

Submission
No 305

**INQUIRY INTO PROPOSAL TO RAISE THE
WARRAGAMBA DAM WALL**

Name: Ms Marieann Duncan

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Partially
Confidential

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Marieann Duncan

Dear Senators,

RE the Warragamba Dam Project.

I write regarding the proposal to raise the Warragamba Dam Walls and to raise a serious concern about the undisclosed risk of the project. By way of introduction, I grew up in Katoomba where I attended both primary and secondary school and regularly visit the area. Separately I am a descendant of a Gundungurra man John Joseph Riley of the Burratorang Valley. He was my great grandfather and had a conditional land grant near the Gungarlook Waterhole, which is a waterhole tied into dreaming stories of the Aboriginal peoples. His farm was known as Gungarlook and was operated by his descendants as a farm until 1954. I am not a registered aboriginal person and do not claim to have deep understanding of the indigenous cultural heritage of the Burratorang Valley but I do have some knowledge of same especially surrounding the Riley family, which was the last farming family to leave the Burratorang Valley in 1954 after commencement of construction of the dam. John Joseph Riley his wife Margaret and other Aboriginal and European families were buried in the cemetery next to St Josephs church all of which became inundated with the creation of Lake Burratorang when the Warragamba Dam was created.

GOVERNMENT PRO DAM ARGUMENTS

The State government alleges it is necessary for flood mitigation purposes on the Nepean floodplain though I do not accept same as the sole or genuine reason. Not least because the last very major flood event occurred in the 1860's, as far as my research suggests there has never been a repeat of a flood event to equal that flood. Of course, since that time at least 11 dams have been built in the region. In addition, the major rivers which might contribute to a flood on the Nepean floodplain are not captured by the Warragamba Dam.

Another reason voiced by the Premier was that it is intended to increase water supply, which is not the view that has been aired by Sydney Water. This justification is in any event unsatisfactory as the serious drought problem in NSW is not in the Sydney area but in the western parts of the state and a billion dollars should not be spent on a Sydney Centric project when the rest of the State is seriously suffering and increasing the walls on Warragamba Dam will not deliver a response to the drought affected areas away from the coastal areas.

EXISTING DAMS IN OR NEAR GREATER BLUE MOUNTAINS REGION

There are already a large number of dams in the Greater Blue Mountains area, Warragamba being the largest and feeding the Prospect Reservoir. In the Wollondilly shire as you probably know there are four other dams, the Avon, Cordeaux, Nepean and Cataract

Dams. Then there are the less well-known dams in the upper Blue Mountains, Medlow, Greaves Creek, Cascade and Woodford dams. As far as south Eastern NSW we can add to those the Woronora Dam, the Tallowa Dam, the Wingecarribee Reservoir and the Fitzroy Falls Reservoir.

ECONOMIC IMPERATIVES

The more likely reason for the proposal to increase the walls is allied to development on the flood plain and commercial interests for instance of the Insurance Council of Australia which supported the proposal during the parliamentary committee investigation in 2018 on the basis it would be saved money in the event of the proverbial 1/100 year flood.. The flood mitigation argument was propounded it appears after an Australian Chinese donated to the Liberal party and then after the Warragamba scheme was given the green light sold land on the flood plain for some three times its purchase price.

ARGUMENTS AGAINST

There are very many problems with the proposal to increase the height of the dam and its storage capacity from four times to to six times the size of Sydney Harbour, not least destruction of cultural heritage, destruction of landscape, species extinction, biodiversity damage, adverse effects downstream as well as upstream.

FLORA FAUNA

Sydney Water on its website some 3 or 4 years ago described the Schedule one land area around the dam which is a protected region as a **Noah's Ark of diversity** extolling the beauty of flora and fauna not impacted by man and development in the protected area which area if the project goes ahead will be in part permanently or temporarily inundated. That will harm wildlife and kill plant species and trees along the valleys where inundated – we need trees they help keep the planet breathing.

INDIGENOUS HERITAGE SITES.

The contractor engaged by Sydney Water to research the Aboriginal cultural impact confirmed it only investigated about a quarter of the impacted region in its draft report but identified more than 300 previously unrecorded indigenous heritage sites in addition to known sites which will be degraded or disappear under water if the flooding of the area increases to the capacity of six times Sydney harbour- If that many new sites were formally identified in approximately one quarter of the potentially impacted region taking into account previously recorded sites and extrapolating across the remainder of the area to be inundated it is potentially the case that more than 1200 sites will be degraded or disappear permanently under water .

