



Fraser Island Defenders Organisation

FIDO — The Watchdog of Fraser Island

c/- John Sinclair,

Phone : John Sinclair:

www.fido.org.au — Email:

Aim: *To ensure the wisest use of the natural resources of Fraser Island*

25th July, 2017

Secretary
Environment and Communications References Committee
The Senate
Parliament House
CANBERRA
ec.sen@aph.gov.au

Re: Inquiry into current and future impacts of climate change on housing, buildings and infrastructure

Dear Secretary,

On behalf of the Fraser Island Defenders Organisation (FIDO), I would like to make a submission to the above inquiry specifically addressing the first three Terms of Reference:

- (a) recent and projected changes in sea level rises, and storm surge intensity;
- (b) recent and projected changes in temperature and precipitation;
- (c) recent and projected changes in extreme weather, including heatwaves, bushfires, floods, and cyclones;

This submission relates to Fraser Island (K'gari) where there is a permanent resident population of less than 100 people but which attracts more than 350,000 visitors annually. Although Fraser Island has relatively few houses and buildings that are likely to be impacted by climate change of this World Heritage site is a very significant national asset that is already being impacted by climate change. More significantly Fraser Island is a buffer between colonic disturbances in the Pacific and the urban centre of the Fraser Coast

An independent study in 2002 by corporate consultants, Kleinhhardt FGI estimated that “*up to 2,880 jobs are generated in the Fraser Coast and Sunshine Coast regions from tourism and recreation on Fraser Island*”, and that the “*Total Economic Value of Fraser Island, incorporating its Economic Value and Direct and Indirect Financial Value from tourism and recreation, is therefore estimated to be in the order of \$277 million.*” http://fido.org.au/Fraser_Island_Reports/Kleinhardt_Study.pdf That study was based on an estimate of 223,000 visitors annually. Since then the volume of visitation has appreciably increased although the Queensland Government hasn't released visitation data since 2005. It is therefore this organization's submission that while there are relatively few houses and buildings on Fraser Island (K'gari) the impact of climate change there will send economic waves out into the surrounding regions. There is however significant impact of climate change on the island's road network that is discussed below. Therefore FIDO believes that Fraser Island definitely falls within the Committee's terms of reference.

This organization has a 46-year history of observing and monitoring a very significant Australian large natural site that has largely escaped the impacts of industrialization. Being an island it would have been assumed therefore that Fraser Island (K'gari) was a logical natural laboratory for the study of climate change. Alas the potential has been largely ignored despite regular pleas. The existing Fraser Island

World Heritage site of 181,851 hectares covers the entire island and includes several small islands off the island's west coast. The observation of the impact of climate change has therefore largely fallen to less precise citizen scientists.

