

BETWEEN: **CAROL JEANETTE BOOTH**

Applicant

AND: **FRIPPERY PTY LTD (ACN 010 890 007)**

First Respondent

MERVYN MEYER THOMAS

Second Respondent

PAMELA ANN THOMAS

Third Respondent

AFFIDAVIT

Filed on: August 2005

Filed by: Environmental Defenders Office (Qld) Inc

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I, **Dr Hugh John Spencer**, Director of the Cape Tribulation Tropical Research Station, Cape Tribulation, in the State of Queensland, affirm:

1. I have been asked by the applicant to respond to points raised by the affidavit of Mr Mervyn Meyer Thomas (the Second Respondent), affirmed and filed in the Court on 4 July 2005, concerning the potential for the electric grid system operated by the respondents on their "Edenvale" property to cause death, injury or harm to flying foxes. I have also been asked to consider these issues in light of the affidavit of Mr Errol Reginald Young, sworn on 21 July 2005 and filed on 22 July 2005.
2. I have read and understood the "Planning and Environment Court of Queensland Guidelines for Experts". I understand that I have an overriding duty to assist the Court and that I am not an advocate for a party.

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Justice of the Peace / Solicitor

AFFIDAVIT OF HUGH JOHN
SPENCER
Filed on behalf of the Applicant
PEC-5

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Relevant expertise

3. I have studied flying foxes extensively for over 20 years, in particular their biology and ecology. Academically I have a strong background in Zoology, Botany, Animal Physiology, Neurophysiology and Pharmacology.
4. I also have a strong, secondary background in electronic design and construction (a necessary corollary to being a neurobiologist) and have taught “Electronics for Biologists” courses at several universities.
5. My formal academic qualifications are as follows:
 - 1965 Bachelor of Science majoring in botany and zoology at the Australian National University
 - 1971 Master of Science at the University of Manitoba, Canada, on the thesis topic of an analysis of the neural responses of a cockroach trochanteral tactile hair to mechanical stimulation.
 - 1975 Doctor of Philosophy at the University of Manitoba, Canada on the topic of an investigation of the nature of putative synaptic transmitters in the rat corpus striatum.
6. Following the completion of my PhD, I lectured in the Department of Biology at the University of Wollongong between 1978 until 1988. In 1988 I established the Cape Tribulation Tropical Research Station with my wife, Brigitta, with the purpose of creating a not-for-profit facility for researchers from many disciplines and many parts of the world to increase scientific knowledge and help support efforts to protect the unique Daintree lowland rainforests. Since 1988 I have been a Director at the Cape Tribulation Tropical Research Station and since 1992, when it was created, Director/CEO of the Australian Tropical Research Foundation.
7. My fields of research and professional interest include:
 - (a) Tropical ecosystems - cataloging animal and plant diversity, pollination ecology of angiosperms (flowering plants) and biology of bats and insects as pollinating vectors, tropical plants as pharmaceutical sources of pharmaceutical agents.
 - (b) Conservation of tropical ecosystems.
 - (c) Applications of electronic technology to biology, with particular reference to radiotelemetry.
 - (d) Human impact on environmental systems.
 - (e) Development and applications of alternative technology and energy.
 - (f) Development of non-lethal deterrents for flying foxes.

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- 8. I note that in the area of non-lethal deterrents for flying foxes, for the past several years I have been pushing for the development of objective assessment technologies for deterrents. I have developed a prototype operating and analysis system, as well as an electric-fence based “aerial grid” driver, for the Queensland Environmental Protection Agency.

Flying fox classification, biology and ecology

- 9. Flying foxes are large bats (Class Mammalia, Order Chiroptera, Suborder Megachiroptera, Family Pteropodidae, Genus *Pteropus*). I have read and I agree with the summary of flying fox biology, ecology and morphology provided by Dominique Germaine Thiriet at paragraphs 4-5 of her affidavit affirmed and filed on 21 December 2004. I have also read and agreed with the summary of the ecology, reproduction and conservation status of Black Flying Foxes (*Pteropus alecto*) provided by Dr Carol Jeanette Booth at paragraphs 23-29 of her affidavit affirmed and filed on 21 December 2004. I note in particular that flying foxes are vital for maintaining ecological processes in tropical to temperate forests through their role in pollination and seed dispersal of many species of flowering plants.

