Australian Government
Department of Industry, Innovation and Science

Mr Mark Fitt
Committee Secretary
Senate Economics References Committee
PO Box 6100
CANBERRRA ACT 2600
By email: economics.sen@aph.gov.au

Dear Mr Fitt

Re Senate Economics References Committee on the consultation processes for the National Radioactive Waste Management Facility (the Facility) in South Australia

Further to the department's submission of 9 April 2018, I would like to update the Senate Economics References Committee with additional information on the continuing consultation processes for the National Radioactive Waste Management Facility (the Facility) in South Australia.

Community vote

The Kimba Council and Flinders Ranges Council will hold a community votes in each community from 20 August 2018 in a manner consistent with the provisions of the Local Government (Elections) Act 1999. The votes will be run by the Australian Electoral Commission on behalf of the two councils.

The vote being conducted by the Flinders Ranges Council concerns the site nomination at Wallerberdina Station. Outback Communities Association (OCA) members (who are not formally in a local government area) within 50kms of the Wallerberdina Station site will be eligible to participate in the vote. The OCA has agreed that the Flinders Ranges Council will act on its behalf in facilitating the vote and supports the Flinders Ranges Council advertising and administering the Supplementary Roll and incorporating eligible OCA voters on the roll.

The boundaries for the community have not changed during the consultation process. There was feedback from elements of each community that they would like to consider the definition of 'community' used for the purposes of our consultation process. The department asked the Barndioota and Kimba Consultative Committees for advice. Both Committees resolved to maintain the existing boundaries.

The department also notes ORIMA's submission (submission 108) concerning the original community survey undertaken on its behalf. Having reviewed the points raised in ORIMA's submission the department stands by the survey and results as having delivered a reliable indicator of early community sentiment.

Information to support community consideration

The department has committed to a schedule of information to be provided to communities to inform the community votes. The schedule was provided to the councils and the OCA in May 2018 and is available on the department's website. The schedule is at **Attachment A**. Factsheets released to date are at **Attachment B**. A letter from AECOM, the consultancy undertaken site characterisation work for the department, addressing points raised in Flinders Local Action Group's (FLAG) submission 73 is at **Attachment C**.

An update of the indicative timings in the Planned Community Consultation and Activities and Indicative Dates table, originally provided to the Inquiry on 9 April 2018, is at **Attachment D**.

Indigenous engagement

The department is committed to engaging with the Indigenous community as part of the site selection process, and beyond, in relation to the Facility's development, operation and community impact. The department's commitment to engage with communities, including Indigenous communities, is a long term commitment consistent with the nature of the Facility.

The department's submission to the Inquiry details its engagement process in Annexures 1 to 4. The process of consultation and engagement includes the provision of necessary technical information and access to experts to inform community consideration about the Facility. Specific Indigenous engagement initiatives are detailed in Annexure 4.

Engagement with local Indigenous groups has increased following decisions to progress site nominations, noting that a less targeted approach would have caused unnecessary concern for unaffected communities. Recent activities include:

- identifying and engaging with relevant Indigenous stakeholders, including preliminary meetings to explain the process
- formation of working groups which can be consulted with on issues of aboriginal heritage
- undertaking an independent Aboriginal Cultural and Heritage Assessments
- attending cultural awareness training for departmental representatives facilitated by Traditional Owners; and
- arranging educational activities with organisations involved with the project such as Geoscience Australia and ANSTO.

The heritage assessment at the Wallerberdina Station site has been completed. The heritage consultancy, RPS Group Plc, ensured that a broad range of community elders were consulted on culture and heritage values.

Members of the Barngarla Indigenous community have shown interest in the project, with an initial representation being made on behalf of the Barngarla Determination Aboriginal Corporation (BDAC) on 7 April 2017 by their legal representative Nick Llewellyn-Jones from Normal Waterhouse Lawyers. The department has since written a number of times to the legal representative seeking to establish a working group to consult on issues of aboriginal heritage, engage the BDAC in a heritage assessment of the Kimba sites and offering to meet their Board.

Yours sincerely

[redacted]

Mark Cully
Head of Division
Northern Australia and Major Projects Division

27 June 18

Attachment A

Information To Be Available To The Communities (Kimba and Hawker) By 23 July To Support The Community Vote

Information topic	Expected Timing
NRWMF Governance	Early May
NRWMF Jobs	Early May
NRWMF Waste Acceptance Criteria	Mid May
NRWMF and Agriculture	Late May
NRWMF Environment, Safety and Security	Early June
NRWMF Design	Mid June
NRWMF Transport	Early July
NRWMF Aboriginal Cultural Heritage	Mid July
NRWMF Site Suitability	Mid July
NRMWF Infrastructure & enabling services	Mid July
NRWMF Long-term community package	Mid July
NRWMF Aboriginal Cultural Heritage Economic Participation Plan	Mid July

Attachment B

Factsheets released to date (June 2018)

PDF attachment to letter

Australian Government
Department of Industry, Innovation and Science

National Radioactive Waste Management Facility

JUNE 2018

Why we need a National Radioactive Waste Management Facility

The case for a National Radioactive Waste Management Facility

A National Radioactive Waste Management Facility will bring together radioactive waste that has built up over about 60 years, which is currently spread over more than 100 locations around the country, and consolidate it into what will be a single, safe, purpose-built, state-of-the-art facility.

That National Radioactive Waste Management Facility will be for the storage of legacy and future Australian radioactive waste. Low level waste will be permanently disposed of at the Facility, and intermediate level waste will be temporarily stored at the Facility, likely for several decades. After the existing proposed facility is built, a separate process will take place to find a different site, for a different type of facility for the permanent disposal of intermediate level waste.

Radioactive waste is currently kept in a number of locations including at science facilities like the Australian Nuclear Science and Technology Organisation (ANSTO) and CSIRO, at the Department of Defence as well as at hospitals and universities.

It has long been recognised that Australia's radioactive waste needs to be managed at one single facility, in line with international best practice. To that end, Australia has had numerous parliamentary inquiries, reports, and consultation processes to find the right location for this permanent facility.

We are following a process that was designed by experts, and includes academics and environmental representatives, and which is consistent with that used in a range of other countries such as France, the UK and Canada.

Finding a location for the Facility

The process relies on three core principles:

1. A site that has voluntarily nominated by a landowner;
2. Land that is technically suitable to host a facility of this type; and
3. A community surrounding the facility who are broadly supportive of hosting the new industry, and who could provide an ongoing workforce over its operational lifetime.

At all points through the process, information is provided to the community transparently, and to inform decision-making.

There are currently three sites being considered for the project – one at Wallerberdina Station, and two at Kimba – and the aforementioned criteria must be met for any of these to be chosen as the final location for Australia's National Radioactive Waste Management Facility.

We are having this discussion with communities who have told us they want to have it.

The two communities are now in the second phase of the project, which involves in-depth community consultation and detailed technical assessments, to understand whether the nominated sites meet the technical requirements and whether the community is broadly supportive.

AECOM is conducting analysis at each site to understand their technical suitability for hosting a National Radioactive Waste Management Facility. Consultation continues in both communities to provide them with information on the project and to capture their views.

What radioactive waste will the Facility hold?

The National Radioactive Waste Management Facility will be for the permanent disposal of Australian low level waste, and will temporarily store intermediate level waste, likely for several decades. Australia does not produce high level waste and high level waste will not be kept at this facility.

A separate process will identify a different site at a different location for the permanent disposal of intermediate level waste. That is in line with international best practice and it is the requirement of the Australian regulator that this will proceed. The detail of this was reconfirmed in the new Framework, which was recently released and can be found at www.radioactivewaste.gov.au.

Why can't the waste stay where it is?

Radioactive waste and materials are currently stored in more than 100 sites across Australia, and in line with international best practice, statements made by the Australian independent nuclear regulator, and bipartisan legislation in the Australian Parliament, these stores need to be consolidated into a single, safe, purpose-built National Radioactive Waste Management Facility

There are a number of reasons for this:

- **None of the facilities that store radioactive waste are disposal facilities.** Temporary storage facilities are not practical for material that requires monitoring for 200-300 years (low level waste), or even longer (intermediate level waste). The National Radioactive Waste Management Facility will be for the permanent disposal of low level waste with intermediate level waste temporarily stored there. A separate process will take place to find a different location for intermediate level waste disposal.
- The Australian regulator and international best practice require **responsible, long-term full life cycle management of radioactive waste.** A central, purpose-built, state-of-the-art facility for the entirety of Australia's waste, means the regulator and community can be confident in knowing that waste is consolidated, its contents is fully understood and that it is being managed safely in line with best practice.
- The National Radioactive Waste Management Facility will need to be operational **for several hundred years with little or no change to it or the land it occupies.** Therefore it should be located in an area without the competing land uses seen in a metropolitan area and near a community that can support the long-term workforce required to operate it. This will also mean the Facility can provide benefits to the host community.
- The Department has already undertaken work to better understand the suitability of Commonwealth land to host the Facility, and **no such land is considered suitable at this time.**

The siting of Australia's radioactive waste facility **follows international best practice,** which places a strong emphasis on voluntary land nominations and community consent.

Why not at ANSTO or Woomera?

Just like the other facilities spread across the country, neither ANSTO nor the CSIRO-managed store at Woomera were built for the purpose of becoming the permanent storage or disposal location for Australia's radioactive waste.

The Woomera site is a Defence Establishment located near operational zones. The waste at Woomera must be relocated out of the controlled defence area.

Other sites, including Woomera have previously been considered for waste facility, and ruled out.

ANSTO's Lucas Heights campus is not large enough to store all of Australia's radioactive waste.

The Facility requires 100 hectares and the Lucas Heights campus is only 70 hectares in size, with already more than 80 buildings on it.

The remaining free space on the site will be needed to accommodate the expansion of the campus's future science infrastructure and research activities, as a dynamic hub for collaborative research, innovation and industry engagement.

The Lucas Heights campus is only licensed by the independent nuclear regulator ARPANSA, to store waste on a temporary basis, and on the condition that a plan is developed by the end of the decade for a final disposal pathway for its waste.

Where does radioactive waste come from?

Radioactive materials bring major benefits to Australia, through their use in medicine, scientific research, industry, agriculture and technological fields. Along with these benefits comes a responsibility for the safe and proper management of the by-product, radioactive waste.

Much of Australia's current and future radioactive waste production is linked to the production of nuclear medicines that, on average, one in two Australians will need in their lifetime. Waste is generated in the production and use of nuclear medicines, as well as through research and from industry.

Nuclear medicine production in Australia is predominantly carried out at ANSTO, in the OPAL multi-purpose research reactor. OPAL is used to produce the world's most commonly used nuclear diagnostic agent, molybdenum-99 (the parent isotope of technetium-99m), which is used for diagnostic imaging of heart and lung disease, and bone scans.

OPAL also currently supports a number of clinical trials, which are testing promising new treatments for prostate and pancreatic cancer, neuroendocrine tumours and childhood cancers.

OPAL is also used to irradiate more than 45 tonnes of high-grade silicon each year, the raw material that enables high-powered electronic devices such as solar farms, hybrid cars and wind farm technology.

One in two Australians, on average, will need to receive a dose of nuclear medicine treatment at some point in their life. Nuclear medicine is used in diagnosis or treatment of heart, lung and muscular skeletal conditions, as well as cancers such as neuroendocrine tumours and prostate cancer.

This document is part of a series of factsheets providing information on the process to site the National Radioactive Waste Management Facility.

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Australian Government
Department of Industry, Innovation and Science

National Radioactive Waste Management Facility

JUNE 2018

Safely managing radioactive waste

Ensuring the safe management of radioactive waste at the Facility

Strict waste management controls are fundamental to the safety of operations at the National Radioactive Waste Management Facility, and will guide what material can and cannot be accepted at the Facility and how the waste will be managed onsite.

Radioactive waste is currently held in more than 100 locations around the country – including at the CSIRO, ANSTO, the Department of Defence, universities and hospitals.

The first layer of control is the Waste Acceptance Criteria that defines processes that need to be undertaken, quality assurances that must be given, and standards that must be met, prior to any waste being sent to the Facility. These form one part of the multiple safety measures that underpin the design and operation of the National Radioactive Waste Management Facility.