There is much that can be aid on loss of bio diversity and loss of indigenous cultural heritage but I am not addressing same in this correspondence I want to draw your attention to the following issue which has not been identified by government departments although known and indeed referenced in committees such as the NSW Dam Safety Committee annual reports.

CAUSE FOR CONCERN SEISMIC RISKS NOT DISCLOSED!

What has not been identified by government to date is that a very large dam can trigger seismic activity. I invite you to read the paper from 1973 Bulletin 164 given at a Symposium in Canberra and refer to the paper from what was then called the Metropolitan Water & Sewerage Board now Sydney Water, titled GEOLOGICAL APPRECIATION OF THE SEISMICITY OF THE SOUTHERN PORTION OF THE SYDNEY BASIN by N. M. GRAY Metropolitan Water Sewerage and Drainage Board, N.S.W. See link below:
https://d28rz98at9flks.cloudfront.net/75/Bull_164.pdf

You will see descriptions of the Robertson earthquake in 1961 which was a 5.5 magnitude earthquake attributable to the dam. You will also see references to the 1973 Picton earthquake also of 5.5 magnitude attributable to the dam and felt as far away as Wollongong with damage reported.

“SUMMARY-: A network of Benioff seismic stations operated by the Metropolitan Water Sewerage and Drainage Board since 1958 monitors the seismicity of the Sydney area to determine possible seismic effects of the storages of large dams. During this period, **two large earthquakes of magnitude 5.5 have occurred: one at Robertson in 1961; and one near the southern end of stored waters of Warragamba Dam in Burragorang Valley, known as the Picton Earthquake or Burragorang Earthquake.** The preferred mechanism for the Robertson Earthquake is for movement along a high-angle reverse fault striking 030° with the west side moving upwards and to the south. The preferred mechanism for the Picton Earthquake is a strike-slip fault striking 006° with the east side moving south. Both earthquakes can be explained by a horizontal north-south stress field. This direction of stress is roughly at right angles to that which formed the Sydney Basin and its structures. The present movements may be along these old basement structures but in a different direction to the original movement. The Picton Earthquake caused no damage to any of the Board's structures. The only recorded temporary effects were some increases in drainage flows at Cordeaux, Avon, and Nepean Dams and possibly in the Nepean Tunnel. -----.

At the time of the Robertson Earthquake, the return period of an M5.5 earthquake in the Sydney Basin region would have been at least 150 years, **but with the Picton Earthquake only 12 years later, on a probably contemporaneous structure, the return period could be much less. However, large earthquakes have been too few for an accurate assessment of return periods to be made. For both these earthquakes, the acceleration in Sydney was assessed at between 0.006 and 0.0 lg; areas closer to the epicentres would have experienced higher acceleration.** New works under construction in the Shoalhaven Catchment Area have been designed for an acceleration of 0.lg.

The Board's older dams did not incorporate a seismic design specifically though the actual design was such that an aseismic component was not necessary. Most of the earthquakes that have been located in the Sydney Basin area seem to occur in specific zones. **The zones cannot be delineated with complete confidence, but they appear to follow major geological lineaments that define the basement structural pattern of the Sydney Basin.** The Board, concerned that deformation of the Sydney Basin may conceivably endanger its engineering structures, is considering precise levelling surveys to monitor strain release across the seismic zones.”

Other geo science information has identified that earthquakes have been triggered with very large dams. See for example link to the Seismology Research Centre, reporting on this issue, www.src.com.au/earthquakes/seismology-101/dams-earthquakes/

It would appear that with very large dams there is an increased risk that in the period up to 15 or so years after the dam is filled, the water pressure will affect the underlying geological formations so as to trigger a seismic reaction.

This may occur only once or twice in the lifetime of the dam (if unaltered) before the pressure equalises [in lay terms] but if the purpose of the increase in the size of the Warragamba Dam is alleged to be to avoid the risk of a major flood event that might occur 1/100 years more or less then I think it equally relevant to highlight the danger of a seismic event which is likely to occur at least once if the size of the dam is increased as proposed by an area equivalent to the area of two Sydney Harbours when it is already the size of four Sydney Harbours according to Sydney Water material online.

