Chapter 7
Transport of Waste to the Repository

7.1 Introduction

Internationally and in Australia, there has been a long record of safe transport of radioactive substances. More than 20 million packages containing such material are safely transported throughout the world each year. Over the past 40 years there have been no accidents where there has been any significant radiological release harmful to the environment or public health.

In Australia over 30,000 packages of radioactive material are routinely and safely transported each year by road, rail and air. Radioactive substances for a wide range of commercial and industrial applications are routinely transported for use. For example, radioactive materials used in medicine (radiopharmaceuticals) are transported to hospitals and clinics for use, and equipment such as moisture meters used in agriculture and road construction, and gauges for use in minerals exploration and the petroleum industry, are routinely transported.

Internationally accepted regulations govern the transport of radioactive materials in Australia. The regulations are designed to protect people, property and the environment from the effects of radiation during the transport of radioactive material.

The result of the application of these regulations is that transport of radioactive materials is considerably less hazardous than the transport of flammable and corrosive materials.

Radioactive waste would be transported to the national repository in accordance with the relevant regulations and codes (including any requirements under Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) licensing), to ensure the safety of people and the environment.

7.2 Proposed Transport Routes

7.2.1 Introduction

The transport of low level and short-lived intermediate level radioactive waste to the proposed repository would be undertaken in compliance with the requirements of the ARPANSA 2001 *Code of practice for the safe transport of radioactive material* (ARPANSA 2001 Code), ARPANSA licensing, and relevant state and territory regulations as described in Chapter 3. These requirements relate to the movement of each discrete consignment of radioactive waste, and define, *inter alia*:

- how differing types of waste materials should be packaged and labelled, and the maximum volumes that could be incorporated into a single load
- the specification of hazard warning signs to be displayed on vehicles transporting waste
- instructions for the carriers contracted to ship the waste, including proposed routes.

The transport of solid radioactive waste in accordance with packaging requirements and standards as outlined in the code does not provide a hazard to people or the environment.

Factors relevant to the type of transport chosen, and arrangements for shipments include the:

- present location of radioactive waste at over 100 sites around Australia
- fact that most sites have only small quantities of waste

- need or requirement for conditioning of waste prior to transport
- location of sites which would generate radioactive waste in the future, after the current inventory of waste had been removed to the repository
- need to ensure secure management of material during transport.

The scale of the transport task, and the logistical factors affecting shipments from each individual storage site, would influence the choice of transport mode (although most waste would be transported by road) and transport route. The following sections describe the main factors likely to drive these processes, and how they are likely to impact upon transport arrangements.

7.2.2 Transport Task

Existing Waste

As described in Section 4.1, Australia has accumulated about 3700 m^3 of low level and short-lived intermediate level radioactive waste from medical and industrial use of radioactive material during the last 100 years. This waste, which would be disposed of in the repository, is currently stored at over 100 sites around Australia. The main sources of this waste are described in more detail in Appendix B. The approximate volumes requiring disposal are restated below:

- 2010 m^3 of slightly contaminated soil, from research by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) into ore processing, which is currently stored in drums near Woomera
- 1320 m^3 of waste from Australian Nuclear Science and Technology Organisation (ANSTO) operations at Lucas Heights near Sydney
- 210 m^3 of waste held by the Department of Defence (Defence) at various locations around Australia
- 160 m^3 of waste, which includes sealed radioactive sources used in gauges, smoke detectors, medical equipment and luminous signs, held by governments, industry, hospitals and research institutions and stored at numerous locations around Australia.

Over half, by volume, of the existing waste (i.e. that stored near Woomera) would need to be transported only a small distance to the repository.

Efforts would be made to consolidate shipments of waste from those organisations holding small amounts of waste, to minimise the number of trucks going to the repository. The waste would be conditioned before transport to be ready for disposal upon arrival at the repository (waste would be conditioned at the repository only in circumstances where a package had been damaged during transport etc).

Future Waste

As described in Section 4.2, future quantities of waste suitable for disposal in the repository are estimated to be less than about 40 m^3 per year. About 30 m^3 is expected to be generated at the ANSTO site, while other waste producers are expected to generate about 10 m^3/yr in conditioned form ready for disposal.

Some consolidation of waste from organisations producing smaller amounts of waste would be sensible in future campaigns in order to minimise shipments.

In addition to that indicated above, waste would arise from the decommissioning of the Moata Research Reactor in 1995 (about 55 m^3), the High Flux Australian Reactor (HIFAR), and from the replacement research reactor. There are various decommissioning options possible for HIFAR and the amount of low level and short-lived intermediate level waste generated would vary from 500 to 2500 m^3, depending on the option chosen. Table 4.2

summarises the estimated routine future arisings of low level and short-lived intermediate level radioactive waste.

7.2.3 Transport Mode

The selection of a preferred mode for transporting the waste is influenced by the following:

- a large number of storage sites nationally, largely holding/generating small volumes of waste to be transported, with some sites located in regional areas
- a potential need to consolidate partial loads for conditioning and packaging
- the need to ensure secure management of material during transport.

Transporting the material to the repository by truck/road provides the most flexible transport option. Trucks have flexible load capacity to facilitate load consolidation at intermediate storage locations. In addition, the use of larger vehicles for longer distance haulage, with continuous chain of custody, provides secure environments for transport. Consideration of possible transport routes and safety issues therefore focuses on the use of the road mode for waste transport. The adoption of other modes is considered further as an option, and is described in Section 7.3.

7.2.4 Logistical Arrangements

The transport logistical arrangements and impact upon truck routing options are considered separately for the major sources of waste material as described in Section 7.2.2. The transport logistics issues associated with each of these sources are briefly described in the following paragraphs.

CSIRO Contaminated Soils

The 2010 m^3 of slightly contaminated soil is currently stored in 9726 drums of 207 L capacity near Woomera within the Woomera Prohibited Area (WPA). The condition of the drums is suitable for transport to the repository with no further containment or conditioning. Access to each of the preferred and alternative sites, including any necessary road works, is described in Section 7.4. In the case of Site 52a, transport would be from Evetts Field, where the waste is currently housed, to the preferred repository site 10 km to the west. In the case of the two alternative sites, waste would be transported approximately 85 km east to Site 40a or 135 km east to Site 45a, using the current proposed routes.

