Submission
2016 National Research Infrastructure Roadmap
Capability Issues Paper

Name	**Mr Peter Millington**
Title/role	**CEO**
Organisation	**ChemCentre**

Introduction

ChemCentre welcomes the opportunity to comment on the National Research Infrastructure Policy issues paper, which will inform the National Research Infrastructure Roadmap.

ChemCentre is a Western Australian statutory authority which provides chemical and forensic science services. Its services and expertise help protect the community and support sustainable development. While the WA community is the ultimate beneficiary of ChemCentre's activities, its major clients include the Western Australian Government, government trading enterprises and industry.

ChemCentre offers a combination of scientific excellence and applied expertise with R&D to identify and develop new methods to assess emerging risks and assist the sustainable development of Western Australia. It fosters collaborative scientific networks with partners at the state, national and international levels. ChemCentre also provides a continuous on-call emergency response capability for dealing with chemical incidents and emergencies throughout WA.

ChemCentre operates a well-equipped analytical chemistry laboratory within the Resources and Chemistry Precinct at Curtin University.

ChemCentre's core responsibilities are to support a safe and prosperous Western Australia, by working:

- Mitigate risks to government associated with public health, public safety and the environment
- Keep the state safe during times of emergency and crisis
- Support the state justice and policing systems
- Support the sustainable economic development of the state
- Support science capability and engagement in the state
- Develop our people and enhance organisational capability

General Comments

The National Research Infrastructure Capability Issues Paper in our view succinctly outlines many key current and emerging knowledge/capability gaps, which will inform the identification of critical scientific research infrastructure.

We believe the document needs to better integrate the research infrastructure needs of "Pure Research" with those of "Applied Research". There is little doubt that pure research drives innovation through applied research. This has been recognised by both the Commonwealth and State governments through, for example, the Cooperative Research Programs, Australian Research Council Linkage Grants, and various state and Commonwealth programs that aim to promote, diversify and increase the competitiveness of the Australian economy and the innovativeness of our industries. It is recognised that this could best be driven by encouraging collaboration between industry, academia and government research institutes.

The critical national research infrastructure needs to support both pure and applied research are essentially the same.

The discussion of research infrastructure needs in the issues paper to support Health and Medical Science effectively illustrates that the same research infrastructure can be used to support the development of emerging pharmaceutical, immunological and gene based therapies as well as the development of more powerful instrumental diagnostic technologies. These same technologies could also be used to support the development not only of the nation's therapeutic and diagnostic based bio-technology industries but also its animal, plant and food production based industries. The technologies/methodologies required to cost-effectively "data mine" big health data are equally applicable to these other industries.

Similar arguments pertinent to the infrastructure need of advanced physics, chemistry, mathematics and materials science are also applicable to the needs of the Australian chemical, materials, and minerals processing industries.

Pure and applied research can be used to drive the development of high value products including:

- Materials: e.g. rare and high value metals, e.g. high purity silicon, magnesium, lithium and alloys needed to support for example the electronics industry
- Chemicals: e.g. lithium salts, rare earths
- Advanced mineral processing technologies and extractive technologies to enable the economic extraction of low grade and complex ores
- Advanced mineral exploration technologies

We also believe that a brief review of the state government's owned scientific infrastructure would complement the document and give greater clarity in deciding what additional infrastructure is required and also highlight any regional infrastructure or access issues that may be limiting Australia's ability to maintain its leading edge capabilities.

Critical Infrastructure in Western Australia includes for example the Square Kilometre Array (SKA), The Pawsey Supercomputer Centre and key scientific institutes, for example the Australian Resources Research Centre (ARRC) and the Resources & Chemistry Precinct of which CSIRO, Curtin University and ChemCentre are members. These institutes are also adjacent to and accessible by industry through the Technology Park, Bentley.

We believe that the issue papers also need to highlight, critical research capability and infrastructure gaps pertinent to:

- National Security: Law & Order
- National Security: Emergency Response
- Anthropogenic impact of contaminants on air water and soil quality

These research capability gaps expose the Nation to unacceptable economic, environmental, social and security risks unless adequately resourced.