The NSW Dam Safety Committee is aware of seismic risk and it is monitored and referenced in various of the committee's annual reports between 2000-2018.

So too is Sydney Water which refers to the dam as 'the quiet beast' and does record and check pressure and movement and according to its own online information the walls move due to pressure though only a few millimetres each year. See the link to the Sydney Water video explaining information about this 'quiet beast'.

[\https://vimeo.com/57820682?fbclid=IwAR2gBrktQQurLDojTsZQLzTnQ10mFW2htgweL0-NOyhSLPWSz0IZbWup4

In literature about collapsed dams there are **several international dams that are reported as having triggered seismic events** causing serious damage but it does appear that the risk of seismic events is to some extent downplayed or explained away by authorities. For instance, there is a report of a dam which was known as the **Baldwin Hill Reservoir** in South West Los Angeles which failed in 1963. This was said not to have been caused by an earthquake but because of the **release of water through the floor of the reservoir resulted in the structural failure of the dam itself due to the "creep" of several geologic fractures** below the reservoir. <https://www.nap.edu/read/13355/chapter/17>

In other words, the stored water seeping into the ground caused geological fractures which destroyed the dam, killed about five people and destroyed 277 homes at the time. It was also speculated that underground work in nearby oil fields may have facilitated the damage.

WARRAGAMBA PROPOSAL – FLOODING IMPACT – RIVER BEDS ETC

With the Warragamba Dam proposal it is anticipated that some flooding will temporarily inundate areas for weeks not permanently- this means that the water flow will not be consistent with the natural river flows but water levels will be unstable in these areas. The Warragamba dam itself has a concrete base- the areas to be inundated upstream will not have a concrete base- there is much potential for a fracking like effect being created in these valleys as occurred in the Baldwin Hill reservoir because of the unstable water

pressures and liquefaction of the underground areas even temporarily creating a risk of geological activity sufficient to destabilise the area.

It is also significant that in the area surrounding Warragamba there has been coal mining activity and old coal mines exist. Coal mining also can be associated with seismic activity. This is recognised for example in the NSW Dam Safety Committee reports and by various authorities.

It cannot be excluded that if the valleys are inundated through the proposal to raise the dam walls the increased dam pressure or ground seepage could create a natural disaster particularly if there may be adjacent interference with the geological sub surfaces through mining or other human intervention.

RECENT SEISMIC ACTIVITY IN THE WARRAGAMBA /BURRAGORAN VALLEY REGION

There have been 43 earthquakes occur within 50 kilometres of Appin in the past two decades, although none of the 5.5 magnitude of the Picton 1973 and Robertson 1961 earthquakes triggered by the Warragamba dam.

2019 APPIN EARTHQUAKE

In May this year 2019 it was reported that an earthquake, measuring 2.2 magnitude, was recorded by Geoscience Australia west of Appin at 11.20pm April 30. **Mr Hugh Glanville of Geo Science stated** that his organisation recorded up to 700 earthquakes across Australia each year.

Mr Glanville said there had been 43 earthquakes occur within 50 kilometres of the Appin earthquake in the past two decades. "The largest earthquake recorded [in that time] had a 3.9 magnitude near Lake Avon in 2002," Mr Glanville said. "It is not uncommon for earthquakes to occur." Mr Glanville said the second largest earthquake in the region occurred near Appin two-and-a-half years ago. *when aquake, measuring 3.8 magnitude, was recorded by Geoscience Australia at 1.13am on January 4, 2017.* The shocks from that earthquake were reportedly felt up to 51 km away from Appin.

<https://www.macarthuradvertiser.com.au/story/6100123/small-earthquake-hits-near-appin/>

2017 APPIN EARTHQUAKE

This 2017 quake was reported in various news media.

<https://www.abc.net.au/news/2017-01-04/appin-earthquake-shakes-homes-of-more-than-100-residents/8160178>

<https://www.smh.com.au/environment/earth-moves-for-residents-of-sydneys-south-west-20120918-263oh.html>

GeoScience Australia also reported that ***since 1999, there have been earthquakes in the area ranging from magnitude-1.9 to magnitude-4.8.*** The quakes generally occur every year or two, according to Mr **Johnathon Bathgate of Geo Science.** He also stated "*But it's not*

always consistent — in 2013 there were about five earthquakes in the space of a couple of months — so it certainly is an area that does have a history of seismicity."