ANSTO Wastes

ANSTO currently holds 1320 m^3 of low level and short-lived intermediate level radioactive waste (conditioned volume) at a single site at Lucas Heights. It comprises packed waste of about 5000 drums of 205 L capacity and 400 drums of 300 L capacity, and unpacked waste of approximately 250 further drums of 205 L capacity.

All waste would be conditioned prior to being transported by licensed contractor to the repository.

Defence Wastes

Defence has about 210 m^3 of waste (conditioned volume), which consists of contaminated soils from land remediation, sealed sources, gauges, electron tubes, equipment (watches and compass parts) and some aircraft ballast and is held at a number of locations around the country. Conditioned waste would be transported by a Commonwealth-licensed contractor to the repository.

Miscellaneous Material Including Disused Sealed Radioactive Sources

The 160 m^3 of miscellaneous material including sealed radioactive sources used in gauges, smoke detectors, medical equipment and luminous signs is located throughout the country. Some is located at state and territory stores and others in hospitals, research institutions and industry stores. In some cases this waste has been conditioned to some degree, although it is likely that further conditioning for disposal would be required. In other cases, no conditioning of the sources has occurred.

All this miscellaneous material would be conditioned prior to transport to the repository site. The material would be consolidated as much as practicable to enable cost-effective transport services to be provided to the repository. The transport of the waste would be undertaken by Commonwealth-licensed contractors.

7.2.5 Proposed Truck Routes

National highway routes would be used for the transport of radioactive waste from capital cities to the national repository in central–north South Australia. Various options are available for alternative routes along state highways and regional connecting roads.

Selection of routes would depend on:

- logistical and operator considerations for the most efficient route to collect waste from a number of sites
- distances involved in various routes
- conditions of the transport route, including the quality of road surface
- weather conditions in various areas at the time of transport.

While the most likely transport routes are suggested below, a flexible approach would be adopted in terms of roads used for transport of waste to the repository, in accordance with the relevant regulations and requirements.

The discussion below excludes consideration of waste shipments from Western Australia to the national repository, as low level and short-lived intermediate level radioactive waste generated within Western Australia is disposed of in the Mount Walton East intractable waste disposal facility.

Route Selection Principles

The route alternatives for each state and territory have been selected with reference to the following road hierarchy:

- national highways
- state highways
- other connecting roads.

The rationale for this hierarchical approach is that national highways have the highest design standards, and provide the fastest most direct route between centres, with many towns and regional centres being bypassed. State highways, whilst also constructed to high standards, do not typically bypass towns, as they are designed to provide access to those towns. Other connecting roads may be used where needed to link between national and state highways, and between current waste storage locations and the national/state road network.

Adelaide to Repository

The most direct feasible route linking Adelaide to the repository is via the Princes Highway (NH1). The Princes Highway route bypasses all towns other than Port Wakefield and Port Augusta. The route comprises two sections:

- Adelaide to Port Augusta via Port Wakefield: on Princes Highway (NH1)
- Port Augusta to Woomera: on Stuart Highway (NH87).

Darwin to Repository

The Stuart Highway (NH87) provides the only feasible road link through the Northern Territory between Darwin and the repository. It comprises four main sections:

- Darwin to Katherine
- Katherine to Tennant Creek
- Tennant Creek to Alice Springs
- Alice Springs to Woomera.

The Stuart Highway is a designated national highway over its full length from Darwin to Port Augusta. Between Darwin and Woomera the route passes through the main centres of Katherine, Tennant Creek and Alice Springs, plus other minor towns and settlements.

Brisbane to Repository

Two separate route options have been defined linking Brisbane with the New South Wales border (near Goondiwindi), with a single preferred national/state highway route from there to the repository through New South Wales and South Australia. The inland routes to Goondiwindi avoid roads closer to the coast, which pass through more heavily populated areas. The route option segments within Queensland are:

Option 1: Brisbane to Goondiwindi via Warwick: on Cunningham Highway (SH15)
Option 2: Brisbane to Goondiwindi via Toowoomba and Millmerran on Gore Highway (SH54/85).

The inland route through New South Wales and South Australia between Goondiwindi and the repository comprises the following six national and state highway segments:

- Goondiwindi to Dubbo via Moree, Narrabri, Coonabarabran and Gilgandra: on Newell Highway (NH39)
- Dubbo to Nyngan: on Mitchell Highway (SH32)
- Nyngan to Broken Hill via Cobar and Wilcannia: on Barrier Highway (SH32)
- Broken Hill to Peterborough turnoff, via Olary and Yunta: on Barrier Highway (SH32)
- Peterborough turnoff to Port Augusta, via Peterborough, Orroroo, Wilmington and Stirling North: on SA state highway to Stirling North, then Princes Highway (NH1) to Port Augusta
- Port Augusta to Woomera: on Stuart Highway (NH87).

Sydney to Repository

Two main route options have been defined between Sydney and the repository. These comprise:

Option 1: via Broken Hill:

- Sydney to Molong via Katoomba, Bathurst and Orange: on Great Western Highway (SH32)
- Molong to Nyngan via Wellington and Dubbo: on Mitchell Highway (SH32)
- Nyngan to repository as per Brisbane to repository route (as described above).

Option 2: via Wagga Wagga:

This option seeks to use the Hume and Sturt national highways, and then state highways to Port Augusta. The Hume Highway is high standard, bypassing towns en route to Wagga. Sections along this option are:

- Sydney to Wagga turnoff via Goulburn, Yass and Gundagai: on Hume Highway (NH31)
- Wagga turnoff to Renmark via Narrandera, Hay, Balranald and Mildura: on Sturt Highway (NH20)
- Renmark to Burra via Morgan. This route bypasses all main Riverland towns, and utilises the recently reconstructed Morgan to Burra sealed road.
- Burra to Peterborough turnoff via Whyte-Yarcowie: on Barrier Highway (SH32)
- Peterborough turnoff to repository as per the route from Brisbane as described above.

A potential sub-option (Option 3) of this route comprises the route Sydney to Buronga in New South Wales (across the River Murray from Mildura as above), then:

- Buronga to Broken Hill via Wentworth: on Silver City Highway (SH79)
- Broken Hill to repository as per the route from Brisbane as described above.