The Facility will ultimately be the location where low level waste is safely disposed, and intermediate level waste is safely stored until a separate intermediate level waste disposal facility is established. Only waste whose contents is fully understood, documented, meets the Criteria and which is packaged in a fit-for-purpose and appropriate container (as confirmed by the independent radiation protection and nuclear safety regulator) will be accepted.

The controls are part of a comprehensive set of policies, personnel and infrastructure put in place to ensure that the Facility is safe at all times for people, local businesses and the environment. This will be the case at all times – from when the waste arrives, to when it is put in storage, through to when the low level waste will no longer present a hazard, and the intermediate level waste is moved to a permanent disposal facility in another location.

Managing Low Level Waste

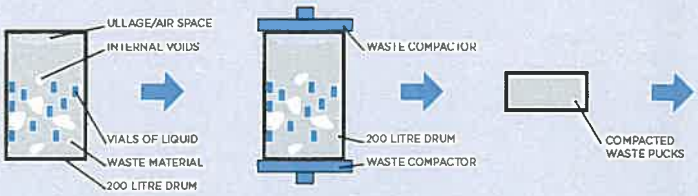
Preparing for transport

In order to meet the Waste Acceptance Criteria, specific treatments will be tailored for each type of waste. An example of such waste treatment is outlined in Figure 1. Here, the proposed treatment process for steel drums containing low level waste from ANSTO's facilities is described. Likely contents would include radiation-contaminated swabs, paper tissues, plastic gloves, used vials and waste metal items like medical tools.

ANSTO will treat laboratory waste by placing the steel drums of waste in a super-compactor and crushing the drum into a stable, puck-shape. Air spaces and any trace amounts of liquids will be squeezed out of the waste (and the liquid is treated separately and safely).

The compacted drums (puck-shaped objects) will then be loaded into a larger drum, and a high performance cement mix will then be poured around them to fill the void spaces in the drum. Therefore, there are three barriers: the original compacted drum, the cement grout and a new outer drum.

Figure 1. Example of low level waste tratment.



Step 1

Low level waste (LLW), in 200 litre metal drum, contains vials of liquid and air pockets.

Drum is scanned to determine the composition and LLW status confirmed.

Step 2

Waste material and drum compacted in a super-compactor.

Step 3

Compacted waste now has no voids and free liquids have been squeezed out.

Waste is now solid.

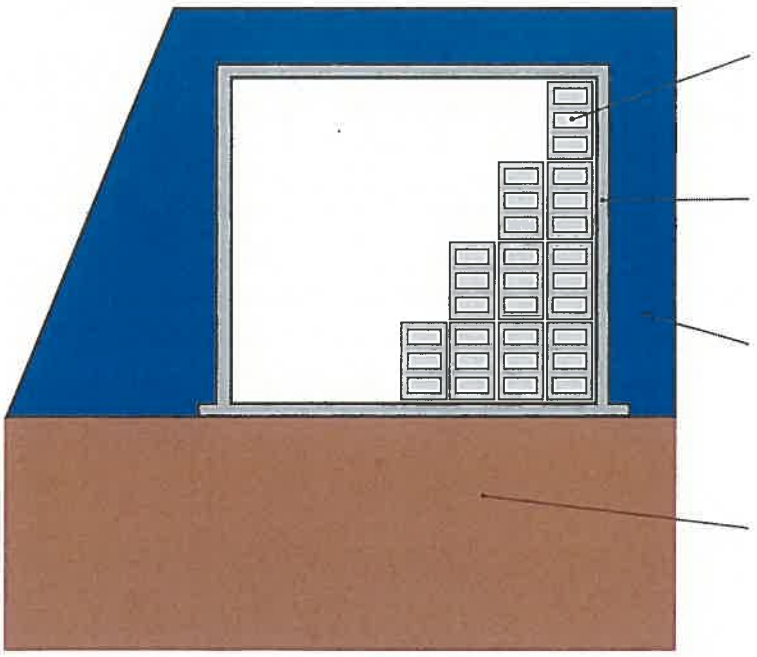
Arrival and disposal

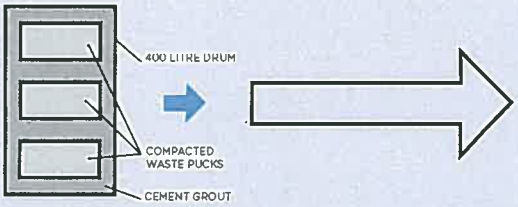
When the low level waste arrives at the Facility, checks will confirm the measurements and specifications recorded prior to transport. The waste will then be unloaded at a special receiving area. Any final packing will then be done, noting that at no time will the waste be open to the environment or workers.

Once ready for final disposal, the low level waste will be placed in above-ground, engineered concrete vaults. Each vault, when filled with waste, will be concreted shut and capped. Complete isolation of waste from the environment and containment of radioactivity will be achieved by the combination of these barriers: the waste package itself; the disposal cell and vault construction and properties; the final capping layer; and aspects of the site geology.

These will combine to prevent the release of radioactivity into the environment. The multi-barrier approach is illustrated in Figure 2 (noting that various types of waste packages may be used).

Figure 2. Illustration of multi-barrier vault for low level waste.





Step 4

Waste pucks are cemented into a 400 litre drum.

Step 5

Waste packages are transported to the National Radioactive Waste Management Facility.

If, after testing by experts at the waste producer, it was determined that waste doesn't need any specific conditioning, then it would be packaged appropriately and safely for transport to the Facility.

Barrier 1

The waste package itself.

Barrier 2

The disposal cell and vault construction and properties.

Barrier 3

The final capping layer.

Barrier 4

Aspects of the site geology.

Managing Intermediate Level Waste

Preparing for transport

Intermediate level waste is currently stored in a range of conditions and facilities around Australia. Before it can be transported for storage, most of it will require conditioning into a solid matrix and packaging into secure rated containers.

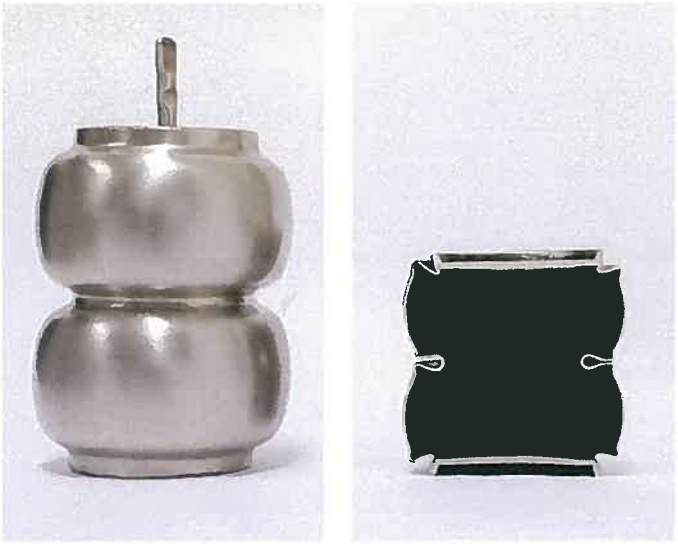
Two methods for preparing intermediate level waste are explained here:

Synroc

An Australian innovation called Synroc will be used by ANSTO to treat intermediate level liquid waste from the ANSTO Nuclear Medicine production facility – turning it into a highly durable, low volume, stable, solid matrix that meets the Waste Acceptance Criteria.

At ANSTO, the liquid waste will be taken from its storage tank and dried in a special drier called a calciner. The dry waste powder will then be mixed with additives. This mixture will then be loaded into a stainless steel can and treated by hot isostatic pressing using pressure and heat, forming Synroc.

Before transport and storage, the Synroc cans will be placed into a shielded container, which absorbs radiation and makes the waste safe for handling and transport from ANSTO to the National Radioactive Waste Management Facility.



Synroc can and cut-away of the synroc wasteform.

Vitrification

Over several years, several shipments of spent fuel from the research reactors at ANSTO were sent over to France for reprocessing.

This essentially involves the recycling of useful material that can still be used as fuel, and the treatment of the remaining material, in a process called vitrification, so that it is solidified and safe for transport and storage.

First, the waste material (after reprocessing) is mixed with molten glass to produce a durable waste form.

The molten glass is then poured into stainless steel canisters, each of which weighs around 500 kilograms when full.

Those containers are sealed and inserted into a TN-81 transportation and storage cask which is made from forged steel.

The TN-81 cask is 6.5 metres long and 3 metres in diameter, with walls more than 20 centimetres thick. It weighs 95 tonnes when empty and can hold up to 28 containers of vitrified waste.

In line with international obligations, in 2015 the TN-81 cask returned to Australia (as shown below).

Arrival and storage

Properly conditioned and packaged intermediate level waste can be managed safely for very long periods of time above ground, but will eventually need to be moved to a final disposal site. While the material inside the containers will be more radioactive for far longer than low level waste, storage of the intermediate level waste packages will pose no risk to people or the environment. You will be able to stand next to the buildings storing the most radioactive intermediate level waste, with no special or protective clothing.

The intermediate level waste will be stored at the National Radioactive Waste Management Facility in one of two ways:

1) Intermediate level waste packages in dual-purpose transport / storage containers, such as the TN-81. These waste packages are shielded and will be stored at the Facility without needing shielded buildings.

2) Intermediate level waste packages transported in shielded reusable transport containers: these waste packages will be removed from a transport container, and then stored in a secure shielded storage building.

The TN-81 container is so shielded, that standing about 10 metres away for one hour, you would receive the equivalent radiation dose to eating half of one banana.

Defence in depth approach to safety

Fundamental to the safety of the facility is the defence in depth approach. What this means is that a hierarchy of systems, controls and barriers perform safety functions independently of each other, so that the even if one of the systems, controls or barriers fail, a number of others will function independently to ensure protection of the health and safety of people and of the environment.

At the highest level the management controls, including Waste Acceptance Criteria, will assure that the Facility will receive:

- Australian low level waste, for permanent disposal
- Australian intermediate level waste, for temporary storage
- Waste forms that are physically and chemically stable, solid, non-dispersible, not reactive and not flammable
- Waste packaged in fit-for-purpose containers that are resistant to degradation
- No radioactive waste generated by other countries
- No high level waste (which Australia does not hold or generate)
- No liquid or gaseous wasteforms

Where is the development of the management controls and Waste Acceptance Criteria up to?

Just as the facility design and the safety case will be developed further as the project progresses, so too will management controls such as Waste Acceptance Criteria. Once a site is chosen, they will be developed and refined to ensure they are fit-for-purpose and right for the site.

The controls and Waste Acceptance Criteria concepts are developed in consultation with a range of national and international technical experts and key waste holders and stakeholders (such as ANSTO, CSIRO, the Department of Defence and ASNO). They are based on standards set down by the IAEA, operating experience from the United Kingdom, France, Spain and Belgium, but also set to meet Australia's needs.

We will make preliminary and operational documents about the Waste Acceptance Criteria available to the public. Further, the final Waste Acceptance Criteria will be required as part of the licence application, and will therefore be assessed as part of the license application by the radiation protection and nuclear safety regulator ARPANSA.

As part of their licensing process, ARPANSA will invite submissions and conduct public consultation on the license application, including the Waste Acceptance Criteria. More information is available at www.arpansa.gov.au.

Operational life of the Facility

The Facility will have an operational life of 100 years. After that it will be decommissioned and monitored for a further 200-300 years subject to regulatory approval, until residual low level waste materials are fully safe and needing no further controls. The waste management controls for low level waste being employed at the Facility will be appropriate for these timeframes. Intermediate level waste will be temporarily stored at the Facility for several decades, until a separate long-term disposal site is developed and built. Controls for temporary storage at the Facility will be appropriate for these timeframes. Intermediate level waste requires disposal at greater depths than low level waste, because of its radioactivity.

Table of comparable radiation doses

Radiation exists naturally in the environment, normally present in rocks and soil and even in bricks, mortar, tiles and concrete. In Australia, the average background radiation dose is approximately 1.5 millisieverts (mSv) per year.