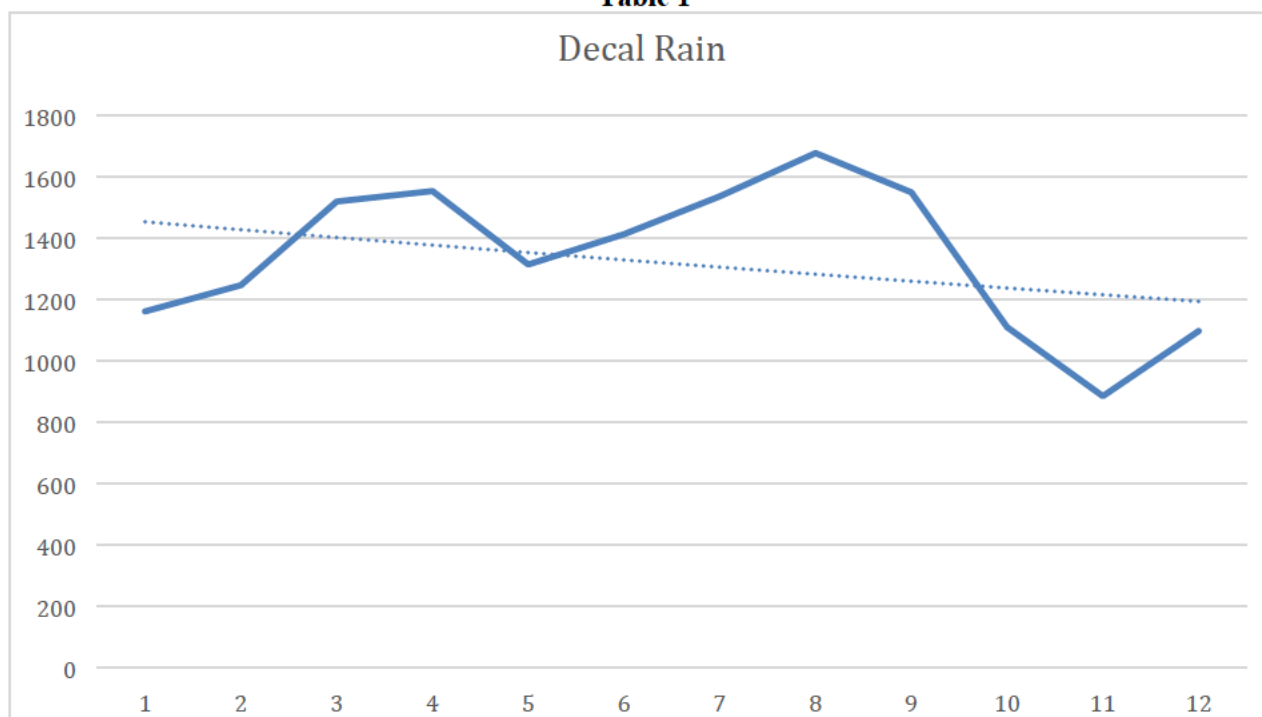
Fortunately this organization has a long corporate memory and has made many citizen science observations both on rainfall, wind and temperatures. However we lacked hard data. This inspired an on-going citizen science project to collect more weather data. FIDO has installed two on-line weather stations that record weather data from both Happy Valley and Eurong. This was as a consequence of there being such a dearth of weather data from the island and a public need to know the state of the weather from afar. The live data can be seen on-line at www.fido.org.au. The data has been so invaluable that FIDO is now aiming to have a network of weather stations to provide basic weather data for this World Heritage site that has previously not been readily available.

The collection of rainfall data started in the Great Sandy Region more than 100 years ago at Sandy Cape and Double Island Point Lighthouses and Maryborough. These stations are far apart but initially they recorded rainfall but not temperature and other weather data. Still an examination of rainfall records indicate that the rainfall of Fraser Island (K'gari) and its immediate environs has been in a slow progressive decline over that time.

One of the spinoffs of FIDO's collection of our own weather data is that it inspired the examination of historic weather data that was relevant to Fraser Island. Although Double Island Point is on the adjacent mainland, it is much closer to Eurong and Happy Valley than is Sandy Cape lighthouse. It was from this data that we stated to note the downward trend in rainfall. While there is a lot of variation in annual rainfall we have made an attempt to smooth this out and develop a graph based on the averages per decade. What was astonishing to find is that the rainfall for Double Island Point based on a trend line shown in Table 1 has declined by 300 mm over the past 100 years.