It is expected that shipments to the repository from the ACT would take place via the Option 2 route from Sydney, with trucks travelling from Canberra to Yass on the Barton Highway.

Melbourne to Repository

In defining route alternatives between Melbourne and the repository, a key objective was to avoid trucks passing through metropolitan Adelaide. In meeting this objective, two main options have been defined. These are:

Option 1: via Bendigo:

This option uses the high standard Calder Highway, via the following route:

- Melbourne to Mildura via Woodend, Bendigo, Charlton and Ouyen: on Calder Highway (SH79)
- Mildura to Renmark: on Sturt Highway (NH20)
- Then Renmark to repository as per the Option 2 route from Sydney to the repository.

A sub-option of this route from Mildura to the repository would comprise:

- Mildura to Wentworth via Buronga, then via Broken Hill to the repository as per Option 3 from Sydney as described above.

Option 2: via Horsham:

This route option would use the following links:

- Melbourne to Horsham via Ballarat and Ararat: on Great Western Highway (NH8)
- Horsham to Ouyen via Warracknabeal: on Henty and Sunraysia highways (SH107/121)
- Ouyen to Mildura: on Calder Highway (SH79).

Then Mildura to the repository as per Melbourne Option 1 as described above.

Hobart to Repository

Three issues have been considered in defining routes for waste shipments to the repository. These comprise the use of the national highway network in Tasmania, the route for shipping the material to the mainland, and the overland route on mainland Australia to the repository.

Of these three issues, the one that most strongly influences the overall route choices is how waste should be shipped from Tasmania. Two main options are available:

Option 1: ship from Launceston to Melbourne on the Princess of Tasmania. This is a roll-on/roll-off passenger service

Option 2: ship from Burnie to Melbourne via a freight shipping service that operates daily between these ports

The latter option is preferred, as it offers a high service frequency. Ship movements from Tasmania to other Australian ports are much less frequent.

Having defined the trans Bass Strait shipping movement, route options between Hobart and the repository effectively reduce to the following components:

- Hobart to Burnie via Launceston: on Midlands and Bass Highways (national highways)
- Burnie to Melbourne: by sea
- Melbourne to repository via either of the two options described above for waste shipments from Melbourne.

In addition to the shipping option, depending on conditioning requirements, air transport of some waste from Tasmania to the mainland is potentially feasible.

7.2.6 Route Summary

Figure 7.1 illustrates the principal routes that may be used in the transport of radioactive waste from main centres to the national repository.

7.2.7 Method and Frequency of Waste Shipments

Estimates of the numbers of truck movements required to carry the accumulated waste from each respective state and territory to the repository have been prepared, based on the waste inventory as summarised in Section 4.1 and detailed in Appendix B. As the detailed arrangements for transport of waste to the repository have not yet been finalised, assumptions have been made as to how the waste would be packaged, the type of trucks to be used and how, in general, the waste would be loaded onto the trucks.

These assumptions are as follows:

- Most waste would be transported in standard 205 L industrial steel drums (Section 4.3.2).
- Packed 205 L drums may be carried in standard 6 m shipping containers for transport to the repository. Up to 72 drums could be double stacked into a standard 6 m shipping container.
- The shipping containers could be conveniently carried on standard container-carrying trucks designed for this purpose, and would provide additional protection for the solid waste in the unlikely event of an accident.
- The 205 L drums would have a maximum weight limit of 300 kg, and the maximum gross weight of a loaded container is proposed to be 20 t.

It is assumed that an average of 10 m^3 of waste is transported in each container. This corresponds to an average consignment of about 50 full drums per container. This is less than the maximum capacity of 72 drums per container; however, some drums may not be full and some containers may have part loads, and the drums would be subject to an upper weight limit of approximately 300 kg. Thus, the assumption is considered to be reasonably conservative.