The key issue here is not such much the requirement for any particular scientific infrastructure but one of access to critical infrastructure that has already been highlighted in the issue papers capability focus areas, for example the geographic isolation of Western Australia exposes the state to additional risks, in particular response times and capacity to render a site/incident safe in the event of a CBR incident.

National Security: Law & Order

National security is appropriately identified as a key strategic priority in the National Science and Research Priorities. However, within the remit of 'crime' in addition to cyber security it is our view that there needs to be an acknowledgment of the need to bolster research and innovation (R&I) infrastructure in the policing sector and more specifically in relation to the Forensic Sciences. It is our suggestion that due consideration be given to incorporating Law and Order as a defined category under the National Security capability area.

Currently the Australian & New Zealand Policing Advisory Agency (ANZPAA) has carriage of the coordination of R&I in policing in Australia and commissions R&I directed at improving policing outcomes. In addition sitting within ANZPAA is the National Institute of Forensic Science (NIFS). NIFS has a remit to coordinate R&I across the key Forensic Science disciplines that provide investigative and evidential services to law enforcement and justice systems within Australia. The key forensic disciplines are Chemical Criminalistics (including explosives, arson, mineralogy, trace evidence identification and comparison), Toxicology (including post mortem, traffic related toxicology, new psychoactive substances), Illicit Drugs (including illicit manufacture and drug profiling), Biology (including DNA), Field Sciences (including crime scene, firearms, fingerprints, blood pattern analysis), Medical Sciences (including forensic medicine, mortuary services, anthropology, odontology, entomology) and Electronic Evidence (including computer forensics, cybercrime, audio and visual analysis and facial comparison).

NIFS is currently developing its own R&I Strategy and Roadmap. Currently, the national infrastructure addressing national R&I needs comprises a network of academia, state government forensic laboratories and jurisdictional police forces.

Historically, the output of R&I initiatives impacts not only on national security but also the areas of Health and Medical Science, and Advanced Physics, Chemistry, Mathematics and Materials science. This is evident in the R&I initiatives of ChemCentre's forensic science laboratory. For example, ChemCentre is involved in R&I initiatives that:

- Address the prevalence of emerging psychoactive substance and assess the impact they have on public health
- Deliver intelligence products through the digestion of data (big and small) associated with state, national and international illicit drug profiling and trends
- Deliver intelligence products through trace evidence data collection and interpretation to improve investigation and judicial outcomes
- Advance the characterisation of emerging drugs and associated agents (incl. doping compounds such as peptides) through the development of proteomic and metabolomic capabilities utilising advanced mass spectrometry techniques.

While ANZPAA/NIFS and the network of R&I 'providers' have done a commendable job with the resources available to them they would clearly benefit from a national, consolidated and coordinated approach in pursuing R&I priority areas through dedicated integrated infrastructure.

National Security: Emergency Response

Combating threats and risks to domestic security from invasive diseases, pests and pathogens, cyber security and crime have been identified as capabilities that need to be addressed. Emerging research areas which may require critical research infrastructure include, biosecurity, cybersecurity and water security. In ChemCentre's view there is a need to better address knowledge gaps pertinent to how the nation would respond to a Chemical, Biological and Radiological (CBR) related incident. Critical research gaps include how best to render safe and remediate contaminated sites and infrastructure in the event of a CBR incident, especially if the incident involves biological agents (for example anthrax) or radioactive materials. Whilst research has been conducted in the US and Europe as to how best to decontaminate land and infrastructure it is not known whether or not these strategies would be suitable in the Australian environment and soil types. Much of this international work has focussed on traditional agents. These are regarded as weapons used by nation states and current thinking is that terrorists are more likely to be using toxic industrial chemicals or larger amounts of readily obtainable toxic materials such as organophosphorous pesticides. There is a requirement for research to understand the interaction of these industrial chemicals and biologicals with the Australian built environment. Other critical knowledge gaps include the applicability of various agent dispersion models in the urban built environment, especially in subways, transit hubs, entertainment centres, shopping malls and similar. The USA and the UK have conducted intensive studies of how and where chemical and biological agents disperse in subway systems in London, Boston, Washington and New York. Whilst Australian researchers have had some involvement in these programs, to date only a cursory investigation of Australian subway systems has taken place (Perth

and Melbourne). No work has been done in the Sydney system which is the largest in Australia. The economic cost to the nation of closing an airport or a subway system is not insignificant and it is only through an understanding of the dispersion mechanism and routes followed by agents that validated emergency evacuation and response plans can be formulated so as to minimise the impact to commuters and to enable the infrastructure to be returned to service in a timely manner.