Table 1

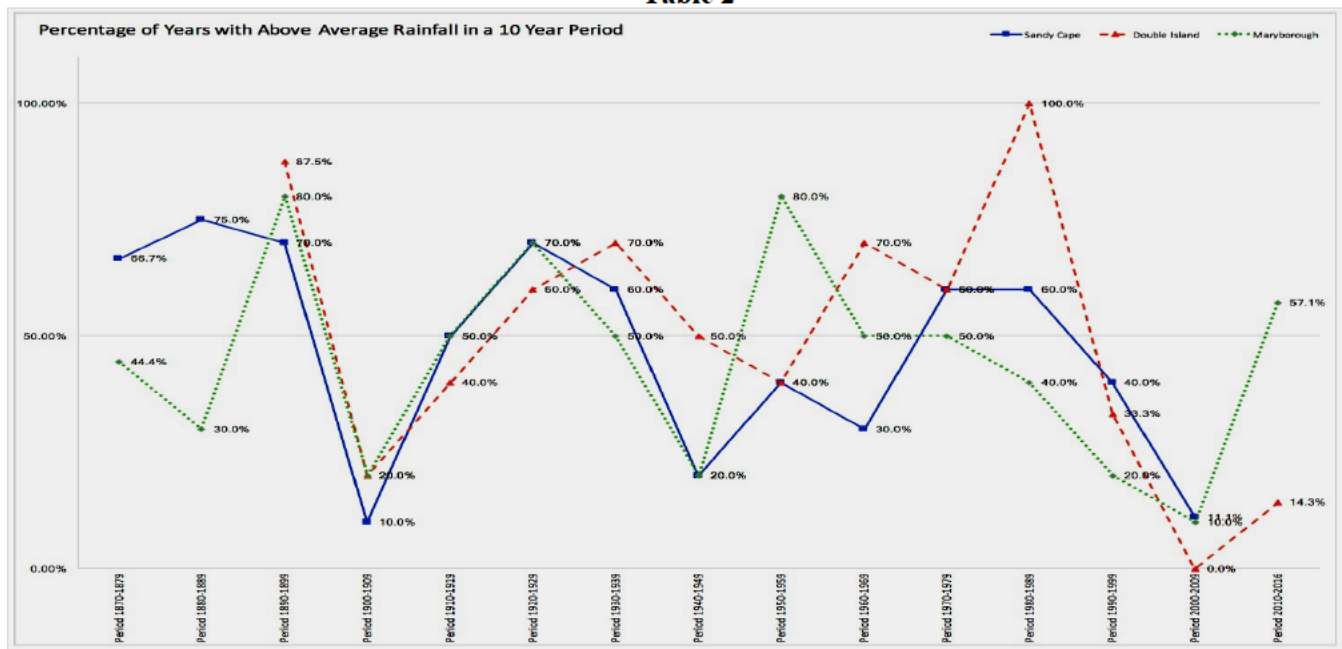
Decal Rain



Graph showing annual average rainfall over 11 decades at Double Island Point lighthouse

We then sought to examine how valid our hypothesis was by comparing the rainfall for Maryborough, and Sandy Cape and Double Island Point Lighthouses over more than 100 years. The graph below shows the decades which are above and below the average and by what percentage. It shows a close correlation for all three recording stations.

Table 2



Graph for 10-year periods for Maryborough, and Sandy Cape and Double Island Point Lighthouses over more than 100 years showing years with below average.

FIDO has become increasingly concerned at the evidence of climate change apparent from our on-the-ground observations. These were first expressed in a Backgrounder published in December 2006. (Appendix A). Since then through our MOONBI newsletter we have continued to publish evidence of the toll that climate change is taking on the biodiversity of this World Heritage site. MOONBI 135 published in April 2017 that is also attached, devotes a large part of its content to this issue. Other issues of MOONBI can be found at <http://fido.org.au/moonbi-newsletter/>

The increasingly severe weather events surrounding Fraser Island (K'gari) are taking a slow but incremental toll on the biodiversity of the Fraser Island World Heritage site. Fraser Island's biodiversity is one of the values for which it was inscribed on the World Heritage list.

Criterion (ix): *The property represents an outstanding example of significant ongoing biological processes. These processes, acting on a sand medium, include biological adaptation (such as unusual rainforest succession), and biological evolution (such as the development of rare and biogeographically significant species of plants and animals).* Climate change is resulting in a loss of species and changes to the composition of K'gari's ecosystems.

There have been three severe weather events (heat-waves combined with drought) impacting on K'gari in the last decade. In September 2009, there were raging infernos on Fraser Island and Cooloola as a consequence. It is believed that the fire that reduced 22,500 hectares of the southern part of Fraser Island to cinders resulted from a fire crossing from the adjacent mainland. (p10 MOONBI 119). The same event that caused that fire was associated with a huge dust-storm that also blew 16M tonnes of Australia's greatest asset, its topsoil into the Pacific Ocean. In 2013-14 the writer first became alarmed at the number of trees that were dead and dying and reported on this in MOONBI 130 (September 2014) <http://fido.org.au/moonbi/moonbi130/moonbi130.pdf> . In 2016-17 the record and extended dry conditions were exacerbated by the hottest weather on record.

The writer developed an acute awareness of the impact of changing climate on natural ecosystems over his 25-year career leading safaris to Australian natural World Heritage sites and noting the progressive retreat of species such as the Little Mountain Palm up the slopes of Lord Howe Island's mountains and its disappearance altogether from Mt Lidgbird. These attuned him to look for signs of climate impacts on Fraser Island flora and fauna.