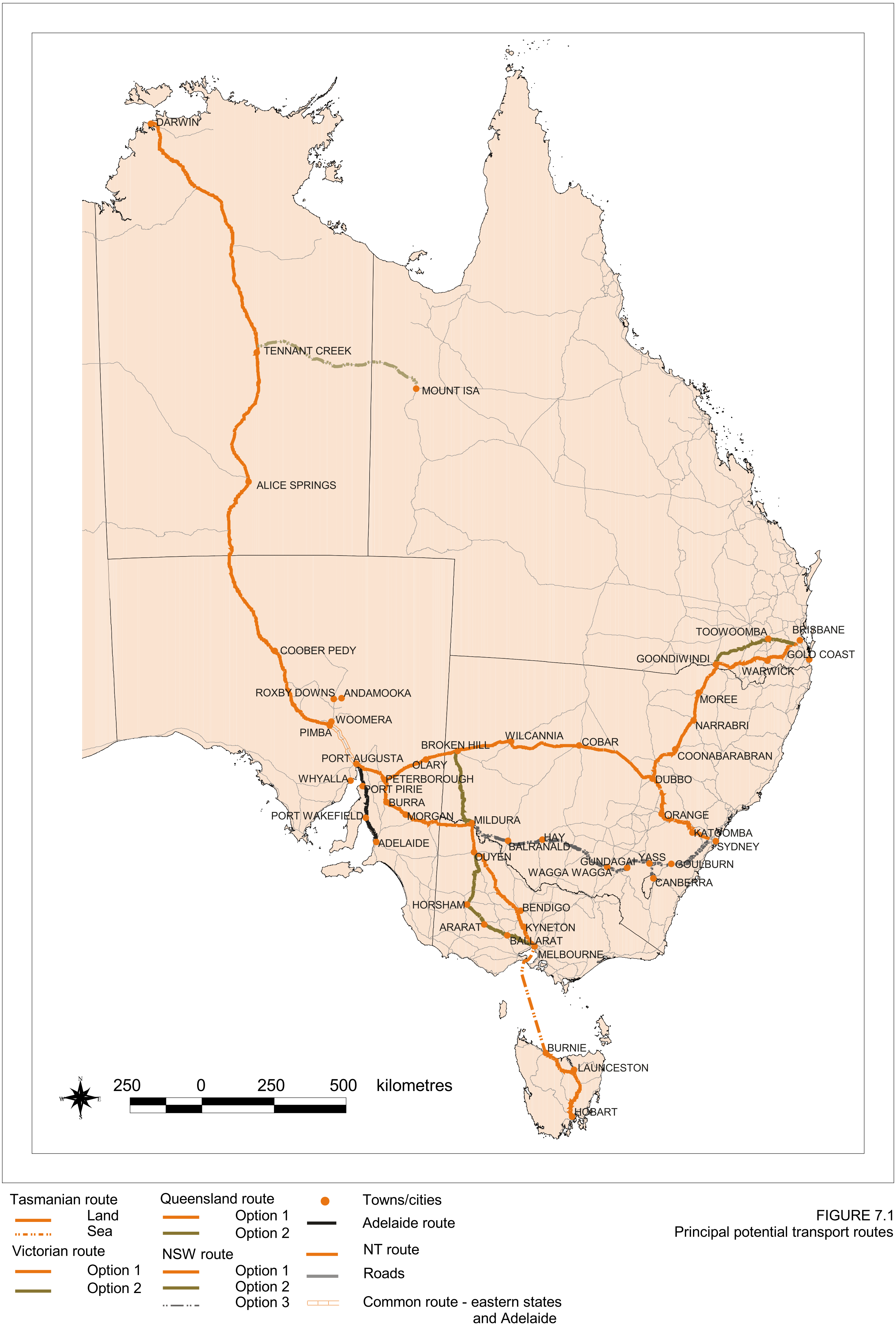


FIGURE 7.1
Principal potential transport routes

Table 7.1 summarises the estimated number of truck movements to ship existing waste based on these assumptions. These estimates exclude truck movements to transport the 2010 m^3 of CSIRO material already being stored at Woomera.

TABLE 7.1 Estimated number of truck movements to the repository

State/Territory of origin	Volume of conditioned and packaged waste to be transported (m^3)	Number of truck movements[(1)]
South Australia[(2)]	218	22
Northern Territory	16	2
Queensland	45	5
New South Wales/ACT[(3)]	1,355	136
Victoria	33	4
Tasmania	15	2
Total	**1,682**[(2)]	**171**

(1) Rounded
(2) Excludes 2010 m^3 of CSIRO material stored at Woomera
(3) Includes 1320 m^3 of ANSTO material stored at Lucas Heights
Source: Department of Education, Science and Training/Consultant analysis

The estimated numbers of truck movements are very low. They could increase under alternative logistical arrangements, but in any event would remain low in comparison with other traffic on the route network.

The estimated volume of future waste of up to about 40 m^3 per year is equivalent to four 6 m containers per year nationally. Given the low volumes of waste involved, it is likely that disposal campaigns would occur at intervals of between two and five years. Allowing for accumulation of waste over several years, only a few trucks would be required for transport of the waste to the repository. Small trucks would be suitable as transport vehicles from some states/territories.

7.3 Transport Options

Road Versus Other Options

Table 7.2 compares the practicality and risk of using different modes of transport. The most practical is road transport, using normal or articulated trucks. Rail transport, where it is an option, is safer than road for accident rates; however, rail transport has distinct disadvantages compared with road transport. All transport operations would be managed in accordance with the ARPANSA 2001 Code (see Section 3.2.3).

Waterborne transport is generally not relevant to the proposed national repository, apart from the specific case of Tasmania where there is a requirement for shipment of a small amount of material to the mainland. Airborne transport would only be considered where it is a practical alternative, for example the small quantities of waste from Tasmania.

As described in Section 7.2.3, the preferred mode for transporting waste material to the repository is by truck. The main reasons for this are:

- the transport of low level and short-lived intermediate level radioactive waste would involve relatively small loads from numerous storage sites, with many of these located in regional areas
- a potential need to consolidate partial loads at a limited number of centralised locations
- a high degree of flexibility in the pick up, consolidation and transport of waste

- the need to maintain a continuous chain of custody of the movement of each load or partial load.

TABLE 7.2 Comparison of risks of different modes of transport

Mode of transport	Comparison of practicality	Comparison of risks
Road	This is the most practical option. Road transport has the most secure chain of custody, as drivers accompany each consignment.	The probability of accidents reduces on major interstate roads, and is higher on minor single-lane roads. The probability of accidents increases with speed. The risks are lower on rural roads and higher as the vehicle drives through urban areas. Overall, the environmental pollution (non-radiation) risks of road transport are higher than for rail transport.
Rail	Road transport to the nearest railway station with freight loading facilities is required, meaning additional handling. Also, additional handling would be required with the unloading of the waste for transfer to a truck for shipment to the repository. Chain of custody is poor compared with road transport.	The risks of rail transport are less than road transport because the probability of a crash is lower, and access to the rail reserve is better controlled. However, although accident rates are lower, in the event of a rail accident, the potential for damage to the waste containment is higher owing to the larger momentum forces. The security of chain of custody is poor compared with road transport.
Air	This is generally likely to be impractical for the large volumes of waste to be transported, and is considered feasible only for remote locations a long way from the repository, e.g. Tasmania.	Type C containers have been specially designed for air transport of higher activity sources. Air transport is suitable provided the special restrictions in the International Atomic Energy Agency (IAEA) Regulations (International Atomic Energy Agency 2000) are followed.
Inland waterways vessel	No inland waterway vessels would be utilised in the transport of material to the repository.	
Ocean-going ship	This is only relevant to the small amount of waste from Tasmania, which could be transported in two trucks on either a commercial freight ship or car ferry.	The recovery of materials in event of an accident is more problematical, but consignments would be conditioned and of comparatively low activity. However, because the distance from Tasmania to the mainland is short, the number of journeys few and the contents small, the transport risks are insignificant.

Notwithstanding the road transport advantages, consideration has also been given to the potential use of alternative modes, how these would fit into the logistics chain, and how they would meet the requirements for transport to the repository. This is described in the following subsection. Again, this consideration excludes reference to waste generated in Western Australia, for reasons outlined in Section 7.2.5.