How electricity kills, injures or harms humans and flying foxes

- 10. A brief explanation of how electricity kills, injures and harms animals such as humans and flying foxes will assist the Court in understanding the effects that the respondents’ electric grids are likely to have on flying foxes.
- 11. A basic definition of “electricity” is the flow of electrons, protons or electric charge. Direct current (“**DC**”) flows in a constant direction. Batteries, for example, deliver DC. Alternating current (“**AC**”) changes direction or alternates from a forward (positive) flow to a backward (negative) flow. Household power outlets deliver AC. AC is substantially more dangerous than DC.
- 12. Electricity is typically measured in units of volts (“**V**”) and amperes or “amps” (“**A**”). A volt is a unit of electromotive force or pressure that causes current to flow. The greater the voltage, the greater the force or pressure for current to flow. Voltage is measured along two points of a circuit, such as two battery terminals. In Australia, 240V is the standard for household appliances. An ampere is a unit of electrical current. More precisely, it is the flow of a certain number of electrons per second.
- 13. An ohm is a unit of electrical resistance. The resistance of a material to electrical current flow depends on the physical and chemical properties of the material. The amount of current flow often determines the magnitude of injury.
- 14. Factors that determine the degree of an electrical injury include the magnitude of energy delivered, resistance encountered, type of current, current pathway, and duration of contact. Systemic effects and tissue damage are directly proportional to the magnitude of current delivered to the victim. Current flow (amperage) is directly related to voltage and inversely related to resistance, as dictated by Ohm’s law ($I=V/R$; where I=current, V=voltage, R=resistance). Of the parameters described by Ohm’s

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law, voltage usually can be directly determined and is used to gauge the potential magnitude of current exposure and, therefore, the magnitude of injury.

15. Electricity flowing abnormally through the body of an organism (whether human or flying fox) produces injury or death in three main ways:
 - (a) by depolarizing muscles and nerves;
 - (b) by initiating abnormal electrical rhythms in the brain (seizures) and heart (ventricular fibrillation); and
 - (c) by producing electrical burns both by heating and by poration (producing holes in cell membranes).
16. The pathway taken by an electrical current through the body determines which tissues are at risk and what type of injury is observed. Electrical current that passes through the head or thorax (that is, the upper body or chest) is more likely to produce fatal injury. Transthoracic currents can cause fatal ventricular fibrillation, direct heart damage, or respiratory arrest. Transcranial currents (that is, currents passing through the head) can cause direct brain injury, seizure, respiratory arrest, and paralysis. Electrical circuits through a person or flying fox that last for protracted periods (minutes) may also produce brain damage if they interfere with respiratory movement.
17. Ventricular fibrillation may lead to a “heart attack” where the heart stops beating. AC current may produce ventricular fibrillation if the path of the current involves a passage through the chest, arm to arm, arm to leg, or head to arm.
18. Electrical injuries may not be visible to the naked eye because electricity “burns” internally due to the heat caused by resistance to the current in tissues. Large currents flowing through body tissues can cause severe internal burns (literally boiling the tissues).

Levels of electric shock that may cause death, injury or harm to flying foxes

19. I have read the affidavit of Mr Mervyn Meyer Thomas, affirmed and filed in the Court on 4 July 2005 and the affidavit of Mr Errol Reginald Young, sworn on 21 July 2005 and filed on 22 July 2005.
20. Mr Thomas and Mr Young discuss whether the electric grid, specifically a version label “MKVII”, is lethal or causes injury to flying foxes based on the Australian Standard (“AS”) 3350, “Electric Appliances for Household and Similar Purposes”. I note that this Australian Standard has been superseded by AS/NZS 60335.1:2002, “Household and similar electrical appliances – Safety – General requirements”. The scope of both AS 3350 and AS/NZS 60335 may be summarised as:¹

¹ Source: SAI Global <http://www.standards.com.au/catalogue/script/Details.asp?DocN=AS428943722126> (viewed 8 August 2005).

- “[AS3350 / AS/NZS60335] deals with the safety of electrical appliances for household and similar purposes, the rated voltage of the appliances being not more than 250V for single-phase appliances and 480V for other appliances. Appliances may incorporate motors, heating elements or their combination. Appliances not intended for normal household use but which nevertheless may be a source of danger to the public, such as appliances intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard [such as are commonly used for cattle fences].”
21. Another Australian Standard is somewhat relevant to these matters, namely AS 3859 “The Effect of Current Passing Through the Human Body”, although this Australian Standard has now been superseded by AS/NZS 60479.1:2002, “Effects of current on human beings and livestock – General aspects”, and AS/NZS 60479.2: 2002, “Effects of current on human beings and livestock – Special aspects”.
 22. Reference to Australian Standards for electrical safety of household appliances and the effects of electric current on human beings and livestock is not particularly helpful for assessing the potential for the electric grids to kill, injure or harm flying foxes.
 23. The limit of 30 milli-amps (“mA”) of AC electric current, which Mr Thomas and Mr Young state is used in the MKVII electric grid, is specified in AS 3859 to limit the possibility of ventricular fibrillation in a human subject. Typically most earth leakage interrupters operate within 50 milli-seconds (“mS”) (that is, 1/20th of a second) to disconnect the electricity supply from the faulty line. However, in the case of the respondents’ MKVII unit, the current is maintained for a nominal one second period, at least 20 times as long.
 24. More important is the current density passing through the body. Flying foxes and humans are both mammals and have very similar thoracic anatomy and tissue composition. A typical normal body weight male human has a cross sectional area of about 710 cm². A flying fox has a cross sectional area of approximately 58 cm² (900 g adult male). The ratio between the cross sectional areas is approximately 12:1.
 25. As a result, the current densities encountered in a human, assuming that the thorax represents an isotropic² saline medium, would be 42 micro amps (“uA”) /cm² (for a current of 30 mA as per AS 3859). For the flying fox, the current densities would be 520 uA/cm² (or about half a mA/cm²). That means that flying foxes experience 12 times the current density experienced by a human. In other words, a 30 mA current limit for humans is experienced as equivalent to a 360 mA current by a flying fox (assuming that the current path would be from the wings to the legs and/or lower abdomen, the most probably path for a bat caught by the legs). This is well above the lethal threshold, regardless of the age, condition or size of the bat. That the body is not isotropic is acknowledged, but the distribution of tissues in a flying fox and human are about the same, and so the simpler analysis still holds.