In the two most recent drought events, the writer recorded his concern on the number of dead and dying plants of particular species observed. The most obviously affected plants were Brush Box (*Lophostemum confertus*), Old Man Banksia (*Banksia serata*), Blueberry Ash (*Eleocarpus reticulatus*), *Phebalium wombye* and *Monotoca scoparia*. All are ominously near the northern limit of their range and as such appear to be vulnerable to increases in temperature. Some plants are the beneficiaries of a hotter drier climate on Fraser Island (K'gari). The progressive invasion of peat swamps and fens by *Melalueca quinquinerva* is evidence of this. All of these changes seem slow and may not be appreciated by people without a long memory but they are incremental and evidence of a changing climate regime. The tall forests of Fraser Island for which it is so famous are over time likely to suffer from a hotter and drier climate. The Atlas of Living Australia shows many other species at or near the northern limit of their range including the grandest and signature tree species of Fraser Island *Syncarpia hillii* along with blackbutt and tallowwood.

While the toll being taken on the flora can be more easily visually assessed through photo monitoring, the toll that climate change is taking on wildlife is much harder to establish although intuitive observations suggest that it gives cause for grave concern. Recently the writer was prompted to compare bird sightings made by a handful of people during just 24 hours in November 1968 in the Eurong area with the numbers and species of birds sighted during a 7-day Bioblitz in generally the same area in late November 2016. Despite the much greater effort only 57 bird species were recorded in 2016 compared with 65 species in 1968. The latest list includes a number of birds that have only become established on Fraser Island since 1968 including the Spotted Turtle-dove, Silver Gull and Indian Myna. Of the 32 species that were recorded in 1968 several species haven't been observed on Fraser Island for years and it is feared that these may have already become extirpated and that climate change may have contributed at least in part to their demise.

There is evidence that some more tropical species of marine fauna are benefitting from the warmer waters surrounding Fraser Island. While the Mary River and Great Sandy Strait were once regarded as the southern limit of Estuarine crocodiles, they were previously rare. Anecdotal reports suggest that while they are not yet common in these waters, their numbers are increasing. Another indicator of warmer waters surrounding Fraser Island is the presence of the potentially lethal Irukandji jellyfish along its Hervey Bay shores. These marine stingers were unheard of south of the Tropic of Capricorn until the last decade but their presence has now been conclusively established.

Since the cessation of sandmining (1976) and the timber industry on Fraser Island in (1991), this organization has identified four major threats to the island's natural integrity. These are climate change, inappropriate fire regime, invasive pests and diseases and unsustainable tourism. To a large extent the later three are influenced by or bound up with climate change. As mentioned earlier, uncontrollable fires are the product of climate. Likewise invasive pests are finding it easier to become established in a weaker ecosystem. Visitation would have less adverse environmental impacts without so many intense rainfall events on highly erodible sand.

One aspect of climate change that is of significance to Fraser Island that has been built up by aeolian sand and shaped over millennia by winds is that the wind patterns have been observed to change. This change promoted an Israeli coastal geomorphologist, Dr Naom Levin to conclude that by the end of the 21st Century all of the sandblows on Fraser Island will be overtaken by vegetation. In FIDO's 46 year history we have observed this happening since our founding. Several smaller sandblows have been invaded and are no longer active while colonizing vegetation is rapidly encroaching on the several larger sandblows that have been moving for about 5,000 to 6,000 years. FIDO attributes this to the changing wind pattern with more northwesterly winds countering the eroding force of the prevailing southeasterly winds. This neutralizing force is accelerating the encroachment that has been more noticeable since 1980.

The impact of severe or high intensity rainfall events is also of great concern to FIDO and these seem to be becoming more frequent. What makes this so important is that this organization attributes one tonne of sand being relocated for every visitor to Fraser Island (K'gari). Vehicles carrying visitors stir up the

sand at any time but the disturbed sand is only mobilized during high intensity rainfall events. While it is logical to expect erosion during cyclonic events, FIDO has observed sand being moved by less than 10mm if it falls in only minutes. The results of this mobilization of sand includes severe down-cutting of roads, smothering of vegetation near alluvial plumes but worst of all the progressive infilling of Fraser Island's unique perched dune lakes with silt from road run-off.