Rail

The national standard gauge mainline rail network links Brisbane, Sydney, Melbourne and Adelaide to a siding on the Port Augusta to Alice Springs line at Pimba. Canberra is linked into the network, with Darwin to be connected following completion of the Alice Springs to Darwin rail line. Tasmania is effectively linked via the shipping service across Bass Strait from Burnie to Melbourne.

An overview of potential logistical arrangements for packaging, conditioning and (possibly) consolidating waste was described in Section 7.2.4. Most of those (intra-state) arrangements could similarly apply if rail was used for transporting waste. Additional steps in the logistics process would require, however, the following activities:

- movement of ISO standard containers onto a railway wagon (an additional transfer step)
- transhipment of the wagon/container between trains at marshalling yards in the various capital cities, and potentially at Port Augusta
- transhipment of containers from the railway wagons at Pimba by truck (a further additional transfer step) and then to the repository.

Waste from Darwin would, in the short term prior to the completion of the railway line, be shipped by road down the Stuart Highway to the repository.

Although rail offers an inherently lower risk of accidents en route, its main disadvantages relative to road transport include:

- additional handling of containers, thereby increasing the potential for accidents and increasing the overall costs of transport
- more inefficient transport arrangements, given the relatively small volumes of material to ship from most locations, both now and in the future
- potential delays in transport of waste; wagons containing the waste could be shunted onto sidings for several days at intermediate locations before being attached to an onwards train
- difficulty in adding further material to a train en route between capital cities; this transfer could be undertaken relatively easily by trucks at nominated intermediate staging points
- longer door-to-door transit times
- poorer security of chain of custody.

In the unlikely event of a rail accident occurring, it could be more severe than a road accident.

Air

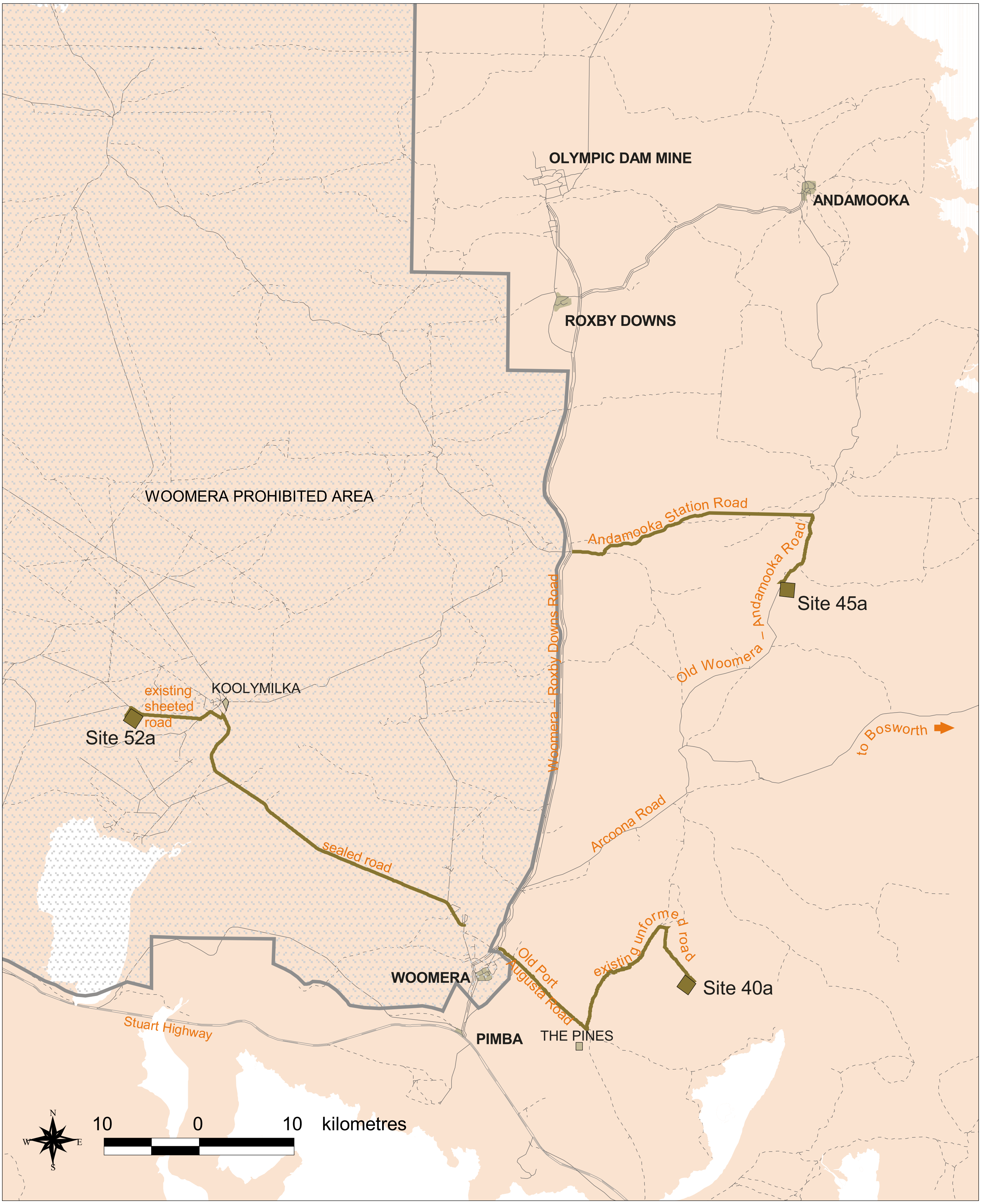
Transport of waste material by air offers a secure transport option. However, it is not a practical/cost-effective alternative for moving relatively large volumes of material. Issues relevant to the transport of waste by air include:

- the need for additional handling of material between consolidation points and airports, and between the Woomera airport and the repository
- the likelihood of conditioned waste being heavy, leading to high air transport costs.

Transport by air is not considered further as an option for mainland sources of waste. It remains, nevertheless, an option for transport of small volumes of waste between Tasmania and the mainland.

7.4 Site Access Routes from Woomera

The access routes from Woomera to the preferred and two alternative sites are shown in Figure 7.2. Site 52a is near Evetts Field West, west of the Woomera–Roxby Downs Road and within the WPA. The two alternative sites (Sites 45a and 40a) are about 20 km east of the Woomera–Roxby Downs Road.



