NSW RFS Monaro FCC Helipad – Rotor Downwash Review

Prepared for NSW Public Works Advisory

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CONTENTS

1 MINIMUM HELIPAD CLEARANCE REQUIREMENTS

Refer to 7: Annexure B: Concept Layout Design for illustration of conceptual layout of the helipad.

These must be regarded as the **MINIMUM requirements** in accordance with:

- CASA Advisory circular 139 R-01 Guidelines for heliports design and-operation.
- CASA Advisory Circular 91-29 Guidelines for helicopters suitable places to take off and land.

Based on the application of the D-value being 20.0m the following required clearances are required:

Table 1-1 - Essential Clearance Areas

Characteristic	Classification	Dimension
D-value	D	20m
TLOF	1D	20m
Helicopter Stand	1.2D	24m
FATO	1.5D	30m
Protection Area	2D	40m
Helicopter Safety Area	2D	40m

2 ROTOR DOWNWASH

Rotor downwash occurs during helicopter hover in close proximity to a ground surface. It has the potential to cause significant damage to nearby vehicles and objects, as well as people. Rotor downwash considerations are recommended in AC 139.R-01 v1.0 Section 2.2.2, which infers that NO non-essential personnel or any objects, structures that can be blown loose should be within 2 to 3 x Rotar Diameter of the FATO. Refer to Annexure A: Aircraft Downwash Data and Beaufort Wind Force Scale.

In the case of the RFS Monaro FCC, this stipulates an area of radius 64.08m from centre of the helipad (Refer to **Figure 2-1: Site Plan**). This impact area needs to be kept clear of people and cars unless there is some sort of physical barrier to protect them from the helicopter downwash.

The downwash area (radius of 64.08m) is shown below as a red hatched circle area for the critical aircraft (UH-70). This hatch area does infringe the northern, eastern & western boundaries. With the northern & eastern exposures being vacant and open grassland area while the western exposure consisting of several industrial sites. It should be noted that the other considered design aircraft (AW139 & B412) only infringe the eastern boundary of the site.

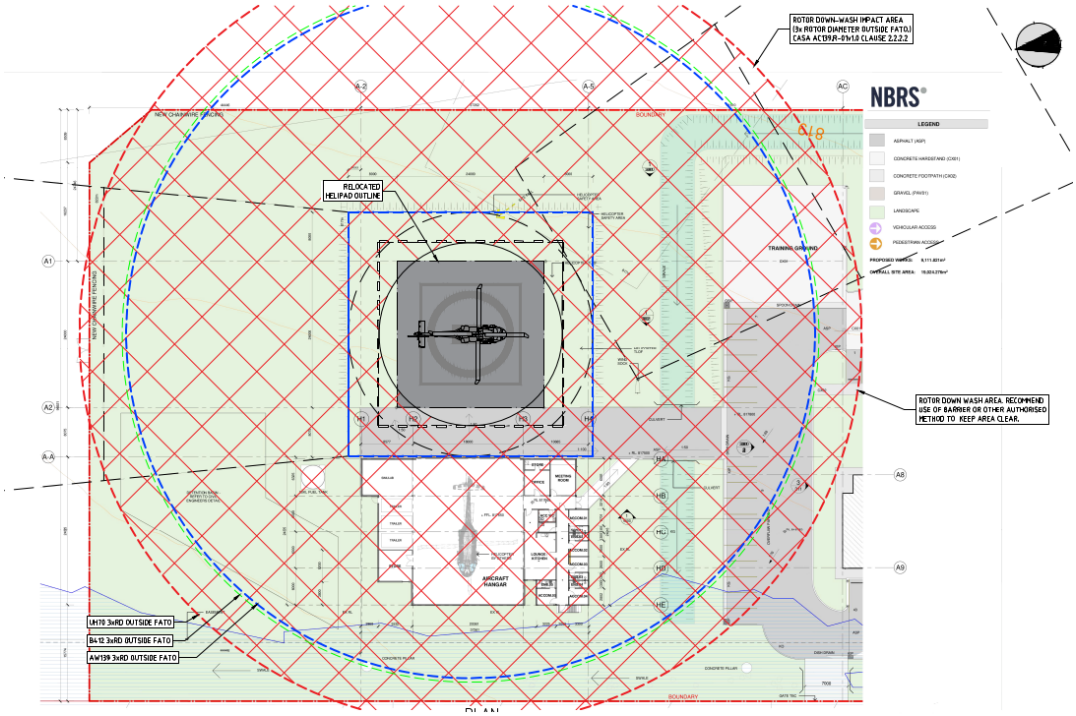


Figure 2-1: Site Plan

Table 2: Summary of potential risks to people, buildings, aircraft and helicopters