This organization fully accepts that fire is a natural part of the Australian landscape and that fire is essential to the ecology. However climate plays a critical role in applying a fire regime especially in an environment of pure sand that is prone to drying more rapidly than heavy soils. The fire regime that was traditionally applied on K'gari by the Butchulla was able to evolve over thousands of years. While there was climate change in that period, they would have had time to fine-tune the regime to circumstances. The pace at which the onset of climate change is affecting the natural ecosystems and the frequency of severe weather events is making the development of the most appropriate fire regime increasingly difficult as more and more attention is directed at property protection at the expense of natural resource management. FIDO regards the impact of the more frequent and more severe fires resulting from climate change as as great a threat to the natural integrity of this World Heritage site as climate change itself.

FIDO's fourth priority concerns invasive species. The appearance of tropical species in the marine environment has already been referred to above. However, the number of weed species found on Fraser Island has increased fivefold in the last 25 years. Most of these weeds are fortunately still mainly confined to the urban settlements where they can be dealt with although this is demanding an ever-increasing effort. Since 2005 FIDO has increased the number of working bees to control weeds in just two centres, Happy Valley and Eurong from one annual trip to now seven and this contribution of more than 2,000 hours annually is barely sufficient to gain control over the weeds. While climate change is not the only cause of the increasing proliferation of weeds, it is a factor. The weeds being dealt with are opportunistic colonizers and ecosystems weakened by the changing climate are creating opportunities for some weeds that may not previously been able to become established.

On the Committee's terms of reference relating to changes in sea level rises, and storm surge intensity attention is drawn to Appendix A that outlines this organization's concern for an island of sand created by aeolian deposits during and sea-level changes over many millennia. Our most immediate concern is those parts of the island that were the result of a drop in global sea levels of about one metre between 5,000 to 6,000 years ago. These areas around Moon Point and the South-eastern part of the island will be especially vulnerable to sea level rise that on current projections could reach or exceed one metre. One of the important World Heritage values, the fens, could be submerged. However except for two rocky headlands (Indian Head and Waddy Point) the entire island and its coastline is based on highly erodible sand. The vulnerability to erosion from severe weather events was demonstrated in 1974 when about 20 metres between the then Orchid Beach Resort and the beach was stripped away in one night leaving the resort swimming pool cantilevered high above the beach. The erosion has continued since and most of the former Orchid Beach Resort site has now been eroded away.

In 1975 the Commonwealth Government established Fraser Island Environmental Inquiry under the Environmental Protection Act (1974) to study the land uses on what is now a World Heritage site. It was the first and only inquiry held under that Act. The Commissioners recommended the end of sandmining and Fraser Island's heritage listing. It also recommended the establishment of science reserves. Sadly this was the only recommendation not pursued by the Fraser Government in 1976. As a result much less is known about Fraser Island scientifically than about the Great Barrier Reef.

One of the expert witnesses to that Inquiry was Prof Bruce Thom. He is acknowledged as one of Australia's leading coastal geomorphologists. For over a decade Prof Thom has advocated for Fraser Island becoming a National Laboratory for Study of Climate Change. His case justifying this is set out in Appendix B.

FIDO trusts that the Committee will accept Prof Thom's justification and follow up the Fraser Island Environmental Inquiry recommendations to encourage a focus of climate change research on this natural laboratory. Just as there are very important records of past climate embedded in the ice of Antarctica, there are records of the climate embedded in the layers of sand laid down over many thousands of years. The major difference apart from the temperature is the accessibility and cost of any research. The University of the Sunshine Coast has established a small Education and Research Centre at Dilli Village to facilitate that research but relatively few scientists have taken advantage of this amenity. It needs some national direction and incentive to get more scientists using Fraser Island as a place for their research.

While this organization doesn't want to diminish the significance of the impacts of climate change on the Great Barrier Reef, we do believe that the impacts of climate change on Fraser Island relevant to its size are equal to or greater and this has been overlooked by the Commonwealth Government that has obligations to protect these World Heritage sites.

This organization is happy to provide more details on the matters raised in this submission if the Committee should require.

Thanking you for the invitation to provide this submission,

Yours sincerely

John Sinclair, AO
Honorary Secretary and Honorary Project Officer.