Repository waste sites
Access roads
Woomera prohibited area
Salt lakes
Towns/settlements
Major road
Sealed seconday road
Minor road
Track

FIGURE 7.2

Access roads

Access to each of the preferred and alternative sites, including any necessary road works, is described below.

7.4.1 Access to Site 52a

Site 52a lies at approximately 158 m above sea-level and just north of Wild Dog Creek (which flows east into Koolymilka Lake). The site is 55.5 km by road northwest of Woomera township. The current access comprises 45 km of two-lane sealed road (approx 6 m wide) in flat to undulating terrain to Koolymilka (old town); and then a further mainly unsealed 10.5 km of road to the west, which is sheeted 6–7 m wide with Bulldog Shale.

This mainly unsealed road includes an initial 1.5 km of narrow seal (4 m wide), which is in very poor condition (this sealed surface could be removed and the road returned to an unsealed state). The existing unsealed surfacing is weak and becomes sandy under traffic, and slippery when wet. The road is currently suitable for dry weather travel; however, use by heavy vehicles in wet weather would lead to accelerated deterioration. Options covered include upgrading the road to be useable in all weather or non-use of the road in wet weather.

The road in the WPA has several sharp angle bends, which would not prevent the passage of large vehicles, but minor sheeting works could be carried out to accommodate large vehicles.

7.4.2 Access to Site 40a

Site 40a lies approximately 189 m above sea-level. The site is approximately 42 km by road from Woomera. This route includes 6.2 km of sealed road (Roxby Downs Road) to the junction with the now unused Woomera–Port Augusta Road. The access route then follows the old Woomera–Port Augusta Road southeast for about 13 km through undulating gibber terrain to The Pines.

This old road is not maintained and is in generally poor condition. Where the surface grades are low (less than approximately 1–2%) the original formation is relatively intact, but where grades are greater and stormwater runoff has been able to concentrate, major gullying has occurred in the formation. The traversing of this road is therefore effectively an 'off-road' situation, suitable only for 4WD vehicles and, to a lesser extent, rigid trucks in dry weather. In wet conditions, the road is passable with difficulty by 4WD vehicles.

At The Pines the track follows Rocky Creek and its tributaries northeast for about 9 km along a north-trending shallow, wide valley, with highly discontinuous sand sheets and low dunes, mainly to the west of the creek lines. The subgrade is therefore a mixture of sandy floodplain sediments and gibber terrain. The route crosses the creek three times.

From the last creek crossing, the route follows gibber terrain for about 13 km east then south along a watershed to Site 40a. This section of the route is unformed (vehicle tracks only). The vegetation and gibber cover has not been removed and the road is generally in a stable condition.

The overall length of unsealed track is approximately 35.5 km. The indirect nature of the route is indicated by the contrasting 'direct' distance of 20 km.

Site 40a would require about 35.5 km of significant road upgrading works, including 13 km of reconstruction along the old Woomera–Port Augusta Road route, which is primarily gibber terrain. This would involve repairing previous damage and establishing a new road formation over the old formation. Floodways would be required at creek crossings.

The remaining 22.5 km of road upgrading would be along the existing unformed track (about 17.5 km in gibber terrain and 5 km in sandy terrain). This section of works would require removal of vegetation and earthworks over the formation width. Where sharp angle bends occur, the formation width could be increased to accommodate large vehicles.

7.4.3 Access to Site 45a

Site 45a is 131 m above sea-level. The site is approximately 52 km (direct) from Woomera, and 91 km from Woomera via the current access route. Of this distance, 49 km is sealed (Roxby Downs Road) and 42 km unsealed.

From the Roxby Downs Road, the road follows an existing road 29.5 km east through sand dunes towards Andamooka Station. This landform consists of clearly defined but closely spaced linear dunes with swales, which are partially filled with sand. The road is roughly parallel with the east–west-trending dunes, and for most if its length runs along swales. It does, however, cross at least two linear dunes and extensive areas of hummocky sand dunes.

Near Andamooka Station homestead, the station road meets the now unused Woomera–Andamooka Road. The access route then turns south for 12.5 km along the Woomera–Andamooka Road through gibber terrain to Site 45a. The route follows Dromedary Creek with a number of creek crossings for 9 km, before reaching the flatter terrain of the watershed between drainage systems upon which Site 45a is located.

Again, this old Woomera–Andamooka Road is in gibber terrain and, like the Woomera–Port Augusta Road, is in poor condition and suitable only for 4WD vehicles and rigid trucks.

An alternative route is available 14 km north of Woomera along the Roxby Downs Road, via the existing Arcoona–Bosworth Station Road (again part of the old Woomera–Andamooka Road). This route follows the Arcoona Road for 27 km, and then continues on a further 20 km north along the now abandoned and 4WD-only Andamooka Road through gibber terrain to Site 45a. This alternative route would place Site 45a about 71 km from Woomera with 47 km of unsealed road, of which approximately 20 km would require new construction. Thus, although this route is 20 km shorter, it includes 5 km of additional unsealed road.

Site 45a via the current access route would require 12.5 km of road upgrading works in gibber terrain along the old Woomera–Andamooka Road. This would involve repairing previous damage and establishing a new road formation over the old formation. Floodways would be required at creek crossings, with minor earthworks to maintain vertical geometry standards.

The alternative route via Arcoona Station would require approximately 20 km of road upgrading works in gibber terrain.

7.5 Community Consultation

Communities have been consulted on transport issues associated with the national repository project through public reports and information sheets, which have been widely distributed (Section 1.5.3).

In addition, transport issues have been addressed at information days conducted in the central–north region of South Australia in 1998 and 2001, at meetings of the various consultative committees, and at meetings with stakeholder groups (e.g. Aboriginal groups).

Consultation on transport issues has also taken place through qualitative research in the form of group discussions undertaken in 2000 and 2001 by McGregor Tan Research in Port

Augusta (SA), Mildura (Vic) and Broken Hill and Dubbo (NSW). Targeted workshops were held in Broken Hill and Mildura, and transport issues were explored more generally in Port Augusta and Dubbo. These centres were selected as they may be on routes used for transport of radioactive waste to the national repository.