Risk	Risk Description	Risk Mitigation
People	*Secondary effects of Foreign Object Debris (FOD) such as dust and sand or other objects becoming airborne causing injury*	*Ensuring that the helicopter movement areas have an appropriate surface and designing helicopter movement areas away from people*
Buildings	*Operational effects on hangars and other building structures resulting in damage to cladding or other structure elements exceeding wind design loads*	*Designing the helicopter movement areas away from buildings or ensuring buildings are designed to withstand additional load*

While not directly related to helicopter rotor downwash, Australia's Civil Aviation Safety Authority (CASA) currently defines the recommended maximum wind velocities affecting people, objects and buildings in the vicinity of an aeroplane in the Manual of Standards (MOS) Part 139.

AC 139.R-01 v1.0 Section 2.2.2 refers to downwash:

2.2.2.1 When manoeuvring at slow speeds, especially during take-off and landing, helicopters generate significant rotor downwash extending out to a distance of 2 to 3 rotor diameters below the generating aircraft. This downwash produces effects comparable to high and gusty wind conditions which may cause building materials (e.g., roofing and cladding), fixtures and light structures to become detached.

2.2.2.2 The design of a FATO should minimize the exposure of persons or loose objects to the downwash of helicopters. Within a distance of 3 rotor diameters from the FATO, no loose objects or light cladding should be allowed in areas which might be overflown by helicopters at low level, and no non-essential personnel should be present in these areas during helicopter operations. The backwards or sideways initial climb phase of a category A procedure should also be considered when assessing areas sensitive to the potential exposure to helicopter rotor wash. Experience suggests, when adopting these procedures, the characteristics of the downwash may exhibit a hard jet on the surface, which though localized, can nevertheless be quite intense.

*2.2.2.3 Provided the elements of the infrastructure surrounding the heliport are designed to withstand gusty conditions up to **Beaufort scale 10/11**, no extra measures should be required to protect the structure against regular planned helicopter operations.*

3 APPROACH AND TAKE-OFF PATH ALIGNMENT

Helipads (ground or elevated) have a series of surfaces to protect the airspace from obstacles. These surfaces include Approach, Transitional & Take-off.

There are three slope design Categories (A, B & C), with slopes ranging from 4.5% (1:22.2) to 12.5% (1:8).

The location of the helipad should ensure that these surfaces are not infringed. It is recommended by ICAO Annex 14 Vol 2 that a helipad has two Take-off climb / approach surfaces. They may be in line or at an angle to allow for variable wind direction or perform a missed approach procedure.

The optimal alignment for approach and take-off would be the same or as close as possible to that of the existing Cooma-Polo Flats Airfield Runway 18/36 (180/360degrees). This alignment would need to be validated by Aeronautical Study.

4 HELIPAD POSITION

1. The defined Safety Area, and Protective Surfaces must be regarded as MINIMUM clearance requirements for the Monaro FCC layout and movement.
2. The additional Downwash impact area is a RECOMMENDATION for safety reasons and should also be considered for mitigation in the RFS Monaro FCC layout.
3. For 1 and 2 this implies that the Ground Based Helipad options poses more restrictions to the layout options and height restrictions on buildings, Fences, Trees and development of adjacent properties.
4. An Aeronautical Study and Risk Assessment would be required as an outcome for the helipad. This is in part due to and in consideration of:
    - proximity to the carpark & neighbouring sites.
    - approach and take-off, which may impact on:
        - construction height restrictions,
        - noise pollution and require assessment and approvals.
    - Types of aircraft operating in the area.
    - Take-off and approach paths at bearings 150& 360 magnetic.
    - This study would be conducted on a similar basis as is those being done at in Queensland at Kingaroy, Millmerran, Esk and Laidley, and other high-risk sites in North Queensland at present.

5 SUMMARY

The proposed position of the helipad as shown in **Figure 2-1: Site Plan** generally satisfies the location requirement for the rotor downwash, however the downwash area does extend into the car park and training ground.