We can also be exposed to additional doses of radiation in a number of common ways – from air travel, medical scans, granite, concrete and other construction materials. These everyday items and activities can minimally increase our radiation dose, but they do so well within safe limits.

At the boundary of the Facility, radiation levels will be indistinguishable from the existing background levels, and will be well within safe levels inside the facility itself. This will be guaranteed by the multi-barrier approach to waste management.

SOURCES OF DOSE	AVERAGE DOSE	COMMENTS/COMPARISONS
Normal background radiation in Australia	1.5 mSv per year	This is the radiation we all receive from day to day natural sources (our houses, our food, and the sun, earth and atmosphere).
The average dose that a radiation worker at ANSTO receives per year	1.75 mSv per year for radiation workers	This is added to the background dose that a radiation worker – who works directly with the material – receives per year, to give the worker a dose of 3.25mSv/y. This is the equivalent of receiving one abdomen scan (13mSv) every 7.4 years.
ARPANSA safety limits for radiation workers	20 mSv per year for radiation workers	These limits are additional to the background radiation. As you can see, ANSTO manages exposure levels for workers and to the public well below ARPANSA limits.
ARPANSA safety limits for the general public	1 mSv per year	These limits are additional to the background radiation. By way of comparison, if you stood at the boundary of ANSTO for an entire year, you would get a maximum additional dose of 0.1 mSv. This is equivalent to radiation caused by the sun at altitude, received in a flight from Melbourne to London.

This document is part of a series of factsheets providing information on the process to site the National Radioactive Waste Management Facility.

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Australian Government
Department of Industry, Innovation and Science

National Radioactive Waste Management Facility

JUNE 2018

New Framework

A new policy established to guide Australian radioactive waste management

Australia has benefitted from nuclear activities including medicine production, health and environmental research for 60-70 years. Along with those benefits comes the responsibility to safely manage by-products, including radioactive waste.

The siting of the National Radioactive Waste Management Facility will mean that a significant amount of this waste can be consolidated within a single, safe, purpose-built and state-of-the-art facility.

To support the construction and operation of the new facility, and a more effective and efficient approach to managing our waste, the Australian Government has developed the first **Australian Radioactive Waste Management Framework**. What this does is outline a full lifecycle approach to managing radioactive waste, and confirms that we have the right structures, processes and institutions to do so.

The new Framework modernises Australia's approach to radioactive waste management, in line with international best practice, and provides a policy structure across the full lifecycle from waste production through to disposal.

The National Radioactive Waste Management Facility will be for the permanent disposal site for Australia's low level radioactive waste, and temporary storage facility, likely for several decades, for intermediate level waste.

Importantly, under the new Framework, the Commonwealth Government will begin the process to identify a site for a permanent disposal facility for intermediate level waste, after the existing proposed Facility is built.

This additional facility will require completely different site characteristics to the one currently being considered.

The Framework sets out the principles and long-term goals for Australia's radioactive waste management.

What the new Framework does:

- ☑ Confirms the requirements for a National Radioactive Waste Management Facility, in terms of waste acceptance, obligations and liability, as well as management arrangements.
- ☑ Establishes appropriate arrangements, practices and policies to coordinate and manage radioactive waste between agencies and jurisdictions.
- ☑ Confirms a process for developing a second, separate disposal facility for intermediate level waste in a location with different site characteristics.
- ☑ Sets engagement requirements between the different levels of government, as well as the regulators.

Waste quantities

The new Framework also updates the public record on how much radioactive waste is stored in Australia. As at the beginning of 2018, the volume of existing low level waste to be disposed of at the Facility is 4,975m^3 and the volume of existing intermediate level waste is 1,771m^3. These volumes include waste packaging. Australia does not have high level waste.

It also includes estimated future volumes of waste including the packaging required for disposal or storage at the facility. It is estimated that there will be an additional 4,843m^3 of low level waste and 1,963m^3 of intermediate level waste to 1 January 2070.

These numbers are larger than previous estimates. This is not because we have discovered major new sources of waste, but because previous estimates were based on raw waste volumes and did not take into account final conditioned and packaged volumes.

A new waste management office

The Framework identified that an office within Government will be assigned the responsibility of coordinating and managing waste holdings, policies and practices, including:

- technical coordination and centralised function for the whole-of-life management of the Australian Government's radioactive waste, as well as the Australian waste sent by others to the facility;
- managing the relocation of radioactive waste to the Facility;
- developing the disposal pathway for Intermediate Level Waste; and
- managing a national inventory database.

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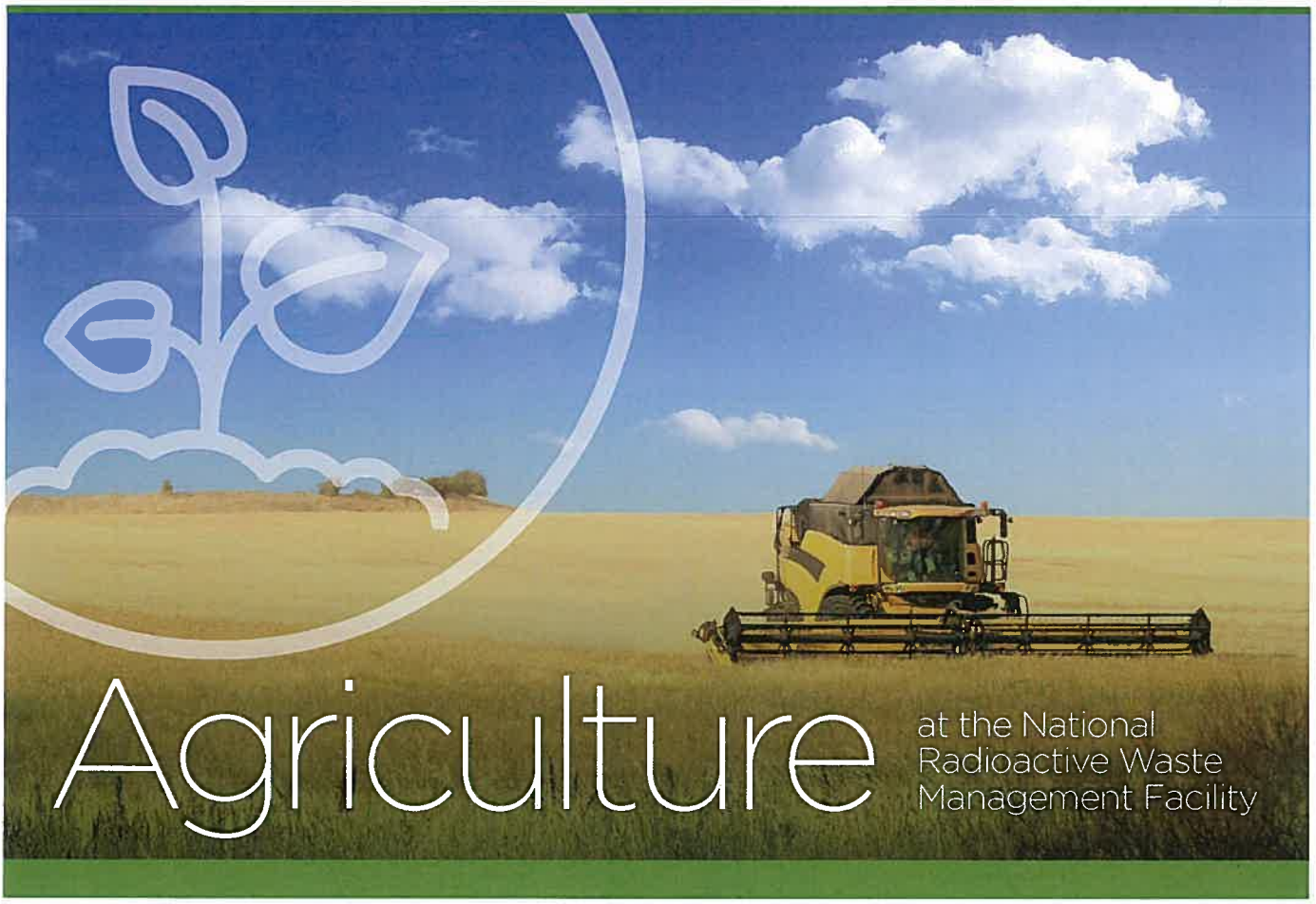
Australian Government
Department of Industry, Innovation and Science

National Radioactive Waste Management Facility

JUNE 2018



Agriculture at the National Radioactive Waste Management Facility

Radioactive waste co-exists with agriculture worldwide

Radioactive waste facilities and farms have succeeded side-by-side for decades, both in Australia and around the world, without any reputational or market impact on surrounding agriculture, tourism or other community activities.

In fact, the common experience of such facilities located in the farming regions of France, Belgium, the UK, Spain, the United States and Germany, is that this industry plays an important role in the life of local communities by providing jobs and investment, and strengthening local economic and social development.

Australia's National Radioactive Waste Management Facility will be a world-class, purpose-built and state-of-the-art. It will be operated in an open and transparent way, in line with international best practice.

The Facility will be expertly run, backed by publicly available environmental and safety monitoring, and overseen by independent radiation safety, and environmental regulators, all of whom will be tasked with ensuring its safe operation.

Radioactive waste is already spread among more than 100 sites around Australia, including about five sites within 200 kilometres of Kimba, and eight sites within 200 kilometres of Wallerberdina Station.

These facilities – internationally and around South Australia – have resulted in no impact on local or regional farming products, prices or reputations, and the new Facility will be no different.

Story continues on page 2.

From page 1.

Australia's limited nuclear activities also play an important role in supporting farmers, their families and the agricultural industry directly and indirectly. Australia has an advanced nuclear medicine industry, with one in two Australians on average requiring a potentially life-saving medicine dose, for diagnosis or treatment.

Nuclear science is also used extensively in agricultural research, to protect and improve crop yields, and gaining a better understanding of water resources and the impacts of climate.

While we all benefit enormously from these activities, we also have a need to manage the relatively small amount of waste products, responsibly and safely. This centralised facility will do that, while also providing valuable long-term economic and social support for a local community and region.

Examples of co-located radioactive waste facilities in farming communities

Large radioactive waste facilities operate in Europe, Russia and the USA including in well-known, high-value agricultural and world heritage tourism regions. For example:

- The Lake District in Northern England is home to the UK's largest and most visited National Park (awarded UNESCO World Heritage Site status in 2017), and the UK Low Level Waste Repository. This facility receives thousands of visitors every year.
- The Champagne region of France – renowned for its grapes and wine including some of the most expensive agricultural land in the world, also hosts a major low level and intermediate waste facility. The local community is currently bidding to host a new waste facility. Local populations, farm output and tourism numbers have all increased in this time.
- The El Cabril Facility in Spain is located in a national park and hunting reserve. Between 1992 and 2014 more than 100,000 people visited El Cabril's information centre.

▲ *The French low and intermediate level waste repository, in the Champagne region.*

Case study: Champagne, France

In 2017, a delegation from France visited South Australian communities and explained that the radioactive waste facilities in the Champagne region have not affected the production of wheat, canola, grape or dairy. Community members were told that the Champagne region's vineyards shipped 312 million bottles, at a value of $7.1 billion (in 2015). Vineyard prices around the facility averaged over 1 million euros per hectare.

Pierre Jobard, 73, is Mayor of Fresnay and a wheat and canola grower and cattle farmer in the Aube region. His property is close to the ANDRA Aube Facility.

"If you can see the curve of evolution regarding the Champagne vine land prices, production and sales, that's been growing in a stable fashion, and there hasn't been any impact from ANDRA's facilities. ANDRA has not affected our way of living or working."

Phillipe Dellemagne, Mayor of Soullaines and tourism board member, was initially opposed to the ANDRA Facility. After learning about its safety, and seeing the benefits that have rejuvenated the local area, he is now a strong supporter.

"We've been able to restore a lot of buildings in our region and get back some of the architectural richness that was there before. Thanks to this we've been able to rediscover our cultural and historical heritage, which has been able to attract a lot of tourists... we do not ever want to lose the facility as it provides too much to our community."