The aim of the qualitative research was to explore people's awareness of, and attitudes and perceptions relating to, the transport of low level and short-lived intermediate level waste through their community. The participants were provided with information concerning the transport of radioactive waste to the national repository in central–north South Australia.

A summary of the outcome of the discussions in the regional centres is outlined below.

7.5.1 Broken Hill

Discussion with Broken Hill residents, through groups engaged for the qualitative research, indicated that transport of waste to the national repository was not a major concern. Some had heard that the Commonwealth Government had plans to dispose of low level radioactive waste. Few knew that the proposed site was in South Australia. Most did not realise that Broken Hill could potentially be on the transport route. For the majority of participants the initial reaction to possibly being on the transport route tended to be one of apprehension or reluctant acceptance.

A number of participants felt that they did not know enough about the issue to be able to pass judgment. Some people felt that it was not necessarily a major issue as they felt dangerous cargo was already transported through Broken Hill, but that the general public was not aware of it.

The greatest perceived risks were associated with the potential for a major accident, and this was enhanced by the fact that the Barrier Highway follows the main roads through the centre of town.

Concerns were also expressed about the capability of the emergency and hazardous material services to be able to cope in the eventuality of such an accident. A number of people did not know what low level waste consists of, how it would be transported and packaged, nor the amount or frequency of transport. They wanted to know what the effect of an accident would be on people and the environment, and what the arrangements would be in the event of an emergency.

Some were of the view that there were more important issues in Broken Hill than the transport of radioactive waste, particularly as they had been living with lead pollution around the town for many years.

As well as the above discussions, consultation on transport issues was conducted in 2000 between the former Department of Industries, Science and Resources (Cwlth) and the Barrier and Darling Environment Group, based in Broken Hill. A teleconference was conducted to respond to questions asked by the group, who were particularly interested in such transport issues as: the amount of waste to be transported, the frequency of transport, the way the waste would be packaged and the contingency plans in the event of an accident.

It was indicated to the group that:

- The transport of radioactive waste to the repository would be infrequent as there was a small quantity of material involved, and that about half of the existing inventory was already stored at Woomera.
- Radioactive material, including waste, is routinely transported every day in Australia and around the world and there is a long record of safe transport.

- Radioactive waste would be transported according to the relevant code of practice, based on international regulations, as well as relevant state and territory safety regulations.
- The type of packaging would depend on the form and level of activity of the waste to be transported. Low level waste generally requires industrial packaging, which meets specified temperature and pressure specifications, drop tests, and water spray and penetration requirements.
- The waste to be transported would be solid, and therefore would not 'spill' in the event of an accident. The package could simply be removed from the scene. Emergency response is the responsibility of the relevant state/territory emergency services, and is covered by existing emergency planning arrangements (see Section 7.6.4).

7.5.2 Mildura

Discussion with Mildura residents, through groups engaged for the qualitative research, indicated that most individuals were not aware of the national repository project. Some had heard of plans to dispose of waste in South Australia. Only one or two people thought that Mildura might be on the transport route.

There was a range of responses to the issue of transport of radioactive waste, from people being uninterested, through those who saw that the waste needed to be transported to a suitable location, to those who expressed reluctant acceptance as long as the material was transported safely. Others were more cautious in their response to the proposal.

Some thought that similarly dangerous material was already transported through Mildura, while others considered that radioactive material had beneficial applications, especially medical, and therefore the transport of such material was necessary. A number of people assumed that safety concerns would be appropriately addressed.

When asked about the perceived risk of transport of radioactive material, the predominant concerns were similar to those raised in Broken Hill, namely the risk associated with an accident, heightened by the fact that the main truck route passes through the middle of Mildura.

A further factor contributing to the degree of concern was the number of trucks that use this route daily and the fact that several parts of the route, especially the Sturt Highway just east of Mildura, are known to be particularly dangerous stretches of road.

7.5.3 Port Augusta

Issues concerning transport raised by the discussion groups in Port Augusta included the need for the vehicles transporting radioactive waste to cross the bridge over Spencer Gulf, and the impact of any potential accident on the bridge. There was a general willingness, however, to accept that the transport of radioactive materials including waste is safely carried out on a regular basis. This was in part due to the fact that uranium from the Olympic Dam operations is routinely transported through Port Augusta.

7.5.4 Dubbo

While the concept of disposing of radioactive waste in a national repository was supported, some were concerned about the transport of the waste. Some wanted more information about the frequency of transport of the material, and safety procedures and precautions, while others considered that too much information might exacerbate concerns.

7.6 Transport Safety

7.6.1 Review of International Accidents

Radioactive material has been transported around the world for more than 40 years, and in that period no transportation-related accidents have occurred involving any significant radiological release or harm to the environment or public health. It is estimated that more than 20 million packages of radioactive material are transported worldwide every year. The majority of these contain only limited amounts of radioactivity used for a variety of purposes, for example isotopes for medical purposes. Only a small number of transport movements actually involve substantial amounts of radioactivity.

Since there have been no major transport accidents involving the release of radioactive material, accurate predictions of likely future accidents are problematic. Therefore, general (non-nuclear) transport accidents have been used as an indicator.

Saricks and Tompkins (2000) compare road and rail transport of hazardous materials (including radioactive materials) in the USA. The report compares statistics from the 1990s with those obtained during the 1980s. There was a total of approximately 67 billion km of hazardous material truck shipments in 1992, with a total accident rate of 3.2×10^{-7} per truck-km. For rail, the number of hazardous material rail transport shipments is not stated in the report; however, the total accident rate was 2.7×10^{-7} per railcar-km.

Thus, accident rates for rail and road are similar but are about 20% higher for road transport, on a per truck-km versus a per railcar-km basis. The rates for road and rail crashes were higher in the 1990s than the 1980s. The report concludes that the following factors contribute to accidents:

- increased road speed
- minor roads, which are worse than large roads
- cold weather in both road and rail transport
- hot weather in rail transport
- rail infrastructure when poorly planned or maintained.

Many organisations collect and publish statistics of international road traffic accidents. In most countries the number of fatalities per 100,000 population, and per registered vehicle, have been reducing every year since the 1960s. This is generally considered to be because vehicles have better safety features (e.g. compulsory seat belts, air bags, side impact protection, anti-skid brakes) and road accident black-spots are designed out.