ChemCentre for example has undertaken and is undertaking a number of projects which will inform

- incident response,
- Incident resolution,
- Incident consequence management,
- Incident recovery,
- Site Decontamination; and
- Restoration of Public Confidence.

Anthropogenic impact of contaminants on air water and soil quality

The Australian economy is heavily dependent upon its extractive industries, in particular mining, mineral processing and the oil and gas industries, including coal seam and potentially shale and tight seam gas.

Australian also has a significant and growing agricultural industry which is likely to increase given the emergence of China and the burdening demand for high quality agricultural produce and food stuffs. This increased demand is likely to be satisfied through the development of, for example, more efficient agricultural production practices, improved cultivars and the expansion of northern agriculture and aquaculture.

The productivity of these extractive and agricultural industries is increasingly dependent upon critical inputs, especially water and low cost energy. The research demands for these have been identified in the Roadmap as has the need to better understand the impact of global warming and the development of strategies and methodologies to “future proof” our agricultural industries.

Other key impactors on the economic, social and environmental sustainability of agriculture and the extractive industries are less well understood. In particular there are significant gaps in our understanding of the anthropogenic impact of contaminants on soil, air and water quality which unless addressed could lead to significant social, economic and environmental legacy loses. Such knowledge gaps unless addressed will lead to significant loses, including lost opportunities unless government and industry can implement informed cost effective risk abatement options

The potential impact of Acid and Metalliferous Drainage (AMD) on ground and surface waters and ecologies is one such exemplar since the potential cost of minesite remediation of the nations, coal, iron ore, base and precious metals mines is likely to be of the order of tens of billions of dollars. The risks to government if mine site closure is prematurely granted are substantial as will be the cost to industry if the waste management practices it puts in place during the mine life prove to be ineffective and as such require expensive remediation to achieve mine site closure.

New predictive tools and knowledge are needed to inform EIA’s, waste management options, mine site closure planning and ultimately approval and consequently the acceptance by government.

Similarly there is a dearth of information on prioritising waste management and remediation options. Significant, multi-disciplinarian research is required to address these knowledge gaps and as such enable the identification of cost effective remediation and waste storage practices as early as possible to ensure that the strategies and practices put into effect are effective and do not expose either industry or government to unnecessary and expensive risk.

Other Anthropogenic contamination risks include:

- Particulate, inorganic and volatile organic emissions in Regional air sheds, e.g. Port Hedland, Gladstone, Mt Isa, Wagerup and Port Pirie and impact on public health
- Sediment and nutrient transport arising from coal mining, agriculture and dredging on sensitive marine ecologies, e.g. reef's, especially the Great Barrier
- Impact of fracking (coal seam gas and oil and gas containing shales and tight sands) on ground and surface waters
- Eutrophication of ground and surface waters as a consequence of agricultural production and the implications for urban and rural planning.
- Utilisation of mineral processing wastes to improve soil quality and to reduce nutrient transport.
- Eutrophication of marine waters as a consequence of aquaculture
- Decommissioning of oil and gas production platforms, especially in marine environments
- Bio-accumulation/magnification of organic, metal and metalloids mechanisms, trigger values and remediation of impacted water and soil.

Anthropogenic contamination of soil, water and land has the potential to exacerbate the impact of a drying climate, degrading landscapes and the unsustainable draw down of scarce ground and surface waters on sensitive ecologies economic productivity/sustainably and social acceptance. Accordingly there is a need to better understand and to develop strategies to better identify, mitigate risks associated with the anthropogenic contamination of soil, water and land.

In closing the ChemCentre considers that it is the nation's best interest to develop, resource and action a National Infrastructure Roadmap and would welcome the opportunity to explore this need further with the relevant Roadmap Working Groups and Capability Experts.