Mitigation measures can be used within the site and for the external fence line to make persons aware of the presence of rotor down wash during helicopter take off and landings. These measures can be a combination of signage (internal and on boundary fence), operational awareness inductions & manuals. The proposed helicopter hangar will provide a level of protection to the area outside the western boundary during the initial liftoff and final touchdown of flight.

The indicated flight paths to the north & southeast will need to need to be assessed and a would need to be validated by Aeronautical Study.

Any building or structure within the affected area would need to be assessed by a qualified structural engineer for suitability against the rotor down wash. During aircraft operations the helipad and surrounding areas are to be free of loose items that may present a FOD risk to operating aircraft & immediate vicinity.

6 ANNEXURE A: AIRCRAFT DOWNWASH DATA AND BEAUFORT WIND FORCE SCALE

AC 139.R-01 v1.0 - GUIDELINES FOR HELIPORTS - DESIGN AND OPERATION

A.1.1 The following table provides data on the downwash impact associated with common helicopter types

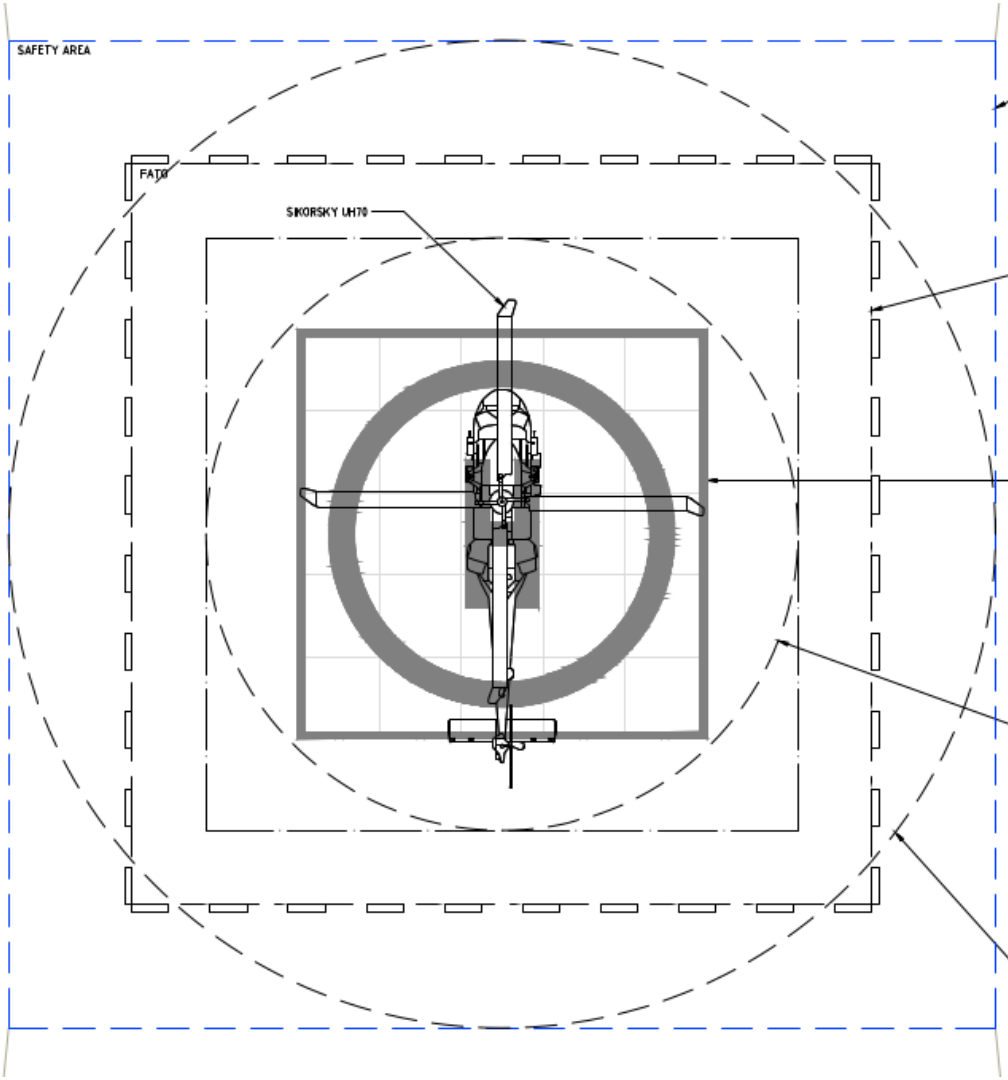
Table 12: Aircraft downwash data

Helicopter Data				Peak Wind Velocity					
Type	MTOW	Rotor Diameter	Disc Loading	Radius @ 40km/h		Radius @ 60 km/h		Radius @ 80 km/h	
	(kg)	(m)	(kg/m2)	(radii)	(m)	(radii)	(m)	(radii)	(m)
AW101	15600	18.6	57.47	7	65	5.5	51	4.1	38
S92	12565	17.2	54.27	6.8	58	5.4	46	4.1	35
H225	11200	16.2	54.34	6.8	55	5.4	44	4.1	33
B525	9299	16.6	42.91	6	50	4.8	40	3.7	31
AW189	8300	14.6	49.58	6.5	47	5.2	38	3.9	29
H175	7800	14.8	45.34	6.2	46	5	37	3.8	28
AW139	6800	13.8	45.46	6.2	43	5	34	3.8	26
H160	6050	13.4	42.9	6	40	4.8	32	3.7	25
Bell 412	5398	14	34.97	5.5	38	4.1	29	3.5	25
S76	5306	13.4	37.57	5.6	38	4.4	29	3.6	24
AW169	4800	12.1	41.61	5.9	36	4.7	29	3.7	22
H145	3800	11	39.99	5.8	32	4.6	25	3.7	20
Bell 429	3175	11	33.41	5.3	29	4	22	3.5	19
EC135	2980	10.4	35.08	5.5	28	4.2	22	3.5	18
