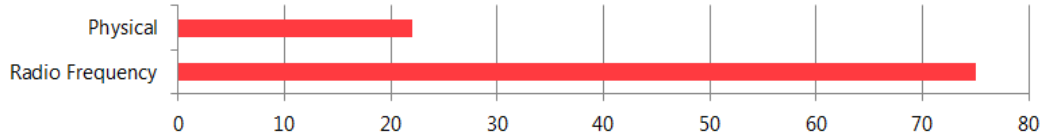
more of a risk than that drone flying illegally and remaining in controlled flight. There is no way any one individual or organisation can know if any drone that they perceive to be flying illegally should actually be flying or not, and then have the authority or right to shoot it down. The best way to deal with illegal drone flying is to follow the drone to its landing area, and then document, fine, arrest or take other enforcement action AFTER the drone has landed safely. On this same note the public and authorities should be educated that they should not interfere with an operator on the ground. Harassing or grabbing controls and the like will only make any dangerous situation worse."

- a recreational RPAS user

7.4 Radio frequency is respondents' preferred counter-drone technology for CASA to focus its attention towards

Respondents provided comments on aspects of counter-drone technology, or its potential uses, to which CASA should devote more attention. Their comments indicated more interest in the exploration of radio frequency, rather than physical, counter-drone technologies (Figure 19).

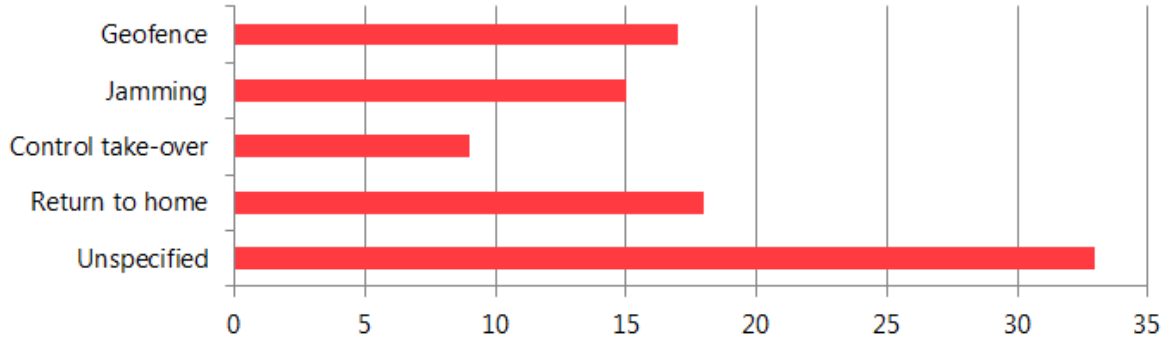
Figure 19 | Support for CASA's attention to counter-drone technology (number of comments)



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

Within the use of radio-frequency counter-drone technology development, respondents' comments indicated a variety of areas they would support CASA exploring further. A mechanism for offending RPAS to be forced to 'return to home' was the most common area, followed by further exploration and development of geo-fencing solutions (Figure 20). This was consistent with the concern that counter-drone technology should not cause danger to the public nor damage the RPAS.

Figure 20 | Radio frequency counter-drone technology for CASA's focus (number of comments)



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

In relation to physical counter-drone technology, respondents discussed the use of nets and trained birds, though the number of comments on these was low (Figure 21).

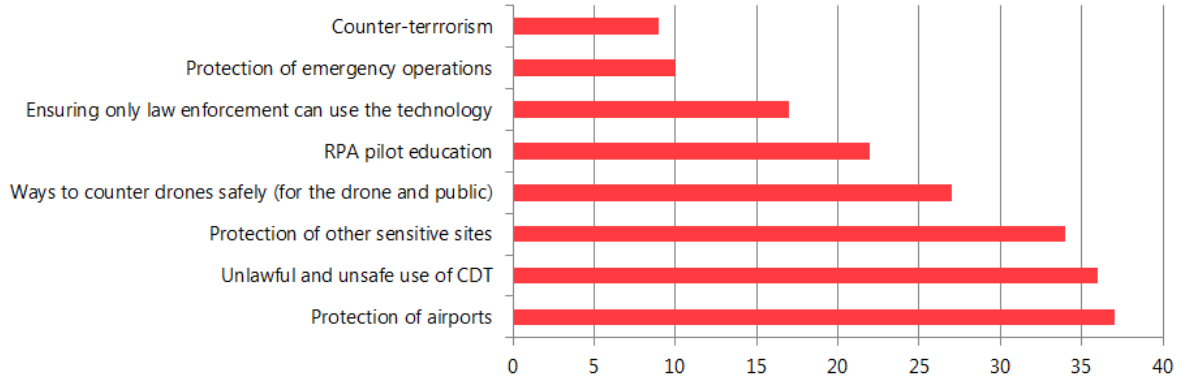
Figure 21 | Suggestions for physical counter-drone technology (number of comments)

Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

7.5 Respondents view the protection of controlled airspace as the priority focus for CASA

Priority aspects of counter-drone technology nominated by respondents for CASA's further attention included the use of the technology to protect controlled airspace, ensuring the safe and legal use of the technology and to protect sensitive sites (Figure 22).

Figure 22 | Aspects of counter-drone technology for focus from CASA (number of comments)



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

A number of respondents commented that counter-drone technology is outside of CASA's remit (12 respondents), as they do not view the technology being directly related to aviation safety. This group consisted of three commercial pilots, six recreational pilots, one RPAS organisation and two non-RPAS organisations. These respondents generally saw law enforcement agencies as the more appropriate area of government to be investigating counter-drone technology.

In addition to the comments discussed above, 17 submissions also provided views on 'counter-drone' technology. A clear majority of these (14 submissions) stressed that only law enforcement and/or defence agencies and personnel should be authorised to use counter-drone technologies. This is due to the perceived risks this technology would pose if it were to be misused intentionally or unintentionally. Submissions presenting this view were provided by: emergency services; airlines; airports; RPAS operators and; other private citizens. The submissions indicated general concerns regarding counter-drone technologies in three key areas:

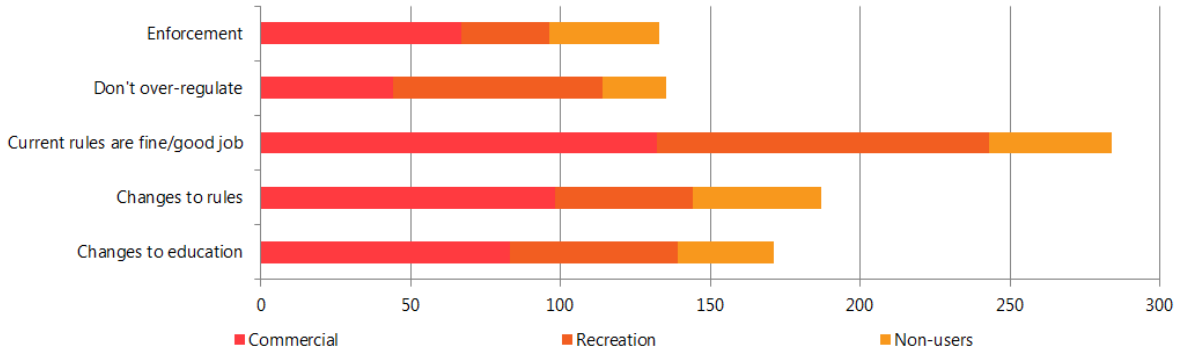
- whether counter-drone technology should be treated as a backup
- whether counter-drone technology could be safely employed without endangering manned aircraft, particularly if this technology involved jamming radio-frequencies
- that more discussion was needed on the unintended consequences of using counter-drone technology, specifically in the vicinity of aerodromes and other critical infrastructure.

Other submissions indicated similar views despite not explicitly stating that only law enforcement/defence agencies should have access to counter-drone technology. These submissions indicated that there was a need to examine the benefits of counter-drone technology to mitigate threats from unauthorised or rogue RPAS operators in order to protect critical infrastructure or other high value assets. These views were provided by an airport, a counter-drone technology solution provider, and a defence industry corporation. The defence industry corporation also flagged that counter-drone measures should not endanger the public, manned aircraft or RPAS users.

8 Respondents presented a wide range of views in relation to CASA's approach to regulation

Respondents provided additional comments on whether CASA is doing enough of the right kinds of things, with respect to both current circumstances and the future. Figure 23 presents the five most common themes within these comments. The most commonly commented theme was that the current rules are appropriate/CASA is doing a good job. Details of these are discussed below.