² That is, of equal physical properties along all axes or the same in all directions.

- 26. To achieve the equivalent current densities in a flying fox, the current in the electric grid would have to be reduced to 2.5 mA (which is about half the current limit claimed for the superseded Mark IV controller).
- 27. Thus at the levels of operating the MKVII electric grid, there is a very high probability that entangled or paralysed animals will die of electrocution. Given the issues of relative current flux through the body, and the resultant higher expectation of frank electrocution, I would say that the MKVII fence controller would kill, injure or harm flying foxes (using a plain meaning definition of these words).
- 28. Black Flying Foxes generally give birth during November-December each year, coinciding with summer food availability. Newborn flying foxes cling to their mothers in flight. This means that female flying foxes that encounter the respondents' electric grids have special vulnerability to electric shock potentially causing an abortion or harm to a fetus or newborn flying foxes clinging to their mother. The potential to kill, injure or harm unborn or newborn flying foxes in this manner has not been tested and cannot be tested for ethical reasons. There is, however, little doubt that if adults can be killed by the MKVII electric grid, then fetuses and newborn flying foxes will also be killed or injured.
- 29. As explained above, electrical injuries may not be visible to the naked eye. In addition to potentially causing a heart attack, electricity "burns" internally and, therefore, a flying fox that flies away from an electric grid may die of internal injuries at a later time. It is very difficult to calculate how many flying foxes might be injured in this manner.

Duration of current

- 30. A current level of 360 mA would probably be lethal if applied for 0.5 seconds. The one second ON cycle used by the respondents' in the MKVII electric grid would definitely kill any animals that were unable to get away.

"Frapping" is not likely to be a cause of death

- 31. Mr Thomas suggests at paragraph 18-19 and 69(vii) of his affidavit that the deaths of flying foxes he observed on his grids were not caused by lethal electric shock but by mechanical entrapment which he refers to as "frapping". This puzzles me. A bat experiencing tetanic contractions (that is, muscle and nerve spasms) due to an electric shock, could conceivably hook its wings through wires and get entangled, but I do not see how the wires themselves can get twisted, especially if the wires are under adequate tension.
- 32. I do not consider that the "frapping" Mr Thomas refers to could have caused the death of the flying foxes. In my opinion the deaths almost certainly resulted from electrocution. As explained above, the level at which the MKVII electric grid operates is sufficient to kill a flying fox.

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Ease of modification of the electric grids

33. I do not consider that the MKVII electric grid is non-lethal for flying foxes as suggested by Mr Thomas; however, it certainly uses much lower electrical currents than could be used if the electric grid were intended to operate lethally. Having lived next to an orchard with several "Fyre-fox" (lethal electric grid) units installed on it, I am well aware of the ease with which a grid system can be directly connected to the mains, simply by running a cable to the connecting wires, and plugging it in to an outlet (with or without a current limiting light bulb in series with the wires). Only by having the power supply fitted immediately adjacent to the wires on the pole could this be made more difficult (the control components could be mounted elsewhere along with the low voltage AC supply). Basically, "where there's a will there's a way" to increase the electrical current to the respondents' electrical grids and thereby increase the numbers of flying foxes that are likely to be killed by the grids.

34. I have made all the enquiries which I believe are desirable and appropriate and no matters of significance which I regard as relevant have, in my knowledge, been withheld from the Court.

All the facts affirmed in this affidavit are true to my knowledge and belief except as stated otherwise.

Affirmed by Hugh John Spencer)
at this)
..... day of August 2005)
Before me:)

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