Radioactive materials and waste have also existed in and around Australian farming communities for decades without any impact

In South Australia, according to a 2003 study by the South Australian Environment Protection Authority, radioactive materials can be found in some 80 locations across the state, including near regional towns and agricultural producers.

In Queensland, a small intermediate level radioactive waste store in the farming community of Esk, in the upper reaches of the Lockyer Valley, has been safely operating without incident for over 20 years.

The ANSTO Lucas Heights campus, which is the home of research and medicine production in the OPAL nuclear reactor and several waste storage facilities, is located in Sydney's south, around 31 kilometres from the CBD. Important farming and fishing industries operate less than 20 kilometres away. About 50,000 residents are located within 5 kilometres, with the closest neighbours less than 500 metres away. ANSTO's campus includes a childcare centre widely used by staff, and is just four kilometres from a K-12 School of about 740 students.

None of these Australian communities or farmers have experienced adverse impact on land values, agricultural prices or in accessing domestic or export markets.

Trevor Cliff is a member of Eyre Peninsula Co-operative Bulk Handling Limited, and attended the Kimba Agricultural Bureau trip to ANSTO's Lucas Heights campus.

"ANSTO was a really impressive facility, and from visiting it I saw that it's a well regulated industry where safety is of the highest priority.

"When it comes to the risk of transporting radioactive waste, it's all processed and grouted into steel drums – we see trucks carrying more hazardous materials, which go through our town and across the country every day.

"I think there are benefits that would come from a facility. It could mean improved phone and internet service for the Eyre Peninsula, because trucks carrying the waste would need to be trackable throughout their route, so any blackspots in the area would need to be fixed.

Export markets will not be affected

In October 2017, representatives from the Australian Government's Department of Agriculture met a farming group from the Kimba region, and addressed concerns raised by some that the location of the National Radioactive Waste Management Facility may inadvertently impact on the ability of nearby farms to participate in domestic and export markets.

"The Department does not expect any implications for domestic or export products originating from these farms. In particular, the Department notes that products such as grains have radiation standards, and the regulatory requirements imposed by Australia's independent nuclear regulator will ensure these standards are not exceeded. More importantly, they protect the safety of workers, public health and the environment.

Given that the main buyers of Australian livestock and grain products also have advanced nuclear and radioactive waste management programs, it is not evident why there would be discrimination against Australian products where there is no evidence of actual contamination."

They also noted that Bangladesh is the only country requiring a radioactive statement for grain exports and that a number of Middle Eastern countries require radioactive statements for livestock exports. Australia has never had any issues supplying these statements, or with market access due to radiation.

"The Facility would only take up 40 of the whole 100 hectares of the site, so we could use that extra land for agricultural research and trials, environmental projects and community projects.

"This Facility would be state-of-the-art, attracting people from all over the world to come and see it, and see what is being done there, boosting our local economy.

"There's also the benefit of new employment. With agriculture becoming more mechanised and automated, we don't need so many workers, so an outside industry would be beneficial to the whole community and economy."

How can we be sure it is safe for farming and the environment?

The Facility will have numerous state-of-the-art, defence-in-depth systems to ensure it is entirely safe for the surrounding environment, communities and workers. These include:

1. All waste, low and intermediate level, will be solid and immobilised in an appropriate matrix (glass, synroc or concrete) and will contain nothing liquid, corrosive or gaseous.
2. All waste will be packaged in shielded cells or containers, ensuring radiation meets the requirement of the regulator and falls below their stringent acceptable safety levels. There will be no measurable radiation above background levels at distances well within site boundaries.
3. Site design and construction will be to recognised national radiation and building standards and assessed against all plausible risks such as fire, flood or seismic events. Site design will feature impermeable barriers, traps and inspection points.
4. This will be supported by real-time, publicly-available radiation monitoring, along with regular independent environmental testing and reporting to further demonstrate that there are no contaminants of any kind entering the environment from the Facility.

To ensure these systems are effectively implemented, the Facility will be assessed and overseen by independent regulators. The Facility will include public reporting, open days and community representatives to ensure full transparency for local communities.

These measures will ensure that there is no way that radioactive materials will enter the environment or pose a risk to farms or the community.

For more information

Call **13 28 46**

Email **radioactivewaste@industry.gov.au**

Facebook **@radioactivewasteproject**

Visit **www.radioactivewaste.gov.au**

Our process ensures that communities are paramount

"The Australian Government has put the community at the centre of the process to find a site for the new national facility for Australia's radioactive waste. We are working with each potential host community to ensure that the facility will provide long lasting benefits that sustain families and promote business. The National Facility will meet the highest standards of safety and environmental protection.

"A National Facility will benefit the local community and boost farm productivity through new jobs, access to associated infrastructure and long-term funding for projects that the community believes are important. This will include improved access to internet and mobile phone coverage and support for agricultural research. We will work with the farming communities to provide assistance for local and regional marketing and branding, and projects that promote economic diversification and product improvement.

"I am confident that the Facility will become a valuable part of the community in which it is located. I am heartened at the positive feedback that we have had through our extensive consultations with potential host communities for this important national project."

What benefits can it bring to the farming community?

The Facility, through its construction and operation, will bring many millions of dollars each year to local businesses and employees. It will provide 45 long-term jobs along with a range of infrastructure benefits, including improved internet and mobile phone services, which will improve farm business productivity.

The Government is working with each community to finalise a package of local and regional measures, which will be available to the successful host community. Details of this package will be announced before the community vote later this year.

Australian Government
Department of Industry, Innovation and Science

National Radioactive Waste Management Facility

JUNE 2018

Agricultural research and nuclear science

It's not well known, that nuclear science and technologies, including the OPAL reactor at Sydney's Lucas Heights, are used to benefit the agricultural industry quite significantly.

Every year, researchers and scientists from agricultural businesses and universities, use technologies at the Australian Nuclear Science and Technology Organisation (ANSTO) for research including:

- Analysing soil cores
- Environmental and pollution monitoring
- Analysing new machinery for wear and fatigue
- Analysing new farm chemicals
- Irradiating seeds to produce new traits for disease resistance, different food qualities and agronomic traits to improve the productivity and marketability of grain crops
- Groundwater assessment

In addition ANSTO provides other services to industry, such as fruit fly sterilisation and fruit irradiation, which assist Australian farmers and make it possible to access key export markets. As an example, New Zealand now accepts irradiated Australian mangoes.

ANSTO meets with Kimba farmers

When CEO of ANSTO, Dr Adi Paterson visited Kimba in May 2018, he met with local farmers and explained how the facility will offer its host community a chance to partner into the broader Australian science and research community.

"The Facility will be resourced as a centre of excellence, becoming part of Australia's world-class nuclear science network that includes the OPAL reactor and associated science infrastructure at Lucas Heights in Sydney, the Australian Synchrotron in Melbourne, and other government and medical facilities."

In May 2018, ANSTO Senior Researcher Dr Mathew Johansen discussed with locals' environmental projects ANSTO is conducting that focus on agriculture.

"ANSTO is involved in a range of research with different universities across Australia and the world conducting agricultural research. Examples include helping grain producers optimise their existing fertiliser methods and adopt new technologies to help improve crop yields, as well as water research that helps to better understand environmental sustainability issues around arid rivers, which could have significant implications for land management."

In 2017, some Kimba farmers visited ANSTO's Lucas Heights campus and met researchers including Dr Justin Davies, Manager of ANSTO's Gamma Irradiations, who spoke about the applications of his work to food and agriculture.

"Our research uses nuclear science to really practical outcomes for agricultural communities, to protect crops and even improve some crops. One of the projects focuses on the irradiation of wheat, and how it could potentially contribute to the creation of new varieties resistant to wheat stem rust."

Australian Government
Department of Industry, Innovation and Science

National Radioactive Waste Management Facility

JUNE 2018

Radiation and the Facility

Radiation exists naturally in the environment, normally present in rocks and soil and even in bricks, mortar, tiles and concrete.

In Australia, the average background radiation dose is approximately 1.5 millisieverts (mSv) per year. We can also be exposed to additional doses of radiation in a number of common ways – from things like air travel, having a granite kitchen, radon from construction materials or medical scans. These everyday items and activities can minimally increase our radiation does, but they do so well within safe limits.

At the National Radioactive Waste Management Facility, radiation will be no higher than background levels at the boundary, and will be well within safe levels inside the facility itself.

This will be guaranteed by a multi-barrier approach to waste management, which can involve processes such as locking it up in concrete or glass, placing it in shielded containers and placing those containers in concrete or a forged steel storage and transport containers in addition to strong oversight by the independent radiation protection and nuclear safety regulator, ARPANSA.

The Facility will at all times be required to operate within safety limits required by relevant legislation (the *Australian Radiation Protection and Nuclear Safety Regulations 1999*), which specifies dose limits for the general public as well as those who work with radioactive materials.

Case study: the Australian Nuclear Science and Technology Organisation (ANSTO)

ANSTO, which operates the OPAL nuclear reactor in Sydney's Lucas Heights, as well as low and intermediate level radioactive waste facilities, monitors radiation around its campus and reports the levels as part of its environmental monitoring program.

The organisation is very well supported by its local community, in part because it operates in such a transparent way. Significant amounts of data from radiation and environmental monitoring is made available on the ANSTO website and in annual reports.

ANSTO measures the environmental dose continuously at 15 locations around the Lucas Heights site. The levels measured at the site and in surrounding suburbs averaged 1.31 mSv in 2016-2017, which is well within the range for normal background levels.

Table of comparable radiation doses

SOURCES OF DOSE	AVERAGE DOSE	COMMENTS/COMPARISONS
Normal background radiation in Australia	1.5 mSv per year	This is the radiation we all receive from day to day natural sources (our houses, our food, and the sun, earth and atmosphere).
The average dose that a radiation worker at ANSTO receives per year	1.75 mSv per year for radiation workers	This is added to the background dose that a radiation worker – who works directly with the material – receives per year, to give the worker a dose of 3.25mSv/y. This is the equivalent of receiving one abdomen scan (13mSv) every 7.4 years.
ARPANSA safety limits for radiation workers	20 mSv per year for radiation workers	These limits are additional to the background radiation. As you can see, ANSTO manages exposure levels for workers and to the public well below ARPANSA limits.
ARPANSA safety limits for the general public	1 mSv per year	These limits are additional to the background radiation. By way of comparison, if you stood at the boundary of ANSTO for an entire year, you would get a maximum additional dose of 0.1 mSv. This is equivalent to radiation caused by the sun at altitude, received in a flight from Melbourne to London.

Australian Government
Department of Industry, Innovation and Science

National Radioactive Waste Management Facility

JUNE 2018

Myths and misconceptions – your questions answered

Will this Facility harm farm values, agricultural prices or access to domestic or international markets?

No. There is no credible evidence, in Australia or anywhere else in the world, that well-managed radioactive waste facilities such as the one proposed for Australia have any impact on market access or land or commodity prices.

Will valuable agricultural land be lost from production?

No. Only a relatively small amount of land – around 100 hectares – will be taken up by the Facility. This will include a 40 hectare Facility set inside a wider buffer zone. Some estimates from local farmers in South Austraia are that this would represent around $100,000 in lost wheat or livestock income.

By comparison, the project will generate many millions of dollars each year to the local community through wages, infrastructure investment, tourism and other means. The government is also working with host communities to explore how the unused buffer at the Facility could be used, and how additional support could be provided to boost farm productivity.

Will this Facility impact the organic status of accredited farms?

No. The experts at Organics Australia have advised that organic certification would not be impacted by a nearby piece of land holding a National Radioactive Waste Management Facility.