WHY IS THERE A HISTORY OF SEISMIC EVENTS?

SCIENTIFIC REPORTS GEOLOGICAL FAULTS IN THE GREATER BLUE MOUNTAINS

The Lapstone Fault is a well-documented geological formation within the Blue Mountains, which is relevant to seismic activity as is the Kurrajong Fault. Refer to information at following links

<https://documents.uow.edu.au/content/groups/public/@web/@sci/@eesc/documents/doc/uow030517.pdf>

https://www.researchgate.net/figure/The-northern-Lapstone-Structural-Complex-showing-the-position-of-key-streams-and-the_fig1_238667795

and

<https://aes.org.au/wp-content/uploads/2013/11/21-Clark.pdf>

The Lapstone Structural Complex extends perhaps as much as 160 km, along the eastern range front of the Blue Mountains west of Sydney. More than a dozen major faults and monoclinical flexures have been mapped. Of the flexures, the Lapstone Monocline is the most prominent, accounting for more than three quarters of the deformation across the complex at its northern end near the Colo River. While these structures have been known for more than 100 years **very little is known about their subsurface geometry and faulting history.**

http://aes.org.au/wp-content/uploads/2015/12/Paper_135.pdf

The Lapstone Fault is the most prominent active fault source within the Blue Mountains region, extending for almost 100 kilometres striking north-south on the eastern edge of the Blue Mountains. This length equates to a maximum magnitude 7.5. The Lapstone Fault is observed as a monocline at the surface but is modelled as a fault dipping westwards at 35° with depths between 2 to 40 kilometres. The Kurrajong Fault is modelled as dipping eastwards with a much steeper dip angle up to 60-80° (Clark and Leonard, 2014). Assumed slip rates are reported as being 1.5-3 m/Myr in the last 10-5 Ma for the Kurrajong Fault with the Lapstone Monocline having about three times that of Kurrajong with 5-9 m/Myr (Clark and Leonard, 2014).

COLLATERAL DAMAGE

There is a serious potential for significant damage to the areas surrounding the Warragamba dam if even one seismic event is triggered including to the surrounding landscape within and nearby the World Heritage Listed National Park potentially affecting not only State Heritage Listed Items but ordinary homes and buildings given past experiences that quakes have been felt as far abroad as the Wollongong and Goulburn areas. If development is unleashed without regard to the potential for seismic disaster then in future the damage to lives and property might be more significant than has occurred in the area to date.

STATE HERITAGE ITEMS.

1. LAPSTONE MONOCLINE

You may be interested to note the Lapstone Monocline is also on the inventory of NSW State heritage items. It would be a tragedy if unnecessary man-made interference damaged it.

<https://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=1170645>

Statement of significance:

Criterion (a) Historical

The Lapstone monocline was the **Aboriginal stairway** from the plains to the Mountains; for the early Europeans it represented a strenuous obstacle to wheeled traffic by road and a major engineering challenge to the railway of the later nineteenth century.

Criterion (c) Aesthetic

The Monocline is the doorway to the Mountains, the universal image of the escarpment seen from the Nepean River. In an uncompromising way, it has **aesthetic significance**, contributing to the landmark qualities for which the Blue Mountains scenery is renowned

Criterion (e) Scientific and technical

The Lapstone Monocline is of **scientific significance** on a State level for its demonstration of a profound event in the geological formation of the Sydney Basin between 15 and 22 million years ago.

2. WARRAGAMBA DAM

Similarly the Warragamba dam was constructed between 1948-1960 and was a remarkable feat of engineering. So much so that in 1999 it was placed on the State Heritage Register, having satisfied the following criteria: "The place possesses uncommon, rare or endangered aspects of the cultural or natural history of New South Wales. This item is assessed as historically rare statewide."

We are asked to believe that at least 14 metres of new concrete will be placed on the existing walls to increase the height so altering and potentially damaging the structure that has been accorded State Heritage Listing. The more likely scenario is that new walls will be built at more significant cost than has been roughly guesstimated to date.

GOVERNMENT UNCONCERNED

The government in forcing the passage of the bill passed in 2018 giving a green light to the proposal by removal of an 'impediment' namely the protection of world heritage listing subject to an Environmental Impact Statement has not wished to preserve the World Heritage Listed Wilderness area of the Greater Blue Mountains and equally appears uninterested or ignorant that the proposal requires altering a State Heritage listed structure.