UH60	9979	16.36	DATA NOT AVAILABLE						

Beaufort wind force scale

Beaufort wind	Mean Wind Speed			Limits of wind Speed		Wind descriptive	
scale	Knots	m/s	km/hr	Knots	m/s		
0	0	0	0	<1	0-0.2	Calm	Smoke rises vertically. Sea like a mirror
1	2	0.8	2.9	1-3	0.3-1.5	Light air	Direction shown by smoke drift but not by wind vanes.
2	5	2.4	8.6	4-6	1.6-3.3	Light breeze	Wind felt on face; leaves rustle; wind vane moved by wind.
3	9	4.3	15.5	7-10	3.4-5.4	Gentle breeze	Leaves and small twigs in constant motion; light flags extended.
4	13	6.7	24.1	11-16	5.5-7.9	Moderate breeze	Raises dust and loose paper; small branches moved.
5	19	9.3	33.5	17-21	8.0-10.7	Fresh breeze	Small trees in leaf begin to sway; crested wavelets form on inland waters.
6	24	12.3	44.3	22-27	10.8-13.8	Strong breeze	Large branches in motion;
7	30	15.5	55.8	28-33	13.9-17.1	Near gale	Whole trees in motion; inconvenience felt when walking against the wind.
8	37	18.9	68.0	34-40	17.2-20.7	Gale	Twigs break off trees, generally impedes progress.
9	44	22.6	81.4	41-47	20.8-24.4	Severe gale	Slight structural damage (chimney pots and slates removed).
10	52	26.4	95.0	48-55	24.5-28.4	Storm	Seldom experienced inland; trees uprooted; considerable structural damage.
11	60	30.5	109.8	56-63	28.5-32.6	Violent storm	Very rarely experienced, accompanied by widespread damage.
12	-	-	+ 118	64+	32.7+	Hurricane	Devastation. Air filled with foam and spray, very poor visibility

7 ANNEXURE B: CONCEPT LAYOUT DESIGN



HELICOPTER SAFETY AREA,
SIZE = 2D (40m x 40m).
1. THE SURFACE SHALL BE CONTIGUOUS AND FLUSH WITH THE FATO, IS RESISTANT TO THE EFFECTS OF ROTOR DOWNWASH AND ENSURES EFFECTIVE DRAINAGE.
2. ESSENTIAL OBJECTS LOCATED IN THE SAFETY AREA SHALL NOT PENETRATE A SURFACE ORIGINATING AT THE EDGE OF THE FATO AT A HEIGHT OF 25 CM ABOVE THE PLANE OF THE FATO SLOPING UPWARDS AND OUTWARDS AT A GRADIENT OF 5 PER CENT.
3. THE SLOPE OF THE SAFETY AREA SHOULD NOT EXCEED AN UPWARD SLOPE OF 4 PER CENT OUTWARDS FROM THE EDGE OF THE FATO.

