CRG / Tripoli Rocketry Association Prefecture #155
Ardlethan Launch Site

Site Specific Recovery Hazard Mitigation Procedures

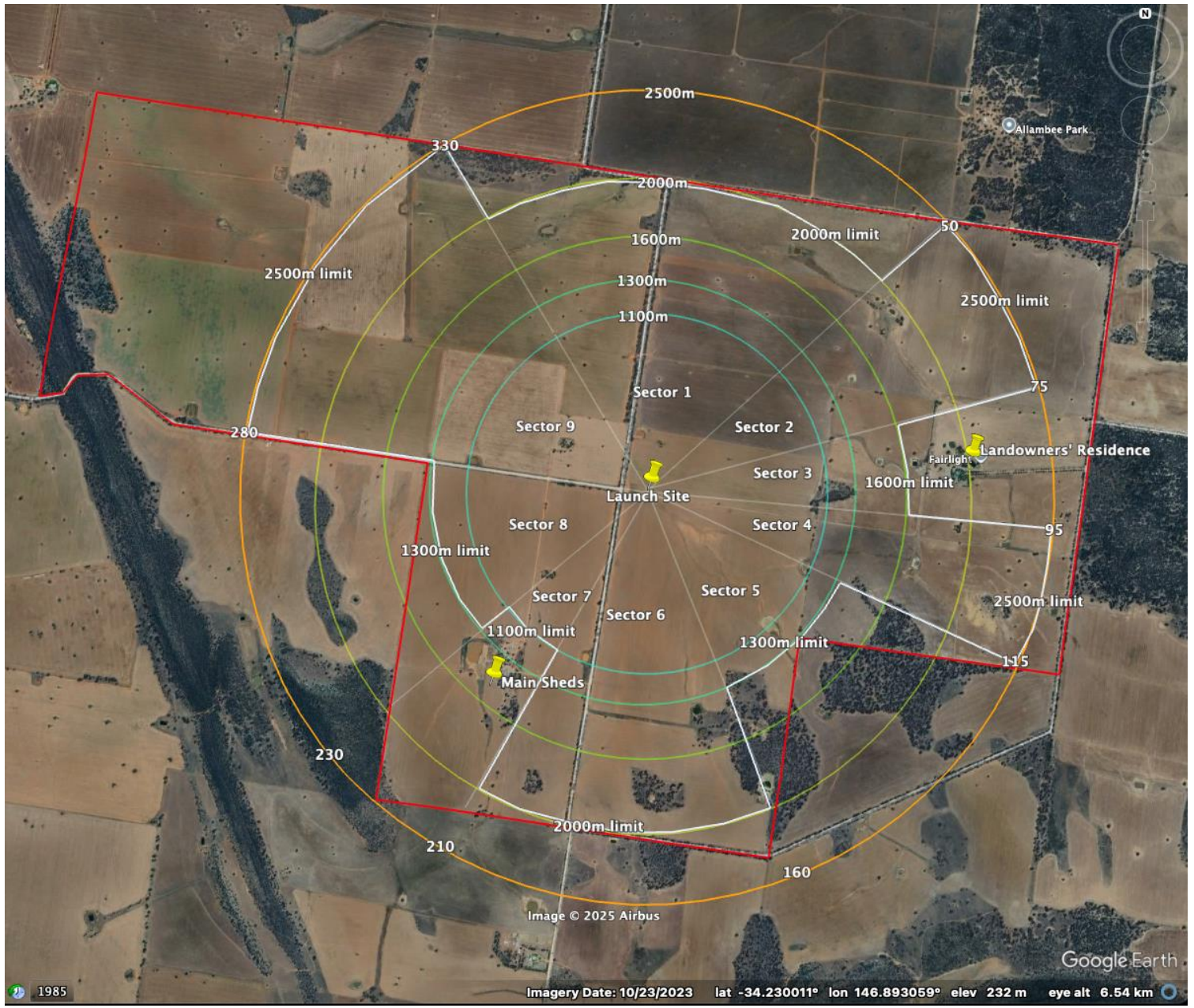
Nominal Flight Recovery Hazard Mitigation Strategy

The purpose of this strategy is to mitigate or prevent the return from apogee under parachute for a nominal recovery outside the landowners' property boundary, or in an area that might be hazardous to the landowner's residence or other co-located buildings, or people, within the site's recovery zone. This strategy would impose limits on:

- Apogee altitude
- Drift distance
- Launch guide tilt & azimuth angles.