Figure 23 | Key themes of comments in relation to CASA's approach to regulation (number)



Source: On-line feedback provided in response to CASA's Review of RPAS Operations Discussion Paper

8.1 Views diverge on whether current rules are sufficient, should be strengthened, or relaxed

The theme which attracted the most commentary discussed the current rules and/or CASA's performance. A total of 284 respondents agreed that the current rules are sufficient and/or thought that CASA is currently doing a good job (Figure 23).

Discussion of changes to rules was the next most frequent theme to emerge from the comments. Comments in this theme mostly related to strengthening rules (42 comments). This aligns with concerns held by many non-users of RPAS that inexperienced recreational operators pose a significant risk. The minimum allowable age for someone to operate an RPAS was raised a number of times in this context. A number of helicopter pilots raised strong concerns specifically about RPAS operating in their shared airspace below 400 feet.

Many commercial operators also noted that stronger rules would be of benefit. Many of their comments related to their significant investments in their businesses being devalued by the recent softening of regulatory requirements for RPAS less than 2kg. This change is seen as enabling a significantly lower barrier to entry for inexperienced, rogue, RPAS operators to provide aerial imaging services and undercut the prices of established and legitimate businesses.

However, not all comments indicated a desire for stronger rules. Many comments were in relation to a weakening of some rules being preferable (30). Many recreational users presented this view. This was often due to views that current rules are overly restrictive and do not keep pace with technological developments. Rules with respect to height limits and Visual Line Of Sight (VLOS) operations were frequent examples. Most of the remaining comments in relation to changes to rules were requesting clarification of rules due to confusion by operators.

8.2 Respondents indicate more should be done to improve inexperienced RPAS operators' knowledge of the rules

The third most frequent theme to emerge was changes to education (Figure 23). This reflects that many respondents across all groups expressed concern not only with inexperienced operators' technical skills, but also that many are ignorant of current rules. There is much appreciation and support for CASA's app (*Can I Fly There?)* but many feel more can be done. Several respondents noted that inexperienced operators are often unaware that rules are even in place and so broad awareness campaigns would be beneficial. An often cited method to increase awareness of current rules was to improve the knowledge of retails staff members that sell RPAS. Many respondents noted that many new RPAS users would happily comply with the rules if they were aware of their existence. Having staff do so at point of sale was identified as an effective way to achieve this, but that the staff's knowledge of the rules was lacking.

8.3 Many respondents raised concerns about over-regulation and low enforcement of existing rules

Another key theme related to concerns that CASA will over-regulate the use of RPAS (Figure 23). This view was mostly presented by recreational users, particularly those operating RPAS below 2kg. However, this view was not held exclusively by recreational users. For example, organisations within the RPAS industry expressed concerns that innovation and economic growth in the industry would be impeded if regulation was too restrictive. A number of users in regional/remote areas voiced concerns that rules required in populous areas will be enforced on them when they are not relevant.

> *"RPA's are becoming an important tool for farmers, surveyors, engineers and scientists. Having a requirement to register machines only adds burden and complexity to [sic] new and innovative field which is still developing and changing. I don't believe that registering RPA's, owners or operators will achieve the desired outcome of reducing unlawful activity, as those who wish to do the wrong thing will simply avoid registering machines. Also this will be a huge enforcement burden for police."*
>
> - a farmer

Issues to do with enforcement of rules were also frequently raised (Figure 23). This theme was raised by both RPAS users and non-users. These comments usually referred to safety concerns, however, privacy concerns were also often raised. When privacy was raised it was frequently with much passion, and an acknowledgement that privacy is beyond the scope of the discussion paper.

8.4 Consistent themes also emerged in the written submissions

Of the submissions provided in response to the discussion paper, 16 presented views in relation to CASA's approach to regulation. Of these, 7 indicated a view that CASA was not on the right path. This view was expressed by: four aviation services; one RPAS services entity; one legal services firm; and a private citizen. Reasons for this view included:

- lagging behind e-identification and e-tracking technologies, geo-fencing and integrating airspace between manned aircraft and RPAS
- the current regulatory regime being "out-dated" in its thinking and application
- compromising the safety of air navigation by deregulating commercial drones.