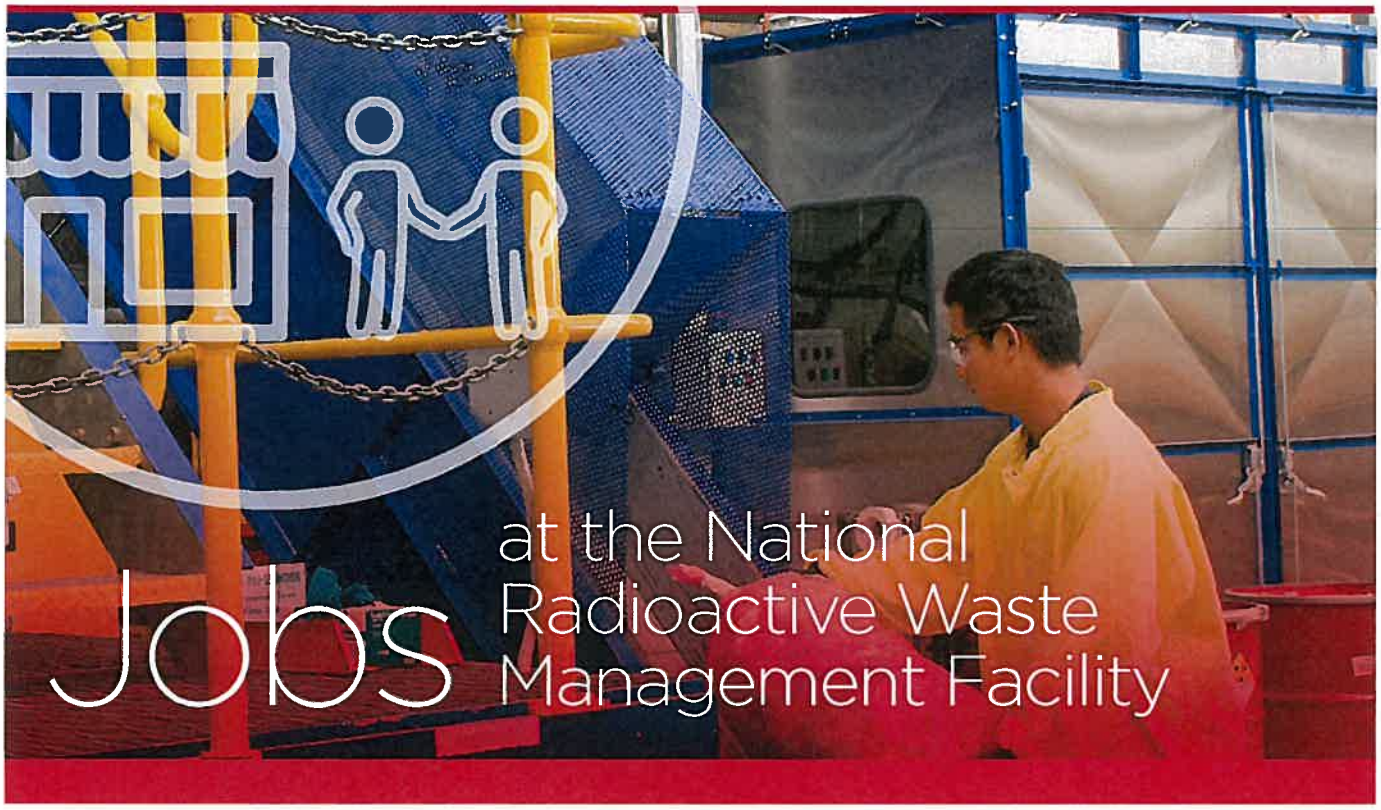
Will this Facility affect local waterways or rivers?

No. All material stored at the Facility will be solid, immobilised and safe, and in addition there will be a number of barriers between it and the environment to further ensure that all risks are mitigated.

A program of environmental monitoring will be part of the licencing arrangements to provide assurance to regulators and the public, that the Facility continues to operate safely.

Australian Government
Department of Industry, Innovation and Science

National Radioactive Waste Management Facility



Jobs at the National Radioactive Waste Management Facility

Release of new organisational structure for the Facility

The Australian Nuclear Science and Technology Organisation (ANSTO), which runs scientific and waste storage facilities at Sydney's Lucas Heights, has completed its full proposed workforce design for the National Radioactive Waste Management Facility.

In addition to the 15 operational jobs already confirmed, the structure now includes roles for community liaison, management, tourism, environmental monitoring, security, health and safety: a total of 45 staff.

The advice from the nuclear experts is that, based on their 60 years' experience, and staffing levels in similar facilities elsewhere, the National Radioactive Waste Management Facility will need to have a staffing of:

- **14** new security and safeguard jobs
- **13** new roles in waste operations and technicians
- **8** new roles in site management and community outreach
- **5** new jobs in environmental protection and quality control
- **5** new jobs in safety and radiation protection

TOTAL: 45 new jobs.

This document is part of a series of factsheets providing information on the process to site the National Radioactive Waste Management Facility.

For more information:
Call **13 28 46**
Email **radioactivewaste@industry.gov.au**
Visit **www.radioactivewaste.gov.au**

Organisational structure

With 45 jobs, the final workforce design and structure will be based on a number of factors including advice from security agencies, the views of the independent regulator and the details of the final business case, with inputs from across government.

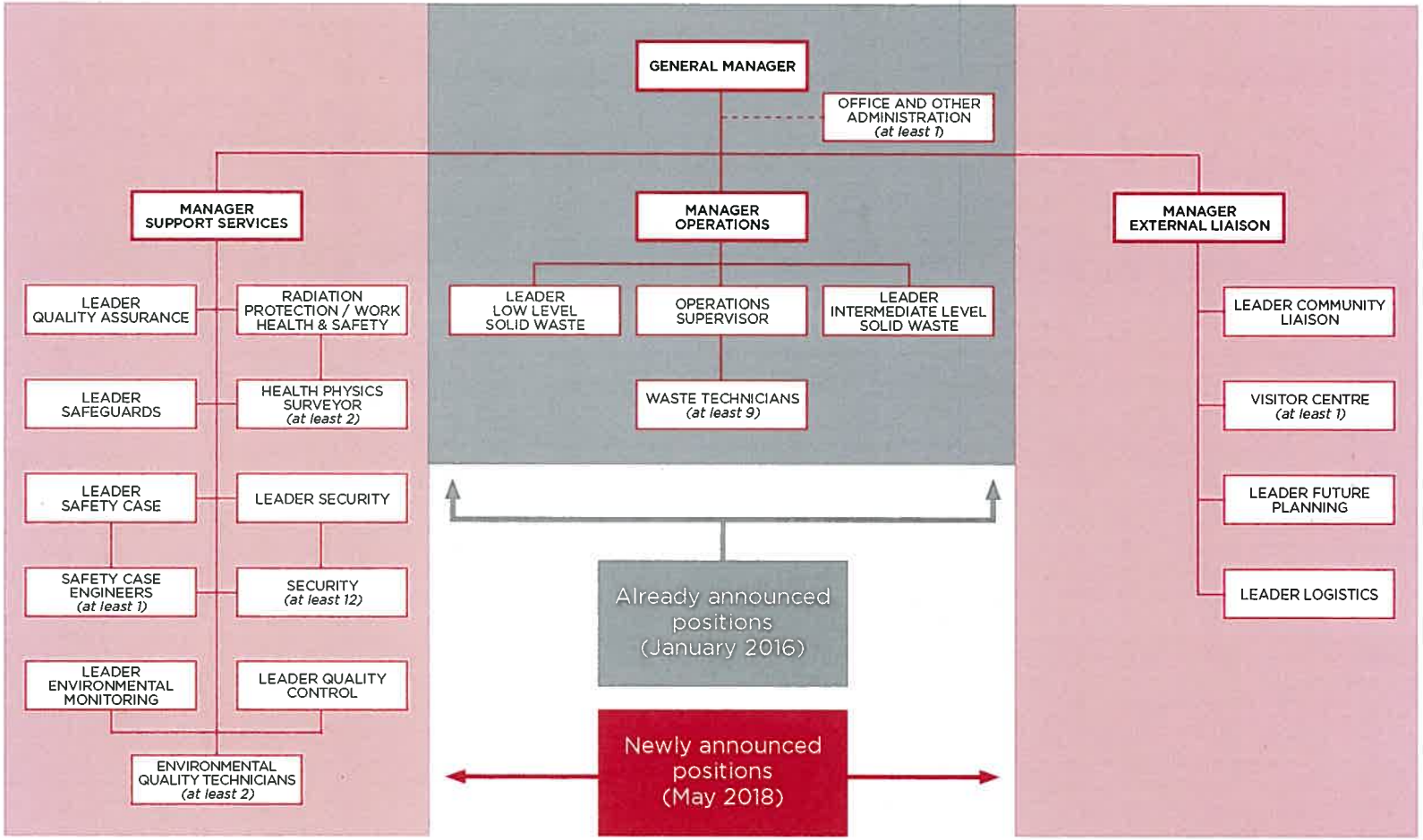
Considerations would include:

- How many staff are needed at the proposed visitor centre, guided by the type of facilities there and the number of visitors;
- How much waste is held, reflecting the fact that the Facility will be filled progressively; and
- How many people would be employed in security at the Facility, subject to further discussions with the regulator and security agencies.

The figures, structure and roles are based on assumptions including that the Facility would include temporary storage of intermediate level waste, environmental monitoring and assessment will be conducted on site, and the community will support inclusion of a visitor centre.

Analysis of the jobs:

- ☑ Full time jobs
- ☑ Shift work jobs
- ☑ On call jobs
- ☑ About 26 jobs will be supported by on-the-job training not requiring previous expertise
- ☑ About 19 jobs will require either TAFE or University qualifications
- NO Fly-in, Fly-out jobs



What type of work will be done at the Facility?

The National Radioactive Waste Management Facility will operate on a full-time basis throughout the year. Some functions such as administration, waste storage and transfer will operate on a normal weekday basis, while others such as security would have a continuous presence.

Some jobs will require traditional working hours, others will require shift work, and some will have an on-call component. There are no fly-in, fly-out (FIFO) workers in the structure recommended by ANSTO. Of the Facility's 45 staff, it is expected that up to 33 would be present on-site at any one time.

Many of the roles will not require initial formal qualifications or experience, and will be supported through ongoing on-the-job training. Other roles will require qualifications through TAFE or university, and some staff may need to obtain security clearances.

Younger members of the community will be provided opportunities through cadetships that could connect to ANSTO's facilities. ANSTO already has successful apprenticeship and cadetship programs that can be built upon. On average, ANSTO has three traineeships offered at a time, and up to four new apprenticeships are offered per year.

In addition, the Government has already made the commitment that there will be a minimum number of Aboriginal jobs, which will be provided for within the structure.

Importantly, staff who work at the Facility will have the opportunity to obtain a number of transferrable skills, including truck and forklift licenses, and certificates in Workplace Health and Safety and technical qualifications. These would be highly valued and regarded by other organisations should a person ever decide to move on to new opportunities.

Snapshot of the type of jobs

When ANSTO designed the new organisational structure, they took into account existing roles held at similar facilities, both at ANSTO in Sydney and overseas. Here are some examples of people who have roles similar to the ones that will be created at the National Radioactive Waste Management Facility.

Different roles will require different levels of qualification:

On-the-job training provided

Additional qualifications would be required

Administration roles:

Rita Fatale

Executive Assistant, Department of Industry, Innovation and Science

Just like at any workplace, administration staff will keep the National Radioactive Waste Management Facility running, overseeing invoices, accounts, diary management, answering the phone and filing. The Taskforce in the Department of Industry, Innovation and Science, which is charged with siting the Facility, has several administration staff who fulfil this important function.

"It seems like a long time ago now that I did a secretarial course through TAFE and went to work for the Government. I have been with the Department for 11 years now. The people and content are so different and diverse, and you never know what's going to happen each day. My job includes running an office, managing diaries, managing travel, finance and invoicing," Rita said.

"I didn't ever think that I would end up in a job talking about radioactive waste and other resources, but here I am, and I've got to say that I love it. It's just so interesting attending or organising all of the meetings, and talking about something that is such an important issue for the community and country."

Waste Technicians

Mitchell Timpano

Waste Technician at ANSTO's Lucas Heights campus

As at the beginning of 2018, Australia has 4,975m^3 of low level waste and 1,771m^3 of intermediate level waste, spread over more than 100 locations including ANSTO, the CSIRO, the Department of Defence, hospitals and universities. Mitchell Timpano, who works for ANSTO, is one of the people with the job of ensuring the radioactive waste is properly managed.