Appendices:

Appendix A — Backgrounder: *Greenhouse Gases & Climate Change* and *Climate Change on Fraser Island* (first published in December 2006)

Appendix B — *Fraser Island — National Library for Study of Climate Change*

Attachment:

MOONBI 135 (published April 2017)

Greenhouse Gases & Climate Change

The direst results of ever increasing emissions by our industrialized society are that a range of gases are forming an insulating blanket in our atmosphere and this is changing global climates. There are four main ways in which climate is either changing or, as some commentators say, being destabilized as a result of this accumulation of industrial gases of which the most conspicuous is carbon dioxide (CO₂). Additional and very dramatic consequences result from rising sea levels. This backgrounder looks firstly at the global picture of environmental impacts and then looks more specifically at how each of these five elements of climate change impacts on Fraser Island.

Humans have learnt to modify their environments to cope with almost any climatic conditions on Earth as long as they have an adequate energy supply. Therefore anthropocentric humans have given little consideration to species which can't modify their environment and which have to live with changes. For most environments, the changes being wrought by climate change are likely to be catastrophic. Plant and animal species will disappear. So too will some significant coastal land.

1. **Global Warming:** Most politicians prefer to speak of climate change rather than global warming. However even acknowledging that there is climate change is a step forward on past denials. It means winters will be generally shorter. This has implications for animals that hibernate or aestivate. It has implications for animals and birds which undertake seasonal migrations. Already it has been shown that a rise in sea temperatures around the World Heritage listed Macquarie Island has resulted in a dramatic and progressive drop in its Crab-eater seal population. In general it can be anticipated that some species may benefit from general warming but it will disadvantage others. Unfortunately the species most likely to benefit are the opportunists that are already expanding their territory and populations at the expense of other species. Scientists have predicted that with a one-degree increase in temperatures cane toads could expand their territory to most of continental Australia. Some mammals in Queensland's Wet Tropics that have already retreated to the higher parts of the Tablelands and high land to get cooler conditions are likely to become extinct. These include species such as tree kangaroos and green possums. It will be likewise with many plant species. There have also been dire predictions on the fate of corals on the Great Barrier Reef. Because water holds less oxygen as temperatures rise. Therefore the marine environment will become increasingly impoverished.
2. **Climate Variability:** A warmer climate doesn't mean that we add a degree or two to the temperatures as we have known them. While the mean temperatures will continue to slowly rise, they may end up oscillating much more, with more extreme cold events offset by really ferociously hot days. The world is already experiencing more extremes of both hot and cold weather. In October, Tasmania experienced a heat wave and bush fires followed by unseasonable snow down to sea level within a week. The cost of climate variability is demonstrated by the heavy impact of a late season frost that wiped out the bulk of the stone fruit crop in Victoria's Goulburn Valley. While these economic impacts are far reaching and being

appreciated, little thought is being given to the effects of these aberrations on wildlife. How many spring nestlings died in the cold snaps? How many will starve because of the loss of flowers and fruit? The effects of these unseasonable events reverberate through all ecosystems.

3. **Stronger Winds:** The higher atmospheric temperature results in greater differentials between the heating of the land and the heating of water that results in greater variability of wind velocities and direction but with stronger winds becoming more common. That is why storms, cyclones, hurricanes and typhoons will generally become more intense and why there will be more destructive Force 5 storms such as Katrina, Larry and Monica. They will all get stronger over water as they approach land.
4. **Rainfall:** Already several parts of the world are getting drier while some are becoming wetter. This is due to the changing of the wind patterns. Rainfall patterns are generally shifting towards the poles. Eastern and southern Australia are generally getting drier. The Roaring Forties are shifting south and so the South West of the continent is becoming drier. The northern areas of Australia, which are subject to the monsoonal influences, are generally getting wetter. Droughts will become longer and more severe.
5. **Sea Level Rises:** Add to this mix the fact that global warming has the dual effect of expanding the volume of water in the oceans as well as melting all of the ice caps — both polar and alpine. This is going to cause ocean levels to rise not just by a metre or to some predictions now suggest a rise of up to 20 metres. This will submerge many Pacific nations and larger nations such as The Netherlands and Bangladesh. However it is more significant to consider all low-lying coastal land. A large portion of China currently sustaining hundreds of millions of people could be affected. Most of the world's largest cities are located near the coast and very significant parts of these including their port areas are likely to be impacted. On Queensland's Gold Coast, billions of dollars of real estate are likely to sink below the sea. Bribie Island will disappear. Similar losses are likely to occur on waterfront land from Miami to Fremantle. It is not just that the seas will rise but the more intense winds will exacerbate the coastal erosion.