These limits are based on the prevailing wind's speed and direction, and the descent rate of the rocket.

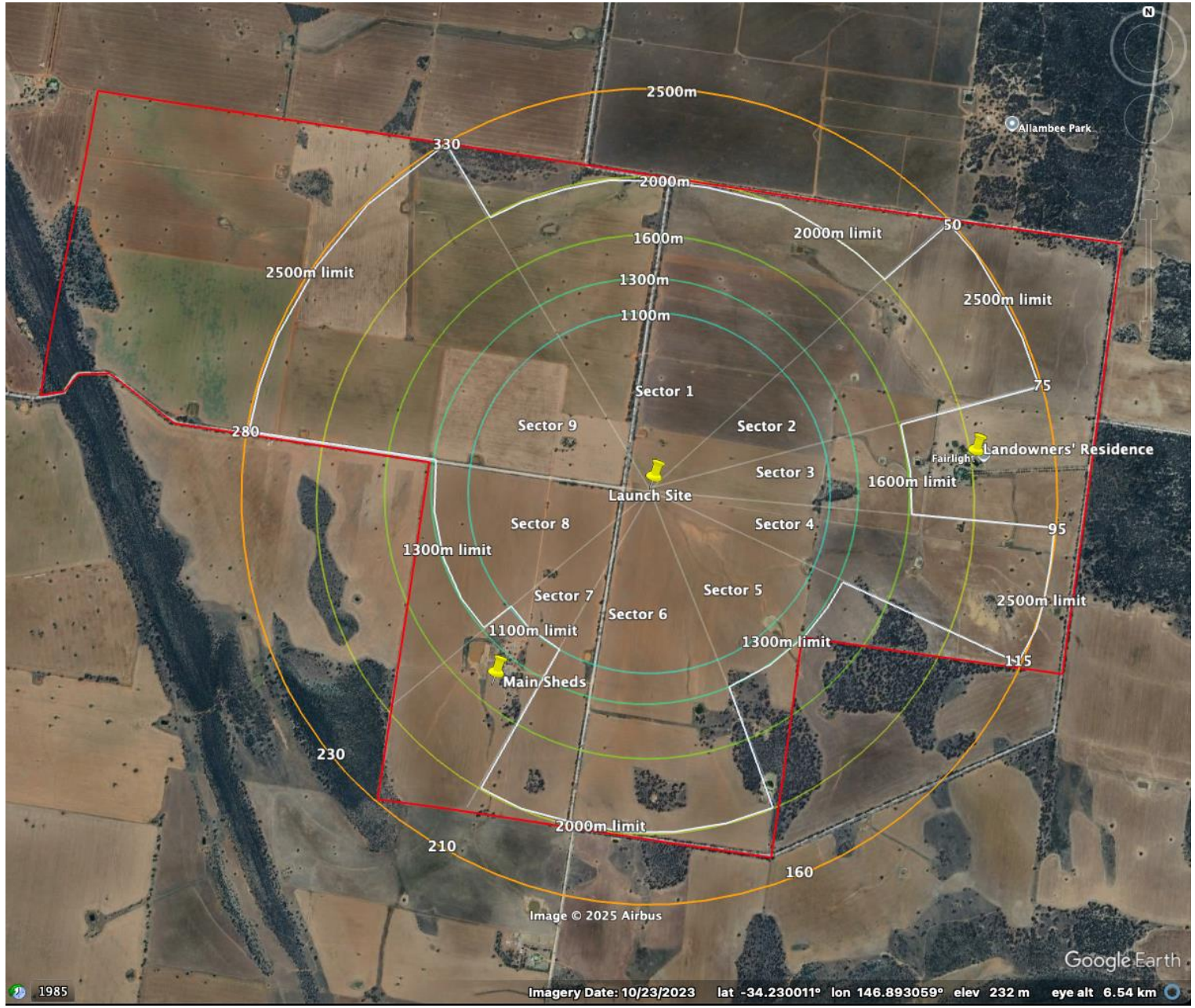
As shown in the adjacent image, there are nine sectors within the recovery zone that would require this level of control. These sectors include the landowner's residence, main shed and storage areas, and the "Fairlight" property boundaries that are within the 2500m zone limit.