"I started here 12 years ago, back when I was 22, and walked in with no qualifications, but a willingness to learn," Mitchell said.

"The best thing about working in a facility like this is the training. ANSTO has provided me with qualifications in radiation protection and health and safety, and helped me to get a whole bunch of tickets including to drive forklifts and trucks, and to work in confined spaces.

"Today, my responsibilities are to look after low level solid waste at ANSTO, which includes picking radioactive waste up, storing it, and repackaging it so that it is suitable for sending to a repository in the future. The work-life balance, on-the-job training, staff activities and culture all mean that I'm very happy here, which is why I have stayed so long."

Snapshot of the type of jobs

Environmental monitoring roles:

Frank Harris
Chief Advisor to Rio Tinto in Radiation Governance

A range of measurement technologies will be installed and used to demonstrate that no risks of any kind are posed to local communities or the environment. A number of people will be charged with collecting and publishing that data. Frank Harris started his career as Environmental Radiation Officer at Olympic Dam, as a 23-year-old in 1988.

"When Olympic Dam first started, my job was to undertake the monitoring to ensure no environmental impacts from the mine. I used both fixed and portable radiation monitoring equipment, and tools that can sample airborne dust, water and gas to ensure everything is safe," Frank said.

"Day-to-day, my job was to ensure that there were no adverse impacts to flora and fauna, and that radiation levels were multitudes below background radiation that people experience every day from certain types of rocks or even the sun.

"I came into the job with a Masters in Medical Physics, but these days you would just need a science or environmental science degree to get a start in this field, and then with a combination of on-the-job training, mentoring and development, you'd quickly become able to provide the necessary monitoring services for a National Radioactive Waste Management Facility."

Waste operations roles:

James Hardiman
Leader, Waste Operations at ANSTO

James joined ANSTO through the Graduate Development Program after studying engineering at university. Since starting work at ANSTO, he has also obtained qualifications in waste management, project management, radiation protection, safety and working at heights.

"Today I manage around 20 operators, and together we are responsible for the handling, packaging, sorting, transportation, conditioning and storage of all of ANSTO's radioactive waste," James said.

"I manage the resourcing of staff and provide technical advice to waste generators, and also provide input to new plans and processes for managing waste on site. My work here is technically interesting, and requires regular problem-solving like you would find at any industrial site.

"Working at a facility like this gives you a sense of community contribution. The organisation plays such an important role in supplying medicines for diagnoses and treatment, and playing a role in helping to ensure the sustainable supply of these is both challenging and rewarding."

Snapshot of the type of jobs

Visitor Centre roles:

Marian Jones
Science Education Officer at the ANSTO Discovery Centre

Similar facilities around the world are located in highly popular tourist areas, and are a tourist drawcard in their own right. In Sydney's Lucas Heights, ANSTO welcomes more than 15,000 visitors each year, including scientists, school groups and members of the local community. The El Cabril facility in Spain was visited by more than 100,000 people between 1992 and 2014, and ANDRA in France received 14,713 visitors in 2015 alone.

"I started my career in office administration, before becoming a Science Teacher in 1986, which is a job that I enjoyed for more than two decades. After that, I wanted to try something new but continue my interest in science, which is how I ended up at ANSTO," Marian said.

"Every day I conduct different types of tours around ANSTO, showing everyone from school students through to community groups, businesses leaders, international scientists and politicians around our campus. I also develop teaching resources that are placed on our website, travel around Australia to give presentations on nuclear science, and go to a whole host of events that ANSTO sponsors.

"Nuclear science and technology is benefiting Australians every day and it's great to share that knowledge with others and get feedback from the thousands of people who visit us here. Safety is always at the heart of everything we do at ANSTO, and by allowing our visitors to see this for themselves is a real joy, and also helps to address misunderstandings about radiation."

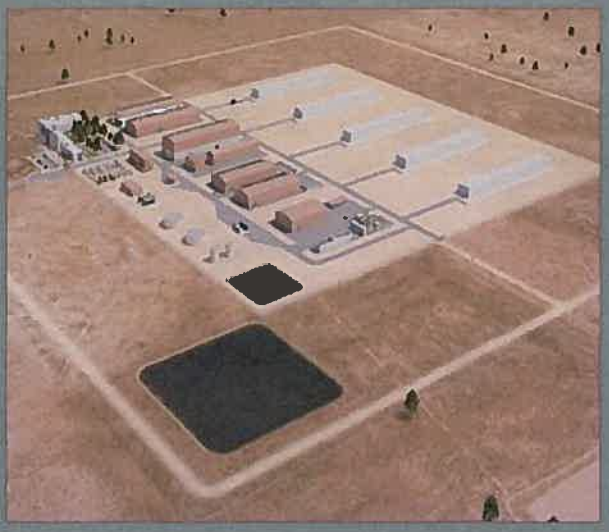
A major construction project

The construction of a safe, state-of-the-art facility will be a major development project for whichever local community supports it. In addition to the operational jobs outlined in this factsheet, during the build there will be an influx of suppliers, transport vehicles and drivers, and a project management team to oversee the construction, most of whom would need to be based locally.

Representatives from government and the regulators would also visit regularly during construction and operation, providing an ongoing boost to the local economy for decades to come. Further, the local community would be involved in the construction activity – potentially as suppliers, as part of the construction workforce, or otherwise.

It is worth noting that once complete, the organisational structure put forward by ANSTO assumes a lot of the maintenance activities, in particular, will be provided by the local community and surrounding regions, including in relation to the site, vehicles and cranes.

Whichever community eventually hosts the National Radioactive Waste Management Facility will have the opportunity to fully harness the opportunities in the contracts, within Government procurement guidelines.



Attachment C

Letter from AECOM addressing points raised in Flinders Local Action Group (FLAG)

PDF attachment to letter

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25 June 2018

Rebecca Mouthaan
Manager, Site Selection Team
National Radioactive Waste Management Project
Department of Industry, Innovation and Science
Level 5, Industry House
10 Binara Street
Canberra City ACT 2601

Dear Rebecca

Response to submission #73 lodged by Flinders Local Action Group (FLAG) to Senate Standing Committee on Economics enquiry into selection process for a national radioactive waste management facility in South Australia

AECOM Australia Pty Ltd (AECOM) was requested by the Department of Industry, Innovation and Science (the Department) in May 2018 to provide technical review and comment in relation to submission no. 73 lodged by the Flinders Local Action Group (FLAG) to an enquiry into the selection process for a national radioactive waste management facility in South Australia being held by the Senate Standing Committee on Economics.

AECOM has been engaged by the Department to conduct Site Characterisation studies at the three nominated properties being considered for siting of the National Radioactive Waste Management Facility (NRWMF), including the site known as Wallerberdina referred to in Submission No. 73 as Barndioota.

The desktop and field studies are focused on characterising the surface and subsurface environments within and surrounding the nominated 100 hectare study areas within these properties being considered for siting of the NRWMF. It should be noted that the findings to date are based on desktop studies using publicly available data and a selective field program. Additional detailed field investigations are envisaged in subsequent stages of the project. AECOM's responses contained within this letter are necessarily based on the extent of data available at this point in the site characterisation process.

AECOM has utilised a range of dedicated technical specialists to conduct the studies including but not limited to seismologists, geologists, hydrogeologists, geomorphologists and hydrologists.

AECOM has conducted its assessment against a range of site characteristic criteria that were developed with reference to Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and International Atomic Energy Agency (IAEA) guidelines relating to the selection and evaluation of sites being considered for the siting of radioactive waste facilities.

Within Table 1 below, AECOM has provided a response to the statements/ representations made by a number of academics on behalf of FLAG with submission no. 73. A number of technical assertions were made regarding the Wallerberdina site within Attachment 2 entitled "Geological and environmental implications of a nuclear waste disposal site in the Barndioota area" and the accompanying Figure 1 "Diagrammatic Cross-Section of Barndioota – Lake Torrens Area" (Attachments 3 and 4).

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To date, no significant environmental hazards have been identified during the Site Characterisation studies within any of the study areas at each of the three nominated sites which should preclude them from further technical consideration from potential siting of the NRWMF. It is noted that this contention is based on the data currently available and that the investigations proposed in subsequent stages of the site selection process will assist with more detailed evaluation.

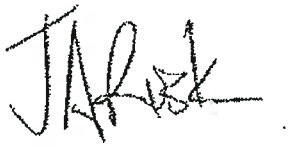
Technical Reports on the Site Characterisation studies for each site will be made available to the local communities along with succinct summaries of the scope and outcomes.

The assessment methodologies and technical reports prepared by AECOM have and are being subject to independent technical review by the Department's own technical advisory group which draws on recognised technical experts from organisations including Geoscience Australia.

A second stage of more detailed Site Characterisation studies will be conducted once a preferred site is selected by the responsible Minister. Data gaps and recommendations for additional work scope items to fill such gaps during a second stage of Site Characterisation are outlined in the Technical Reports.

AECOM supports the development of a robust conceptual site model and environmental dataset to support the development of a safety case for the NRWMF and applications for licensing and environmental approvals. Baseline conditions must also be established to enable future surveillance and monitoring during construction and operation of the NRWMF.

Yours faithfully



James Rusk
Team Leader Environment South Australia
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Attachment

- Senate Standing Committee on Economics, Enquiry into the selection process for a national radioactive waste management facility in South Australia, Submission no. 73 made by lodged by the Flinders Local Action Group (FLAG) – excerpt "Geological and environmental implications of a nuclear waste disposal site in the Barndioota area" (attachments 2 to 5)

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Table 1 AECOM Response to "Geological and environmental implications of a nuclear waste disposal site in the Barndioota area" from Submission No. 73 lodged by the Flinders Local Action Group (FLAG) to the Senate Enquiry into the selection process for a national radioactive waste management facility in South Australia. Note: the response is based on currently available data.

Section of Submission No. 73	Statement/ Representation	AECOM Response
Attachment 2 (text) Attachment 4 (figure legend)	*"The proposed area is in a zone of active normal and reverse (thrust) faulting."* *"We are concerned that a storage or disposal facility near Barndioota would not be able to survive a possible severe seismic event, one that could well occur within the half-life of the radioactive waste. We are talking about a huge timespan - thousands of years - and we only have seismic records going back about 100 years."* *"Major seismic events in the area in question have occurred in the not too distant past, as clearly indicated by nearby faults that displace unconsolidated alluvial sediments."* *Figure legend:* *" * It is a seismically active zone* ** It lies within a zone of active "normal" and "thrust" faulting"*	The proposed area is understood to lie in a zone of active thrust faulting (the western range front of the Central Flinders Ranges), but the locations of the faults of the range front have not yet been identified at the Wallerberdina property; surface faults have been demonstrated from targeted on-ground seismic surveys by AECOM to not be present at the subject study area, although they could be located nearby. It is unlikely that these faults are normal faults. While the historical record of earthquakes only spans about one hundred years, the paleoseismic record (preserved in the geology of fault zones) in the Central Flinders Ranges spans the past five to ten million years. The recurrence interval of very large earthquakes in the Central Flinders Ranges is thought to be on the order of tens of thousands of years, which is at least an order of magnitude longer than the half-life of the subject radioactive waste. Preliminary studies indicate that the expected levels of ground shaking and ground deformation at the site do not present unacceptable hazard levels within the time frame relevant for the disposal of low level radioactive waste. Even if a large earthquake were to occur in the next few thousands of years, engineers are capable of designing the storage facilities to withstand the potential ground motions without release of radionuclides. For example, nuclear reactors in other countries have withstood very large ground motions with no significant structural damage in large magnitude earthquakes; these ground motion levels have been far beyond the level expected in the study region for return periods of a few thousand years.