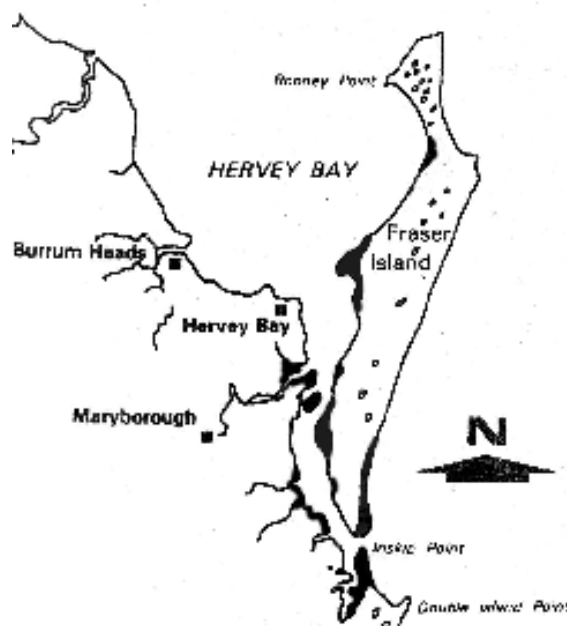
In general the combination of these five elements of climate change indicate a very dire outcome for the whole of Australia unless **URGENT ACTION** is taken to stop the effects, which have already begun. According to Al Gore's *"An Inconvenient Truth"*, it isn't too late but it requires more enlightened political leadership to confront global greenhouse and energy issues.

Appendix A

Climate Change on Fraser Island

It is hard to predict the full ramifications of climate change on Fraser Island given the dearth of hard data. From the known impacts occurring and predicted globally and based on FIDO's monitoring of environmental changes on Fraser Island over the past 35 years some changes can be anticipated. Observations include the dramatic reduction in the area of bare sand in the sandblows, changes of direction of several creek mouths and erosion on the western side of Fraser Island especially near Moon Point. Some of these can be directly linked to climate change. This backgrounder addresses those impacts observed and those that may be anticipated. The impact on the biota and the pace of the change are not well understood.

1. **Climate Warming:** Fraser Island has long been recognized as an important overlap zone with many species reaching the northern limit of their range on Fraser Island because further north is just too hot for them to tolerate. These species include huge forest trees such as blackbutt and tallowwood. Due to higher mean temperatures over the long-term, these species will disappear from Fraser Island. Likewise some species of fish such as Tailor may retreat to cooler latitudes. Coral and other marine life will be heavily impacted. Species from warmer climates will invade but opportunistic (weed) species will do better. While some species of mangroves that now only grow in more tropical areas may become established on Fraser Island, several terrestrial species of plants and animal may not be able to so easily drift to the south. This will result in a lower biodiversity. Higher temperatures will increase evaporation rates of lakes and water tables.
2. **Climate Variability:** While the impacts haven't been properly assessed, it is likely that, even if severe frosts occurred rarely in this island, they could have profound impacts on both flora and fauna.
3. **Changing wind patterns:** Already the increasing prevalence of northerly winds is neutralizing the impact of the constant south-easterly winds that once swept the sandblows forward in only one direction. The advance of sandblows has almost ceased. People walking across Hammerstone Sandblow to Wabby Lakes will often find themselves confronted with sand blown from the north-west. This may be part of the reason why the sandblows are being overtaken by vegetation so rapidly. In the last two decades the erosion from the south-east has been neutralized. Changing wind direction patterns along the east coast have resulted in more algae (referred to by fishers as "weed") in the surf. This spoils both fishing and swimming. It is obviously having a more profound effect on marine life. The shift to more days of northerly wind is resulting in a change with more creeks along Fraser Island's east coast flowing to the south instead of to the north. In the past 30 years, Govi, Gerrawea and Eli Creeks have all swung to the south because there are no strong waves breaking from the south to constantly wash away the northern banks of the creeks. The littoral drift of sand from the south to the north which has resulted in bringing sand from the south, including over the millennia, vast amounts from the Blue Mountains, may also be disrupted if the proportion of days with northerly winds continues to increase. Stronger winds and a warmer climate will also result in more severe fires — also impacting on bio-diversity.
4. **Rainfall:** While other parts of South East Queensland are definitely showing signs of being drier, so far fortunately, there is no evidence of any significant variation in Fraser Island's annual rainfall. While many other parts of southern Queensland are showing signs of becoming drier, Fraser Island so far seems to have escaped this widespread desiccation. While there is still irregularity of rainfall, the island's droughts are not as severe as elsewhere.
5. **Sea Level Rises:** 10,000 years ago, the sea levels were as low as science has ever been able to establish. Fraser Island was then part of the mainland and the coastline was several kilometres east of its present location. 6,000 years ago the sea levels reached the highest level known to science, but then fell about one metre over the next 500 years. This resulted in much new land being created on Fraser Island. If the sea rises by only one metre (a fraction of the current estimates) it is anticipated most of this coastal land will be consumed by the sea. Sea level changes will affect Fraser Island in three ways:
 - (a) The Parallel Dune ridges especially behind Moon Point and North Spit as well as the Fens are all likely to be submerged. Most of the land less than 10 metres above sea level may be lost.
 - (b) Great Sandy Strait can be expected to be widened due to submerging the Inskip Point Peninsula and the eastern shores of the mainland from Mary River Heads to Tin Can Bay. This is likely to result in significant changes to tidal flows and ocean currents
 - (c) More coastal erosion will result all around from the increased wind velocity and stronger storms attacking the coast and from the stronger currents flowing through Great Sandy Strait.