Nominal Flight Recovery Hazard Mitigation Strategy (Cont)

Sector #	Drift Sector Radials (°)	Sector Anti-radials (Wind Direction) (°)	Sector Drift Limit (m)
1	330 - 50	150 - 230	2000
2	50 - 75	230 – 255	2500
3	75 - 95	255 – 275	1600
4	95 – 115	275 – 295	2500
5	115 – 160	295 – 340	1300
6	160 – 210	340 – 30	2000
7	210 – 230	30 – 50	1100
8	230 – 280	50 – 100	1300
9	280 – 330	100 – 150	2500

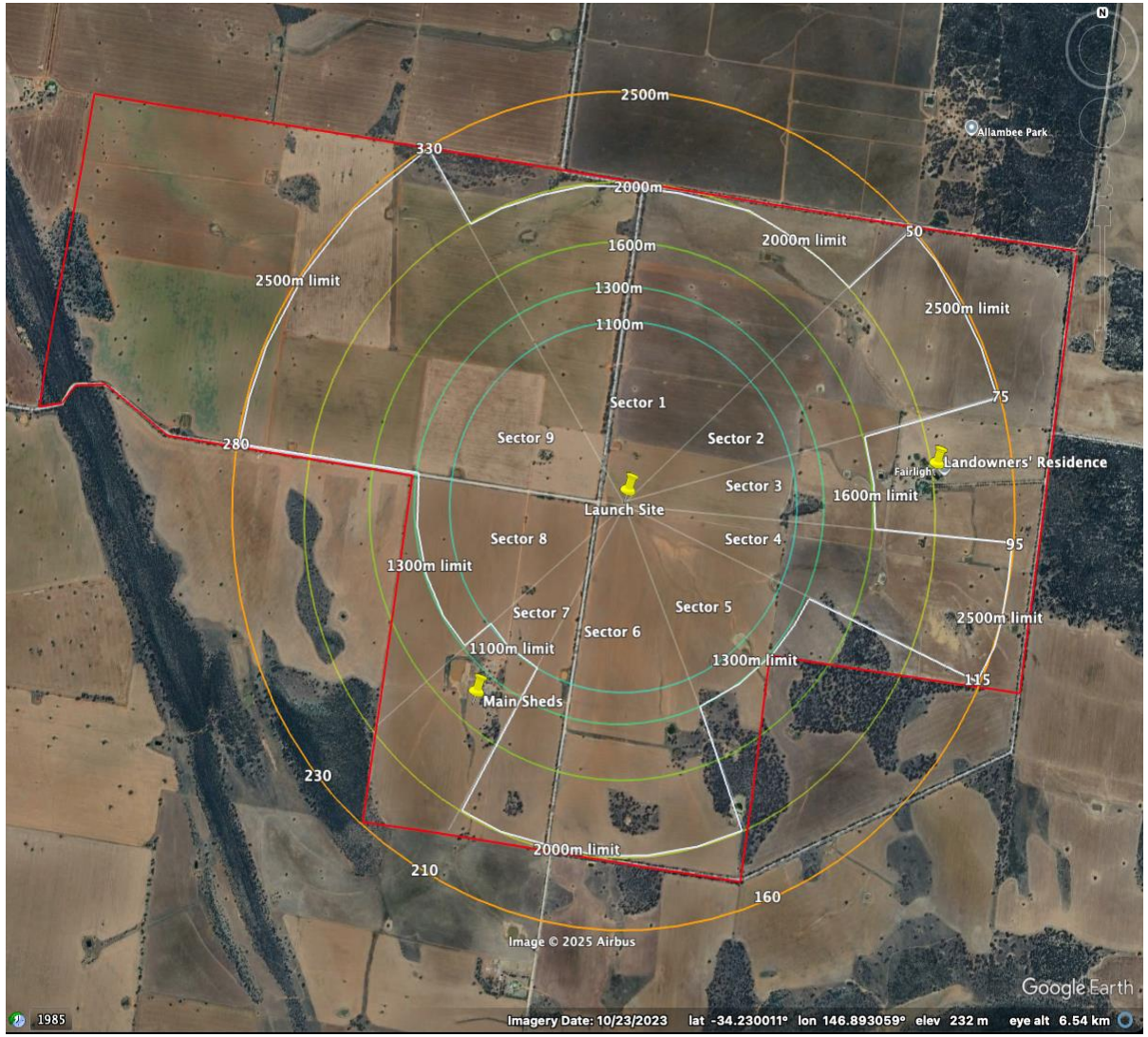
The table above shows the sector details including the sector radials with compass bearings (where 0° is directly North from the launch site), drift limits and the wind direction that defines which drift sector will be used for the calculation. For example, if the wind is coming from a westerly direction, say between 230° - 255°, then the drift will be into Sector 2 which has a 2500m drift limit. If the wind is coming from between 255° - 275°, then the drift will be into Sector 3 which has a 1600m drift limit due to the landowners' residence.



