TERM OF REFERENCE 3: CLOUD SEEDING

*The causes of the floods which were active in Tasmania over the period 4-7 June 2016 including **cloud-seeding**, State-wide water storage management and debris management.*

1 CAUSE OF THE FLOODS

(a) It is clear that the direct cause of the flooding that affected northern Tasmania (including the Mersey, Forth, Ouse and South Esk rivers) during the relevant period was caused by "*a persistent and very moist north-easterly airstream*" which resulted in "*daily* [rainfall] *totals* [that were] *unprecedented for any month across several locations in the northern half of Tasmania*", in some cases in excess of 200mm.[1]

(b) This paper addresses the Hydro Tasmania cloud seeding flight of 5 June and outlines the conclusion, supported by expert analysis, that it did not cause or contribute to the floods.

2 CLOUD SEEDING

2.1 Overview

(a) Between 10.57am and 12.31pm (1 hour and 34 minutes) on 5 June 2016, Hydro Tasmania conducted a cloud seeding operation over the Western Tiers, just north of Great Lake.

(b) Hydro Tasmania understands community concern about the possibility that the 5 June 2016 flight may have contributed to the flood event.

(c) Significant analysis was undertaken using data from the flight, and findings were published in a report provided to the Government, and released publicly, on 29 July 2016.

(d) That report concludes that the cloud seeding operation had no measurable impact on rainfall on 5 June 2016 because the cloud that was seeded already contained significant ice and was already precipitating freely.

(e) A copy of that report is attached at annexure A.

[1] Bureau of Meteorology's Special Climate Statement 57, issued on 17 June 2016.

2.2 Background to seeding operation

(a) Hydro Tasmania brought forward the start of its cloud seeding season this year as part of efforts to rebuild storages, which were low following an unprecedented dry Spring and Summer and the then current Basslink outage (which later ended on 13 June 2016).

(b) The flight was undertaken both as part of Hydro Tasmania's usual practice of seeking to enhance rainfall over hydro catchments and also having regard to the need for storage recovery given those circumstances.

(c) The decision to undertake the 5 June 2016 cloud seeding flight had regard to water levels in key Hydro Tasmania storages, the forecast weather conditions on the day and the flood warnings issued by the Bureau of Meteorology (BoM).

(d) The operation was undertaken with the intent of enhancing rainfall into hydro storages in the Upper Derwent catchment (including Lake Echo, which was still below its preferred level at that time). Had the seeding flight been successful it was possible there would also have been an effect in the Great Lake catchment, Arthurs Lake and Woods Lake.

(e) There were no flood warnings in place in the Upper Derwent or Great Lake catchments at the time of the flight.

(f) Cloud seeding began at 10:57am, in seeding conditions that were described on the Flight Log as "marginal", and continued for 1 hour and 34 minutes to 12:31pm.

2.3 The impact of seeding

(a) Post-flight analysis of data has shown that the cloud seeding operation had no measurable effect on rainfall on 5 June 2016.

(b) Data collected by the aircraft's instruments and data obtained from the BoM, and analysed post-flight, show the cloud that was seeded on 5 June 2016 already contained significant ice and was already precipitating freely, meaning that in those particular circumstances, any seeding effort to initiate precipitation was redundant.

2.4 Expert analysis by Associate Professor Steven Siems of Monash University

(a) Associate Professor Steven Siems, of Monash University, School of Earth, Atmosphere and Environment *and* School of Mathematical Sciences, has been engaged by Hydro Tasmania to assist it with understanding any impact that the cloud seeding flight had upon rainfall on 5 June 2016 and in the following days.

(b) A/Prof Siems has concluded that the cloud seeding flight undertaken had no measurable impact on precipitation on 5 June 2016 and the following 48 hours.

(c) A/Prof Siems has provided a report dated 8 November 2016. Hydro Tasmania is prepared to disclose that report for the purposes of the Government Flood Review. A copy is attached at annexure B. A copy of A/Prof Siems' curriculum vitae is attached at annexure C.

2.5 Ongoing review

(a) Hydro Tasmania is currently undertaking a review of the cloud seeding program to make improvements in its processes, including in relation to seeding when there is a risk of floods, so that future decisions about cloud seeding are more in line with community expectations.

(b) Hydro Tasmania commenced preliminary consultation with key stakeholder groups in September 2015 including representatives from local councils in municipalities where cloud seeding is undertaken and the Tasmanian Farmers and Graziers Association. Hydro Tasmania is and will continue to actively collect feedback on community concerns in relation to its cloud seeding program from key stakeholder groups.

(c) The initial feedback collected since September this year has been used to scope the cloud seeding review process that is currently underway.

(d) Previous reviews of the cloud seeding program were conducted in 2002 and 2008 in collaboration with key stakeholders in response to community concerns and some improvements to the program were made as a result.

(e) Hydro Tasmania's cloud seeding program remains on hold and will not

resume until the review of the program has been completed, including extensive stakeholder consultation, and any appropriate improvements have been implemented.