Section of Submission No. 73	Statement/ Representation	AECOM Response
Attachment 2 (text)	*"You will be aware that it is important to plan and construct such disposal sites in areas that, to the very best of knowledge, will be secure for many thousands of years into the future, to account for the long half-lives of the potentially dangerous radionuclides. This, of course, is in the event that the storage facility could be for some reason, be it a seismic event, mud flows, a 100-year flood, human error, or breakdown of the containment facility accentuated by corrosive saline groundwaters."*	All radioactive waste will be accepted at the site in a solid form only. The NRWMF is proposed to receive low level radioactive waste for around 100 years which will be permanently disposed in an above-ground vault for up to 300 years (and not thousands of years), a period after which the radioactivity of the waste will have decayed to background levels within the store. Intermediate level waste will only be stored at the site for up to a few decades until a permanent disposal option is identified. The low level waste disposal vaults of the NRMWF will be constructed at ground surface. Any subsurface structures associated with this building (e.g. footings, piles etc.) will only likely extend some metres below ground surface. AECOM has identified mildly brackish quality groundwater in the water table aquifer at a depth of around 20 m below ground surface. Moderately saline soils have been identified in the subsurface at depths which would interact with footings and other subsurface structures. Therefore based on the site conditions identified to date, it would be unfounded to suggest that the breakdown of the facility could be accentuated by corrosive saline groundwater conditions. The NRWMF study area at Wallerberdina is located approximately 3.5 km from Hookina Creek. A digital elevation model of the property and immediate surrounds has been developed using data obtained from a LiDAR aerial survey. The AECOM team has developed a hydrological model and carried out probabilistic 2D flood modelling for a range of episodic flood events of various magnitudes. Deeper flows breaking out from Hookina Creek during more extreme flood events (>= 1 in 100 AEP) reach a small portion of the site with minor inundation, whilst break-out flows from a larger rare 1 in 1000 AEP event are predicted to lead to inundation over a larger portion of the site. Engineering mitigation measures can be employed to protect site structures against flooding and erosive forces for even the rare extreme flood events modelled to date. The NRWMF study area is situated in a section of the Barndioota station property well away from Hookina Creek and the resultant major flood inundation and major erosion forces. Further modelling and assessment will be undertaken in future to consider fluvial processes include risk of avulsion of Hookina Creek, floodplain sedimentation and scour, and the impact of any engineering mitigation structures on flow patterns and hydraulic loadings in light of the existing model outcomes.

Section of Submission No. 73	Statement/ Representation	AECOM Response
Attachment 3 (Figure 1)	*"The lake (Lake Torrens) is what is known as a "groundwater sink area", where the hydraulic potential is in an upward direction below the lake as shown, which is typical of playa lake systems. In other words runoff and shallow groundwater from the range-front are shown to actually come to the surface from below, which is quite normal for a desert playa lake system. They evaporate when they reach the surface, precipitating halite (NaCl, common table salt) and gypsum, which mixes with or is layered with the down-washed muds and silts from the alluvial fans and creeks. The playa itself is repeatedly deflated by wind action, with clay pellets (the result of gypsum and halite growth "fluffing-up" the clays), halite and gypsum being blow well away into surrounding areas, for distance of hundreds of metres to kilometres, during periods of high winds. All of this results in the lake floor ending up at the horizontal regional water-table below the lake, which controls the deflation level. Thus all that washes or flows into the lake, including potential radionuclides from a possibly failed storage area, could eventually blow away into surrounding regions.*	Lake Torrens is located approximately 25 km west of the Barndioota study area. At a conceptual level, the description of the lake as a "groundwater sink" is fundamentally correct and these contentions are generally supported: 1. Regionally groundwater flows from the Flinders Ranges towards Lake Torrens; 2. Groundwater discharges in the low topographic depression which is now expressed as a salt lake; 3. Migrating groundwater will eventually discharge through the lake bed; and, 4. The characteristic saltpan is the result of the accumulation of groundwater and surface water concentrated salts over a geological timeframe. While these statements apply to the migration of groundwater over extended geological periods of time, the process of both vertical and horizontal migration of any fugitive emissions (whilst unrealistic due to the solid nature of the waste and the design mitigation measures in place to address any risks outlined within the safety case) from the NRWMF through underlying sequences of soils and rock is extremely complicated and becomes more complex as the scale of the system increases. The entrainment of any contaminant, its transport via groundwater and subsequent environmental release pathway as described in both text and the conceptual illustration fails to explain the complexity of the process and its consequence on a critical factor – time. The subsurface environment below the site is reasonably well known, from on-site investigative drilling and data from other boreholes in the region, to be dominated by clays and clay rich sediments extending to the water table. The subsurface environment is generally dominated by very low hydraulic conductivity material, both in the vadose zone and below the water table. A low hydraulic gradient was identified in the water table aquifer beneath the site. Assuming the likely conductivities of the saturated sediments beneath the study area are reflective of those present between the site and Lake Torrens then travel times would be in the order of 1000's of years for groundwater to migrate over the distance between the site and the lake. The process for the vertical migration of groundwater to discharge up to the lake surface would also take a considerable timeframe due to the complicated process related to waters moving through reflux brines (hypersaline dense water).

Section of Submission No. 73	Statement/ Representation	AECOM Response
From above	From above	*Continued*: The combination of very low hydraulic gradients and very low hydraulic conductivities means that the transport velocity of any fugitive contaminants from the site would be very low even if such contaminants were released in liquid form despite being deposited in the facility in solid form. For example, if the hydraulic conductivity of the transport medium is 1×10^{-8} m/sec and the hydraulic gradient is 1×10^{-4}, then the time for fugitive contaminant to travel one kilometer would be more than 6 million years. The combination of very low hydraulic groundwater transport properties, not only below the site but between the site and the potential discharge point, Lake Torrens, means that – should the extremely unlikely scenario that stored radioactive material be released in solute form from the site to the sub-surface environment - the eventual discharge of that material as described and illustrated under Submission 73 and without human intervention, could likely take many millions of years to manifest itself. Mindful that the potential "contaminant" in this instance degrades at known geological time frames, the timescale for the process by which it could be released to the environment (in a Lake Torrens wind-blown release scenario) is likewise geological and likely to be at greater timescales than the radioactive decay of the low level radioactive elements held in dry storage at the proposed facility.
Attachment 3 (Figure 1)	Dip direction of the fault	The fault shown in Figure 1 has reverse faulting, but would raise the Torrens Basin and lower the Central Flinders Ranges, which is the opposite of what is thought to be occurring (e.g. Clark, 2018). A fault that dips down to the east instead of down to the west would produce the expected sense of relative motion of the Torrens Basin and the Central Flinders Ranges. Clark, D. 2018. *Desktop study of neotectonic setting of the three shortlisted National Radioactive Waste Management Facility sites*, Geoscience Australia Professional Opinion 2018/01: 8 pp.

Geological and environmental Implications of a nuclear waste disposal site in the Barndioota area

We are extremely concerned that a "low level" nuclear waste disposal site, together with what has been described as a temporary "intermediate level" nuclear waste storage site, are being considered for the Barndioota area of South Australia.

Our concerns are based upon our joint proven experience and considerable research, over the past several decades, on the geology of the Flinders Ranges and adjacent areas. This includes research on the nearby and closely related saline Lake Torrens (known as a "playa lake"), the associated alluvial fans, and expertise in hydrological systems and playa-lake behaviour. We outline below some of the problems associated with this proposed site, which lies adjacent to Lake Torrens.

You will be aware that it is important to plan and construct such disposal sites in areas that, to the very best of knowledge, will be secure for many thousands of years into the future, to account for the long half-lives of the potentially dangerous radionuclides. This, of course, is in the event that the storage facility could be breached for some reason, be it a seismic event, mud flows, a 100-year flood, human error, or breakdown of the containment facility accentuated by corrosive saline groundwaters. If intermediate level as well as low level waste were to be stored even "temporarily" in the area, significantly more care would need to be taken. Hence it is essential that a "fail- safe" site be chosen as the only responsible way to proceed.

Based on the geology of the region, there is no fail-safe condition at Barndioota for intermediate level waste. In fact, the area ticks all the wrong boxes! So, let's examine the situation with a site such as Barndioota, in view of the above concerns.

One problem is that it lies in one of the most seismically active regions in Australia. We are concerned that a storage or disposal facility near Barndioota would not be able to survive a possible severe seismic event, one that could well occur within the half-life of the radioactive waste. We are talking about a huge timespan - thousands of years - and we only have seismic records going back about 100 years. Major seismic events in the area in question have occurred in the not too distant past, as clearly indicated by nearby faults that displace unconsolidated alluvial deposits. Such events are likely to occur again in the future. The proposed area is in a zone of active normal and reverse (thrust) faulting.

Vast mud-flow deposits are major constituents of the alluvial fans near the proposed disposal site. The fans in turn are major components of the western flanks of the Flinders Ranges, right within the area in question. Such mud-flows are triggered by episodes of intense and prolonged rainfall.

Massive earth displacements of this nature should be considered a very serious deterrent to a nuclear waste storage facility in such a setting. Sourced from the surrounding ranges, these geologically recent mud flows, for example the obvious one near Hookina Creek (close to the proposed storage site), have involved huge quantities of fluidised mud and boulders, single deposits being several metres in thickness and many square kilometres in area. These are no mean events! It is likely should future mud flows occur in the area, that any disposal site would be severely compromised.

It needs to be emphasised that playa lakes such as Lake Torrens are "groundwater sinks", in other words, regions where groundwaters flow upwards to the lake surface, where they eventually evaporate. Lake Torrens is essentially a "closed basin", so the water that enters the lake, and eventually evaporates there, comes either from surface and subsurface runoff from regions such as Barndioota, and it also comes from underlying confined and unconfined aquifers below and around the lake. Some of these aquifers would be porous beds within the alluvial fans, and some are much older, deeply buried aquifers millions of years in age. It is well established that there exists there an "upward potential" in water pressure, and this drives most of the underground waters upwards, focussing on the normally damp floor of the salt lake itself. And this water, when it emerges in the numerous springs which have been studied within the lake, evaporates to produce salts which are mainly halite (essentially "table salt") and gypsum. Any possible contaminants, in either the surface runoff or in the emerging groundwaters, would thus be concentrated in the salts and clays which form the lake floor.

So what happens next? It is very well established that playa lakes exist due to wind-deflation. Were it not for continuing deflation, such a lake would be choked with all the washed-in clays and the evaporitic salts. However, what happens is that continuing wind deflation in such arid regions blows the clay-rich sediments, along with some of the evaporitic salts and any possible contaminants, away into the surrounding countryside, spreading them over vast areas. This deflation removes all of the clay and salts down to the regional water table beneath the lake sediment, thus accounting for the totally flat and horizontal surface of the lake floor. This is a feature of playa lakes the world over. Indeed, there is a real risk that such wind-blown material, potentially contaminated with radioactive material, would be a hazard to future generations in such a situation.

To summarise, in the event over the next few thousand years of catastrophic mudflows, a seismic shock, or breakdown of the storage facility, nuclear waste could end up in the surficial sediments of Lake Torrens. Ongoing deflation could then result in widespread wind dispersal of radioactive material over a vast area, likely to be inhabited by humans in the future.

Professor C.C von der Borch, Emeritus Professor of Marine Geology, Flinders University. Relevant expertise: Sedimentology and stratigraphy of the Flinders Ranges; hydrology of playa lakes.

Dr. V.A. Gostin, Associate Professor retired, Earth Sciences, University of Adelaide. Relevant expertise: Sedimentology, stratigraphy, Flinders Ranges geology.

Dr. G.E. Williams, DSc. Relevant expertise: Sedimentation in arid zones, including alluvial fans along the western flank of the Flinders Ranges.

Dr. A.R. Milnes, Relevant expertise: Landscape evolution; mine rehabilitation; environmental management.

Dr. D.M. McKirdy, Associate Professor retired, Visiting Research Fellow, Department of Earth Sciences, University of Adelaide.