Sector #	Wind Direction (°)	Sector Drift Limit (m)	Maximum Apogee Altitude (ft) Single Deployment		
			Wind Speed 5 km/h	Wind Speed 15 km/h	Wind Speed 25 km/h
1	150 - 230	2000	10000	7800	4750
2	230 – 255	2500		9750	5950
3	255 – 275	1600		6250	3800
4	275 – 295	2500		9750	5950
5	295 – 340	1300		5100	3100
6	340 – 30	2000		7800	4750
7	30 – 50	1100		4295	2600
8	50 – 100	1300		5100	3100
9	100 – 150	2500		9750	5950

Sector #	Wind Direction (°)	Sector Drift Limit (m)	Maximum Apogee Altitude (ft) Dual Deployment		
			Wind Speed 5 km/h	Wind Speed 15 km/h	Wind Speed 25 km/h
1	150 - 230	2000	10000	10000	10000
2	230 – 255	2500			
3	255 – 275	1600			
4	275 – 295	2500			
5	295 – 340	1300			9250
6	340 – 30	2000			10000
7	30 – 50	1100			7850
8	50 – 100	1300			9250
9	100 – 150	2500			10000

The adjacent tables indicate the maximum apogee altitude permitted for the current prevailing wind speed and direction when employing single or dual deployment recovery.