Black shows land to be lost with 1 metre sea level rise

Appendix B

Fraser Island

National Laboratory for Study of Climate Change

Justification

The accumulation of massive amounts of sand deposits on Fraser Island is clear evidence of episodes of climate change over at least the past 800,000 years. The varying age of the dune systems on Fraser Island and the types of vegetation are all products of different episodes of climate change and demonstrate how climate changes over the millennia have impacted on the geomorphology and ecology of Fraser Island. Almost completely devoid of rock, the highly erodible coastline provides an opportunity to study the impact of sea level rise as well as the influences of high energy storms.

Fraser Island has a critical latitudinal position for seeing impacts of global warming combined with natural extreme events driven by decadal forces on dune dynamics.

1. Fraser Island provides a long-term geologic record of dune sand accumulation without parallel especially as this record has not been disturbed by mining.
2. This record reflects the interplay of interacting but at times opposed forces of wind, waves, sea level change and vegetation recovery and destruction over many different episodes during the Quaternary era.
3. The interplay of forces continues today and will continue into the future.
4. The scale of changes between episodes of dune construction and stabilisation has varied over time but essentially involves the establishment of two types of transgressive dunes: parabolic and long walled.
5. The different ages of the dunes are well represented by associations of distinctive plant communities and soil types, which have been well studied and provide a background for the documentation of future changes reflecting sea level and wind-wave regimes.
6. Dune lakes contain histories of both ecologic change and dune building episodes and as such provide a depository or library of island history that will continue into the future; selected lakes should be used to continue to monitor ecologic changes including those imposed on the island by human use (at least one lake must be isolated from human presence as with science designated reefs of the GBR).
7. Blows are where the action is connected to the beach. Impacts of storm periods like that of 1974 offer examples of measuring change so that several blows along with beach profiles are needed in locations to record into the indefinite future the long term trends in dune morphology, rate of sand movement and vegetation and other ecologic changes that are driven by the interacting forces.
8. The western side of the island and the tidal deltas also need to be monitored—the extent to which sea level rise is impacting on these shores needs investigation and again the island offers locations that should be monitored. There is an issue of contrasting responses of east and west shores to wave erosion and recovery post storms; we don't understand this at this stage.
9. Fraser Island is a protected World Heritage site located on the east coast of Australia in a transitional latitude with uncertain impacts of climate shifts arising from global warming. Its potential value to science and our understanding of climate change impacts could more than rival its value as a tourist asset. It must be seen as having value for understanding the nature of climate change along the east coast of Australia. While the Great Barrier Reef provides one story, more locations in strategically vital positions are needed to inform the nation of changes in forces that impact on its natural and built assets. Too many sites to the south of Fraser Island are conflicted or contaminated by human interference with natural systems; Fraser Island represents a key location in what should be a national/international grid to help us pick up the signals and tipping points of climate change.