5/3/2018

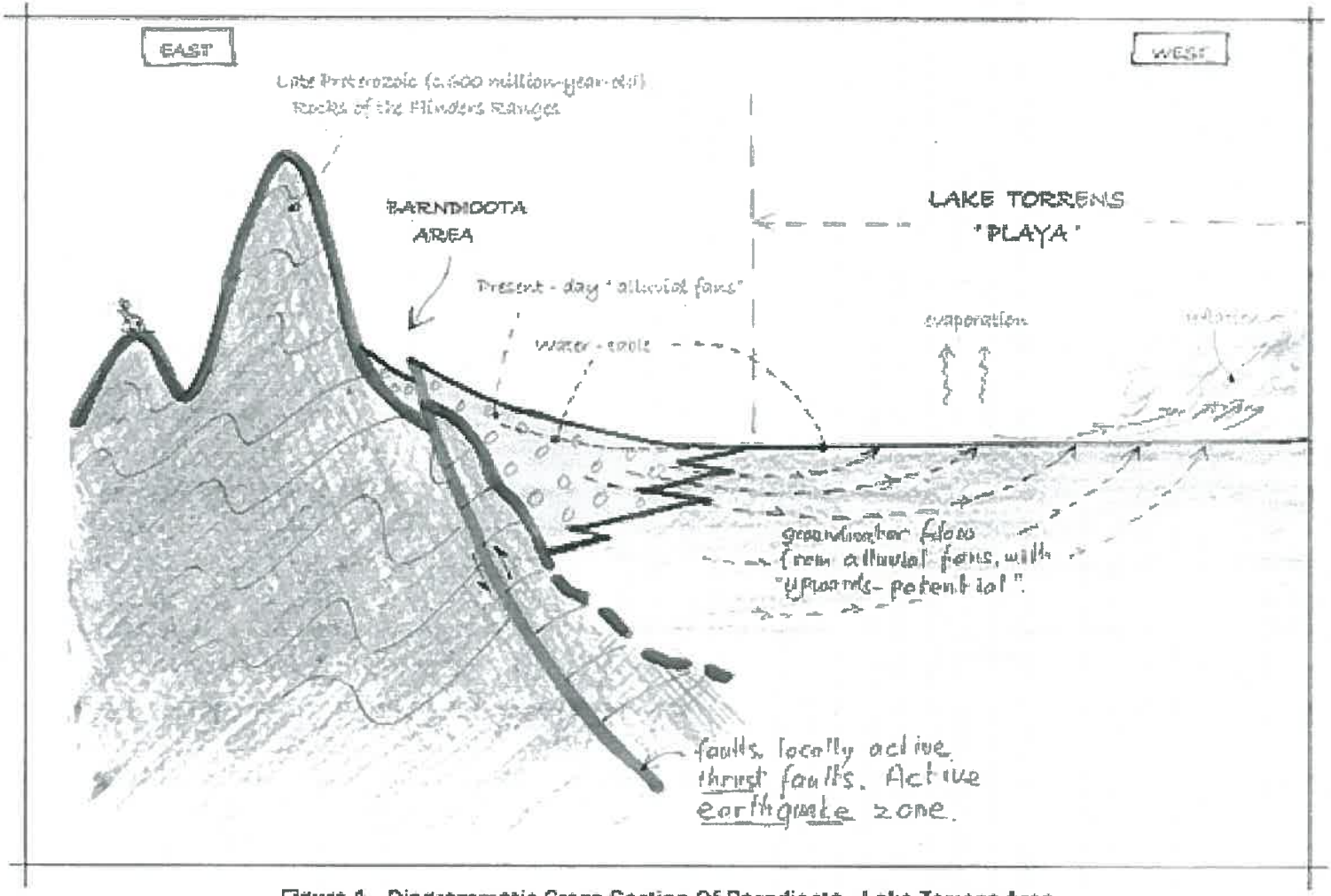


Figure 1. Diagrammatic Cross Section Of Barndioota - Lake Torrens Area

Selection process for a national radioactive waste management facility in South Australia
Submission 40 - Supplementary Submission

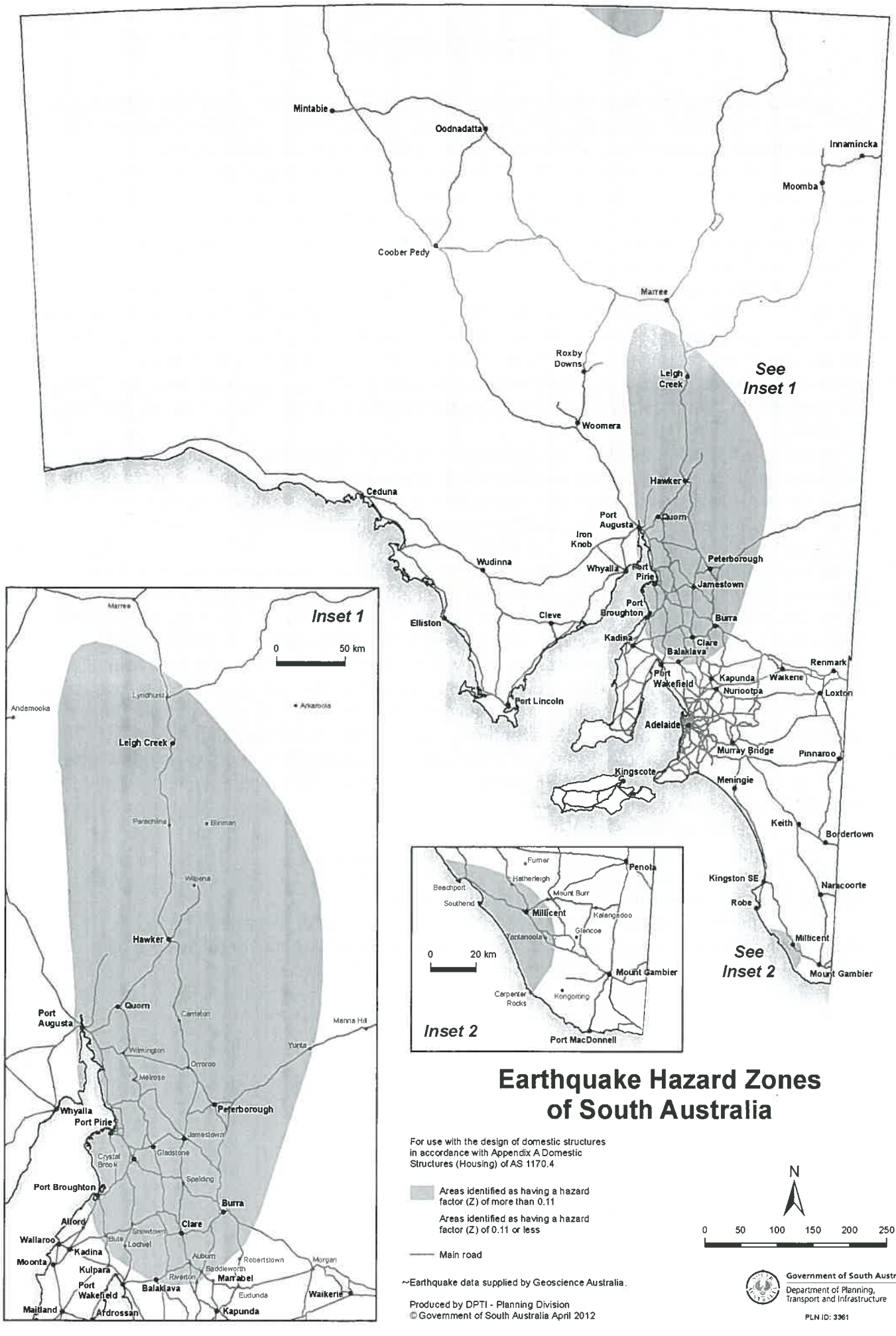
FIGURE LEGEND

This figure, and east-west cross-section ("cake-slice") represents a stylized summary of the geological relationships along the western front of the southern Flinders Ranges. It is significantly exaggerated in a vertical sense, in order to illustrate relationships.
The up-thrust late Proterozoic (c.600 million-year-old) sedimentary rocks of the Ranges are depicted in red on the left. Active faulting, and locally very recent THRUST-FAULTING, is illustrated, where modern alluvial fan sediments have, in nearby areas, been thrust OVER the late Proterozoic rocks of the Ranges. This is, indeed, one of the MOST seismically active areas in Australia.

Present day alluvial fans (yellow) are shown, building out from the actively uplifting range-front, by a combination of sheet-flooding and catastrophic mud-flows. The mudflows themselves represent pre-historical but relatively recent liquefaction and down-slope flow of surface mud accumulations within the alluvial fans. Seismic activity as well as catastrophic flooding likely would contribute to the liquefaction of the mud deposits. These fan sediments interfinger with saline and gypsum-bearing muds of Lake Torrens, depicted in blue.
The lake is what is known as a "groundwater sink area", where the hydraulic potential is in an upwards direction below the lake as shown, which is typical of playa lake systems. In other words, runoff and shallow groundwaters from the range-front are shown to actually come to the surface from below, which is quite normal for a desert playa lake system. They evaporate when they reach the surface, precipitating halite (NaCl, common table salt) and gypsum, which mixes with or is layered with the down-washed muds and silts from the alluvial fans and creeks. The playa itself is repeatedly deflated by wind action, with clay pellets (the result of gypsum and halite growth "fluffing-up" the clays), halite and gypsum being blown well away into surrounding areas, for distances of hundreds of metres to kilometres, during periods of high winds. All of this results in the lake floor ending up at the horizontal regional water-table below the lake, which controls the deflation level. Thus all that washes or flows into the lake, including potential radionuclides from a possibly failed storage area, could eventually blow away into surrounding regions.

The setting of the Barndioota area is illustrated in the diagram. It is obvious that it "ticks all the boxes" as the WORST CASE SCENARIO for a potentially unstable storage site for middle-level nuclear waste, because:

* It is a seismically active zone
* It lies within a zone of active "normal" and "thrust" faulting
*It is a region of active creek and sheet-flooding, and mudflows, with resulting Waters ending up in the terminal drainage area of the playa.
*Potential radionuclides from a failed storage site eventually would end up in the continually deflating Lake Torrens surficial sediments, and would eventually be blown away, along with lake clays and salts, into the surrounding areas.



Earthquake Hazard Zones of South Australia

For use with the design of domestic structures in accordance with Appendix A Domestic Structures (Housing) of AS 1170.4

Areas identified as having a hazard factor (Z) of more than 0.11

Areas identified as having a hazard factor (Z) of 0.11 or less

Main road

~Earthquake data supplied by Geoscience Australia.

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0 50 100 150 200 250 km

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Department of Planning, Transport and Infrastructure

PLN ID: 3361

Attachment D

Planned community consultation and activities and indicative dates to June 2019

Activity	Topic	Indicative timing
Information	RWMF Governance Framework released	Q1/2018
Consultation	Kimba Economic Working Group established	Q1/2018
Engagement	Quorn Work Experience Program - ANSTO	Q1/2018
Consultation	Barndioota Consultative Committee meets	Q1/2018
Consultation	Kimba Consultative Committee meets	Q1/2018
Information	Wallerberdina Aboriginal Heritage	Q1/2018
Information	Monthly newsletters – Wallerberdina and Kimba	Q1/2018
Consultation	Barndioota Consultative Committee meets	Q2/2018
Consultation	Kimba Consultative Committee meets	Q2/2018
Consultation	Barndioota Economic Working Group meets	Q2/2018
Consultation	Kimba Economic Working Group meets	Q2/2018
Consultation	ANSTO visits and consults Hawker and Kimba	Q2/2018
Event	Hawker Community Industry Expo	Q2/2018
Event	NRWMF Agriculture meeting	Q2/2018
Information	Monthly newsletters – Wallerberdina and Kimba	Q2/2018
Information	NRWMF Agriculture information	Q2/2018
Information	NRMWF Operation and jobs information	Q2/2018
Information	NRWMF Safety and Security	Q2/2018
Information	NRWMF Waste Acceptance Criteria	Q2/2018
Information	NRWMF Facility design	Q2/2018
Information	NRWMF Transport	Q3/2018
Information	NRWMF Site Suitability Assessment	Q3/2018
Information	NRWMF Infrastructure and enabling services	Q3/2018
Consultation	Barndioota Consultative Committee meets	Q3/2018
Consultation	Kimba Consultative Committee meets	Q3/2018
Consultation	Barndioota Economic Working Group meets	Q3/2018
Consultation	Kimba Economic Working Group meets	Q3/2018
Information	Senate Inquiry hands down report	14 August 2018
Event	Communities vote	20 August 2018

Note: Shaded activities have been completed.