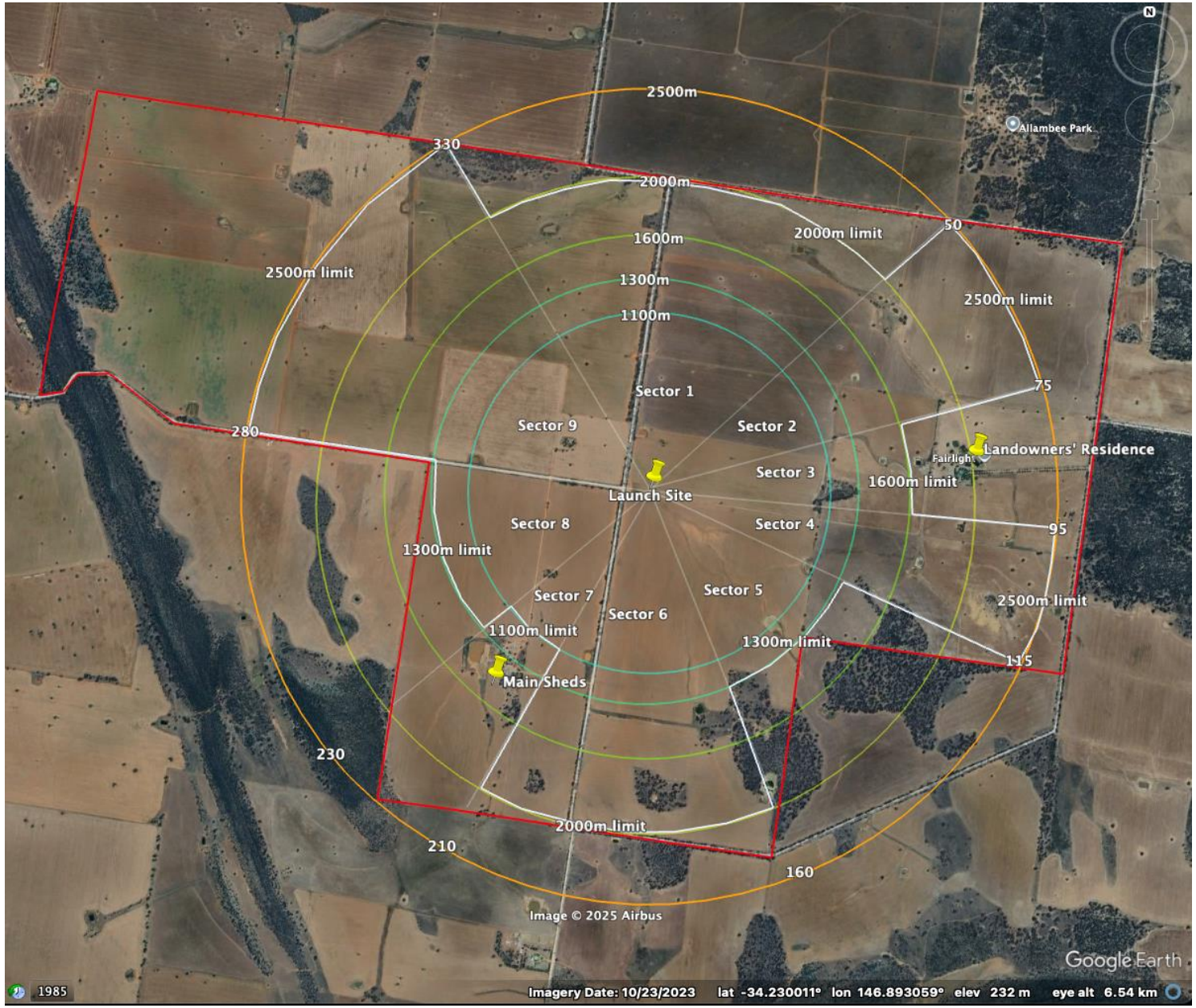
Nominal Flight Recovery Hazard Mitigation Strategy (Cont)

A chart showing the sector altitude limits based on the prevailing wind direction and speed will be displayed near the RSO table. The current altitude limit will be updated periodically throughout the launch session as the wind conditions change.

All flyers are required to review the information on the chart prior to preparing for their next flight to assess what changes, if necessary, are needed in the preparation for their flight, e.g., motor impulse and/or parachute size selection.

While this chart is based on a relatively simple drift analysis calculation, a more sophisticated analysis of where a particular rocket might land is possible through simulations prior to the launch. These simulations would use the multilevel wind data. A detailed description of this analysis is found in Appendix C of the ***CRG Flyers Regulations and Procedures v1.03*** document.

The full description and calculations for this strategy are to be found in the document "***Proposed Mitigation Strategy to Contain Flight Profile to Within the 'Fairlight' Boundary***".