Five submissions indicated that CASA was on the right path but could do more in the following areas:

- improved consistency in advisory and educational resources

- removal of restrictions such as those placed on the use of RPAS for commercial operations
- increased investment in education and awareness campaigns so that RPAS users understand their responsibilities, the regulatory environment, and risks associated with operating RPAS.

Of these five submissions, three were from aviation services, one from a professional services advisory firm, and one from an airline.

Three submissions representing emergency services, an airport, and a technology company, said that CASA was doing the right things across the following areas:

- applying a risk management approach to the regulation of RPAS
- launching the *Can I Fly There?* app
- commitment to developing a roadmap for future RPAS regulation.

9 Further responses reinforced feedback provided in other questions

Respondents to the discussion paper were also able to provide comments on any other issues or factors they believed CASA should take into account when considering its approach to the regulation of RPAS. 439 respondents took the opportunity to provide additional free text commentary. The responses in the free text field generally aligned with the responses provided in earlier responses. This was also the case for submissions as they provided further detail on the areas of consideration put forward by the discussion paper.

The final free text commentary of the on-line questionnaire reflected that many respondents appreciated the consultation process and welcomed the opportunity to be engaged the discussion. 51 of the 439 responses noted an appreciation of the community and stakeholder consultation and many users thanked CASA for the opportunity to provide feedback. 90 of the 439 comments noted that CASA is doing a good job overall. A number of users were optimistic that CASA's active engagement of stakeholders will lead to the development of robust solutions:

> *"Congratulations, CASA on being innovative, collaborative, realistic, pragmatic and positive in your measured approach to date. And for your forward thinking broader engagement that can only produce a workable, innocuous, widely and readily adopted framework."*
>
> - a recreational RPAS user

Further details of the commentary provided in the final responses provided in the on-line questionnaire are presented below.

9.1 Many responses focused on regulation, raising awareness and enforcement

The most consistent emerging theme from the final comments was the need to not over regulate (93 comments). Multiple comments reflected a concern that negative media coverage in relation to RPAS may lead CASA to impose significant restrictions on RPAS and users. These comments noted that any additional regulatory requirements should consider both the cost (implementation and enforcement) and the benefit of regulation prior to implementation.

77 comments suggested changes to the regulation or the development of new rules, this included:

- changes to registration and licensing requirements
- banning recreational users
- minimum operating ages
- minimum training requirements
- restrictions on RPAS retailers
- insurance requirements

In addition to the above suggested changes, multiple respondents highlighted the need for regular reviews of existing rules to ensure CASA kept pace with technological developments.

Commentary relating to changes to rules also focused on the need for certainty for companies and operators and the need for simplification of rules and affordability and accessibility of support to ensure compliance.

> *"The Christmas toy boom season is where the current rules are ignored due to the lack of education. Creating multiples of new rules will only harm the RC enthusiast and not have any effect on the current problems created by casual law ignorant users."*
>
> - a recreational RPAS user

A significant number of respondents (62 comments) focused on the need for education in order to communicate the rules to a broader audience. The *Can I Fly There* app was noted in 15 responses, 13 of which noted the positive benefit of the app in enabling users to safely operate an RPAS.

A number of respondents focused on the need to consistently enforce existing rules (59 comments). Multiple respondents noted that there are relatively limited consequences for non-compliance with current rules and expressed frustration at amateur users who were not compliant with the rules yet did not appear to be penalised for non-compliance. Five responses specifically noted instances of drone footage being broadcast through social and traditional media that was not compliant with the CASA rules and regulations.

> *"Regulations without enforcement are a waste of time and money"*
>
> - an individual commercial RPAS user

9.2 Free text comments did not address other aspects of the review as frequently

Within the free text commentary there was limited consideration of geo-fencing (12 comments) and counter-drone technology (5 comments). Of the comments referencing geo-fencing there was again a diverse range of opinions both for and against geo-fencing. In relation to counter-drone technology and its appropriate use, responses were divided with a split between respondents who were against counter-drone measures and respondents who were for counter-drone measures under appropriate circumstances.

Some of the responses covered in the free text commentary called for action that was beyond the role of CASA. This included; managing privacy concerns and consideration of individuals right to privacy in public spaces, calls for penalties for media organisations who use footage created by non-licensed operators, and working with other government departments to develop drone safe zones.