But if the plan goes ahead and geological forces of nature react *this has the potential to be a catastrophic event*. There is risk to the dam structure itself, or even if the dam is preserved a seismic event will cause damage to both the natural and the built areas over a considerable distance.

The 1961 Robertson and 1973 Picton earthquakes both of 5.5 magnitude were experienced as far away as Wollongong.

The Insurance Council of Australia might find it costly to cover loss in such instance unless their policies exclude that risk. The potential for catastrophe is more likely from seismic events than the potential for flood damage as the mooted reason to justify the proposal.

Either way the public should be on notice of this risk which has been carefully hidden by the authorities to date.

This risk of a seismic event is a risk to the wider population and the landscape surrounding the Greater Blue Mountains upstream and downstream and is certainly not less significant than the alleged one in a hundred year flood risk given the Lapstone Fault runs for some 100 km along the Great Dividing Range in the Blue Mountains .

IN SUMMARY

1. There is scientifically reported incidence of large dam failures as a result of seismic activity.
2. There are well known geological fault lines in the Greater Blue Mountains area.
3. There is regular seismic activity in the area, although not to date of catastrophic proportions.
4. There is or has been coal mining nearby which contributes to seismic risk.
5. The annual reports of the NSW Dam Safety Committee [2000-2018] would suggest that the walls of an older dam of this type could not be dramatically increased with any guarantee of safety. In order to withstand seismic events Dam Safety Committee Guidelines have been developed, which post-date of construction of the Warragamba Dam would have to be implemented. This ties in with the leaked report that the real proposal is to significantly rebuild the dam.
6. Increasing the size of the dam by 50 percent to a total volume equivalent the size of six times the size of Sydney Harbour potentially creates a risk of more dangerous seismic events occurring based on the recorded instances of regular small earthquakes in the area and given the geological formations of the Greater Blue Mountains and the fact that an active fault line (the Lapstone Fault line) exists.
7. While it may be possible to engineer a stable dam wall, it is impossible and anyway undesirable to build a base across the upstream section of the valley in the natural terrain which would be flooded drowning the valleys and rivers; and with a much increased volume of water there will be pressure build up and or potentially

water creep into geological formations underneath those flooded natural river and valley floors.

8. The proponents of the project to increase the dam wall and storage capability, suggest that much of this inundation might be temporary but if there is a very large volume of water for any length of time increasing pressure far beyond the impact of the natural river flow, this has the capacity to impact geological formations and fault lines. This impact might be caused by water creep into the geological sub strata or simply by the build- up of pressure but either could cause a seismic event and even a dam failure leading to damage to the surrounding landscape for a very large radius affecting the landscape and the built areas.
9. A dam failure can be caused by spillway damage or unplanned gate openings as has occurred. Naturally it would be catastrophic if the whole dam wall failed but even if the dam wall and all the spillways remain secure, as would be the aim no doubt in any engineering project, this could not avoid loss and damage to surrounding areas from seismic events triggered by any increase the size and capacity of the existing dam.
10. The worse catastrophe would be if the dam wall did give way thereby creating an unnecessary flood in addition to damage from an earthquake –Such damage would be entirely attributable to the negligence of the government if it allows a construction to proceed knowing the area is subject to regular seismic activity and there is no way of knowing what additional level of pressure or water creep from increased volume of water would trigger a magnitude 8 or 9 earthquake capable of destroying the dam itself.
11. As stated, if the dam is so enlarged that the natural environment cannot withstand the impact and geological forces are set in play even if the dam walls withstand a major earthquake that would not prevent loss and damage occurring elsewhere in the surrounding area occasioned by the seismic event. Again, that would be attributable to government negligence in allowing the project. Imagine the potential for loss and damage from a seismic event if additional housing is located on the floodplain.

Warragamba is located in or in the vicinity of an earthquake prone area. It is definitely a concern that if the dam size is dramatically increased there is a far greater potential for a

natural disaster which would inflict more loss and damage to property and people than the alleged risk from a once in a hundred year perfect storm flood event. From a purely economic perspective the entirely foreseeable risk of loss through a seismic event, if this plan goes ahead, is higher than the alleged benefits of flood mitigation or development or water supply

Yours faithfully

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Solicitor & Notary Public

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