HELICOPTER FATO (FINAL APPROACH & TAKEOFF)
SIZE 1.5D (30m x 30m).
1. GRASS SURFACE TO BE CAPABLE OF WITHSTANDING IMPACT OF LANDING AIRCRAFT.
2. MAX SLOPE 2%
3. FATO PERIMETER MARKERS (REFER DRG 5001)

HELICOPTER TLOF (TOUCH DOWN & LIFTOFF AREA)
TLOF TO CONTAIN A CIRCLE SIZE = 0.83D (16.6m).
SURFACE TO BE:
1. HAVE SUFFICIENT BEARING STRENGTH TO ACCOMMODATE THE DYNAMIC LOADS ASSOCIATED WITH THE ANTICIPATED TYPE OF ARRIVAL OF THE HELICOPTER AT THE DESIGNATED TLOF;
2. IS FREE OF IRREGULARITIES THAT WOULD ADVERSELY AFFECT THE TOUCHDOWN OR LIFT-OFF OF HELICOPTERS;
3. HAS SUFFICIENT FRICTION TO AVOID SKIDDING OF HELICOPTERS OR SLIPPING OF PERSONS;
4. IS RESISTANT TO THE EFFECTS OF ROTOR DOWNWASH;
5. ENSURES EFFECTIVE DRAINAGE WHILE HAVING NO ADVERSE EFFECT ON THE CONTROL OR STABILITY OF A HELICOPTER DURING TOUCHDOWN AND LIFT-OFF, OR WHEN STATIONARY;
6. HAS A MAXIMUM SLOPE OF 2%

HELICOPTER STAND
SIZE 1.2D (24M DIA) . SURFACE TO BE :
1. IS RESISTANT TO THE EFFECTS OF ROTOR DOWNWASH;
2. IS FREE OF IRREGULARITIES THAT WOULD ADVERSELY AFFECT THE MANOEUVRING OF HELICOPTERS;
3. HAS BEARING STRENGTH CAPABLE OF WITHSTANDING THE INTENDED LOADS;
4. HAS SUFFICIENT FRICTION TO AVOID SKIDDING OF HELICOPTERS OR SLIPPING OF PERSONS; AND
5. ENSURES EFFECTIVE DRAINAGE WHILE HAVING NO ADVERSE EFFECT ON THE CONTROL OR STABILITY OF A WHEELED HELICOPTER
6. HAS A MEAN SLOPE THAT DOES NOT EXCEED 2%

PROTECTION AREA
SIZE 2D (0.4D OUTSIDE OF STAND = 40m DIA)
THE SURFACE SHALL:
1. BE AN AREA FREE OF OBSTACLES, EXCEPT FOR ESSENTIAL OBJECTS WHICH BECAUSE OF THEIR FUNCTION ARE LOCATED ON IT;
2. BE CONTIGUOUS AND FLUSH WITH THE STAND, AND IS RESISTANT TO THE EFFECTS OF ROTOR DOWNWASH
3. ENSURES EFFECTIVE DRAINAGE
4. EXTEND OUTWARDS FROM THE PERIPHERY OF THE STAND FOR A DISTANCE OF 0.4D
5. SLOPE SHOULD NOT EXCEED 4% UPWARD SLOPE FROM EDGE OF STAND.

HELICOPTER DATA		
HELICOPTER	DIMENSION	"D" VALUE
BELL 412	17.25m	
AW139	16.66m	
SIKORSKY UH70	19.76m	20m

PHYSICAL CHARACTERISTICS ICAO Annex 14 Volume 2		
NAME	DIMENSION	CLAUSE
FATO	1.5D (30m X 30m)	3.1.3
SAFETY AREA	2D (0.25D BEYOND FATO) (40m x 40m)	3.1.9
TLOF (TAKE-OFF & LANDING)	0.83D (16.6m DIA)	3.1.24.b.1.i
HELICOPTER STAND	1.2D (24m DIA)	3.1.45.a
PROTECTION AREA	2D (0.4D BEYOND HELICOPTER STAND) (40m DIA)	3.1.50