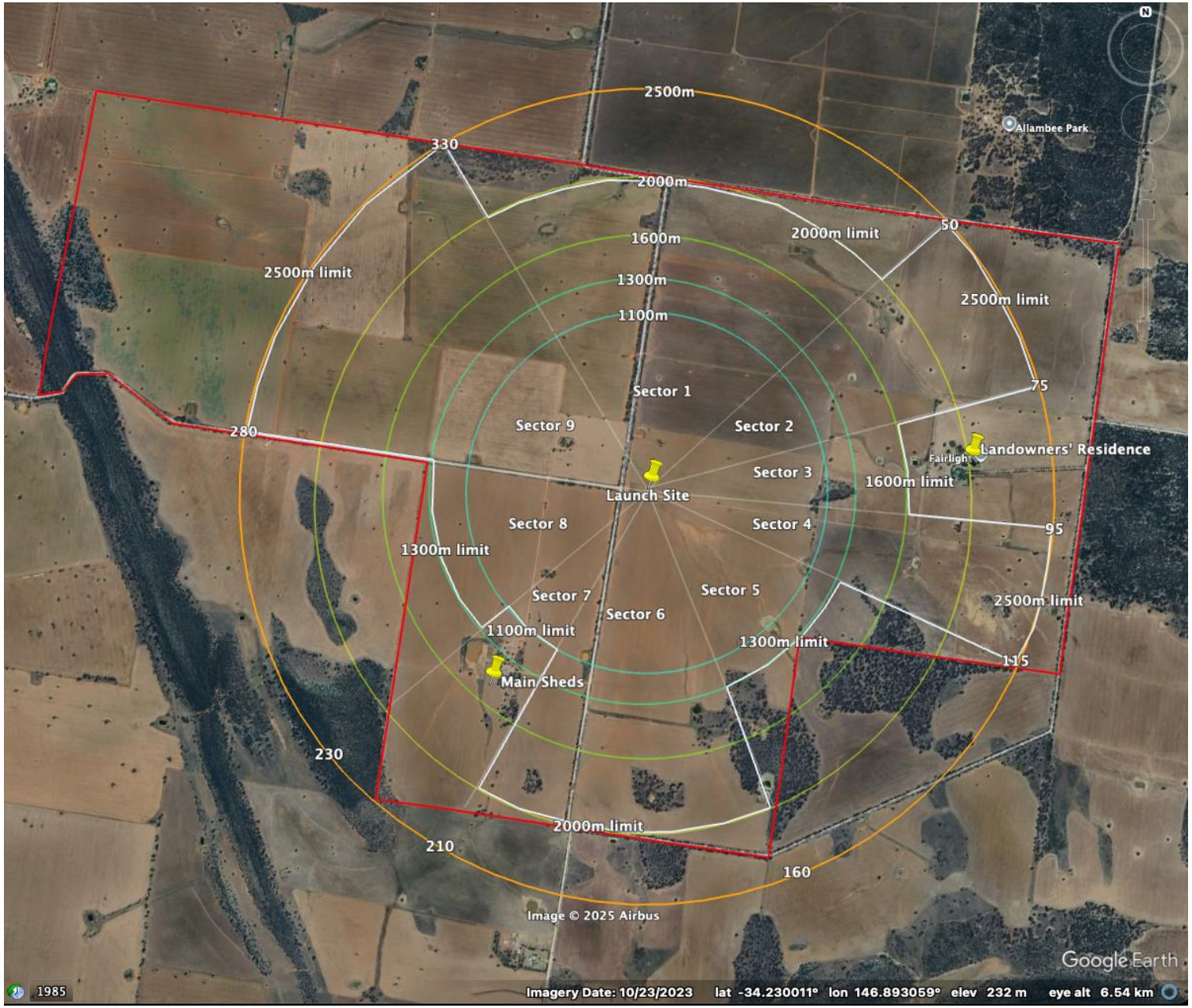
Ballistic Flight Recovery Hazard Mitigation Strategy

Ballistic returns of high power rockets from apogee, while rare, represent one of the most hazardous recovery scenarios. The ballistic range of a rocket can be determined from a simulation with the deployment of the parachute(s) disabled.

The principal input here is the launch guide tilt angle. Typically, the launch angle is from 0° to 10° off vertical, depending on the wind conditions at the time. For high power rockets the maximum launch angle is limited to 20° off vertical, but this would rarely be used.

Simulations using the optimal launch angle and azimuth to compensate for the prevailing wind speed and direction will provide an estimate of the ***nominal expected ballistic range***.

Simulations run with the launch angle set at 20° will provide the ***maximum expected ballistic range*** when the launch angle is set to the maximum allowable tilt.



Ballistic Flight Recovery Hazard Mitigation Strategy (Continued)

The ***absolute maximum ballistic range***, of course, typically results from a launch angle of 45°. This should never occur intentionally.

To avoid ballistic returns into the identified hazard areas or outside the current sector limit within the operation zone, the launch guide angle and azimuth will be adjusted to bias flights into Sector 9 to the Northwest (280°-330°).