In a road traffic accident involving radioactive cargo, the cargo is not the cause of death/injury. Such a cargo has a very low hazard potential in normal road traffic accidents; it is simply a heavy load like any other. The principal hazard is physical impact, which is independent of the contents of the load. If appropriately packaged, the radioactive contents are contained within the packaging and are not released to the environment. The transport of radioactive materials is considerably less hazardous than the transport of flammable and other hazardous chemicals that are routinely transported by road.

A comparison of international transport fatality rates by Monash University compares Australia with selected major industrial countries over recent years, and shows that Australia is slightly better than the average in terms of fatality rates, with 1.45 fatalities per 10,000 vehicles, and 9.4 fatalities per 100,000 population. The USA has the highest fatality rate and Sweden the lowest. Data from the international road traffic and accident database, which compares Australia with a much wider selection of countries (for the year 1999), show that Australia has a lower rate than the international average in terms of fatalities. Korea is considered to have the highest fatality rate and the UK the lowest.

Davies (2000) reports on railway safety figures for the UK over the last 10 years. Statistics are given for a variety of accident types, including fatalities and major injuries for passengers, the workforce and the public; catastrophic accidents; signals passed at danger; suicide; and vandalism. The set of statistics most relevant to the Australian national repository relates to collisions and derailments. The average over the last five years has been 0.14 collisions or derailments per million train-km.

7.6.2 Likelihood of Incidental Exposure

The transport of radioactive waste to the repository would take place mostly by road. After the initial campaign to dispose of the current inventory of waste, movement of waste to the repository would be infrequent. The most normal form of transport would be by road in a dedicated truck. Dedicated means that the truck would only carry radioactive waste for the repository on this journey, and the driver would be suitably qualified and experienced.

Stringent controls and procedures such as driver selection and training, careful choice of contractor by safety record, good maintenance and condition of trucks, pre-planned road routes, emergency planning, and trained and equipped escorts would reduce the number of accidents from road transport. However, accidents cannot be ruled out altogether.

What makes the proposed transport safe are the characteristics of the waste to be transported, the design/selection/testing of the packaging and the strict adherence to Australian Transport Regulations.

The risks associated with the proposed transport arrangements are acceptably low because of the:

- characteristics of the radioactive waste to be transported (solid / low level and short-lived intermediate level; see Sections 4.1 and 4.2)
- design/selection/testing of the packaging (see Sections 3.2.3 and 4.3)
- strict adherence to IAEA and Australian Transport Regulations (see Sections 3.1 and 3.2.3).

In the unlikely event of an accident, the solid waste form, and multiple packaging for sealed sources (an inner shielded container, the 205 L drum, and finally the 6 m ISO standard container) would help ensure that radioactive material was not widely distributed around the accident site.

Radiation exposure risks during transport are discussed in Sections 12.4.3 and 12.9. An assessment of the risk of a traffic accident follows.

7.6.3 Risk of Truck Accidents

The potential risk of accidents involving trucks carrying radioactive waste to the repository has been assessed through a three-stage process:

- derivation of average truck accident rates per section of the alternative truck routes
- estimation of the indicative number of truck movements needed to transport the waste from the respective states and territories
- estimation of truck accident risk by applying the accident rates to the indicative numbers of truck movements.

As described below, the accident potential for trucks carrying waste is low, due to a combination of relatively small numbers of truck movements and low probable accident risks involving trucks on the regional Australian highway network.

Port Augusta forms a confluence of truck routes from all states and territories (excluding the Northern Territory). Routes pass through the city and across the bridge over northern

Spencer Gulf. Consideration of truck accident potential within Port Augusta is separately considered.

Derivation of Accident Rates

The approach adopted in assessing truck accident potential was to define average truck accident rates by section of route, as a function of historical accident levels and traffic volumes. This approach obviated the need to undertake detailed accident analyses in each town and city along the respective routes, especially given high level of uncertainty in the logistics of moving the waste (regional pick-ups and truck types).

Average truck accident rates were derived in terms of the number of truck accidents per million vehicle kilometres of travel (all vehicles) per year, based on:

- average annual truck accidents recorded over the past five years. These included accidents in towns and cities along the respective routes, but excluded accident incidence on the outlying sections of higher trafficked capital city roads where accident rates are generally much higher. Typically, accidents were sourced from the respective road authorities over the period 1996–2000.
- average annual daily traffic over each route section. The respective road authorities provided values for 2000 (or 1999 depending on data availability).

Summary average rates thus derived are shown in Table 7.3.

The results of the accident analysis reported in Table 7.3 confirm that accident rates involving trucks on the defined national and state highway routes are low. It is expected that the corresponding incidence of accidents involving trucks carrying the radioactive waste material would also be low, as demonstrated in the following section.

Estimation of Truck Accident Potential

Indicative estimates of accidents involving waste-carrying trucks were derived based on the following set of assumptions:

- Accident rates for a single selected route between each respective capital city and the repository were used. Alternative routes may be chosen with differing accident rates but, for the purpose of this analysis, a single route provides representative accident estimates.
- All accumulated waste material from each state or territory would be carried out within a 12-month period, from the respective capital city to the repository (actually it would occur within a limited time interval within the first year of operation of the repository.
- Numbers of truck movements required to carry the accumulated waste were derived using the assumptions described in Section 7.2.7. Note that these movements are based on a standardised truck carrying a container with a load of material of standard volume of 10 m^3 in 205 L drums (see Section 7.2.7). The actual numbers of truck movements may change depending on the logistical arrangements put into place, but the analysis below provides an indicative estimate of accident potential.

Table 7.4 summarises the estimated numbers of accidents for waste material transported separately from each state/territory to the repository in the initial disposal campaign.

A separate analysis for the transport of the CSIRO waste already stored at Woomera indicates an accident rate of 0.001 for Site 52a and up to 0.006 for the alternative sites, that is a negligible additional amount.

Table 7.4 indicates that less than one accident involving trucks carrying the accumulated waste from the respective states and territories to the repository might be expected. The potential number of accidents involving trucks carrying future waste (expected to total up to some 50 m^3 per year) would be negligible.

TABLE 7.3 Average truck accident rates

State of origin/ capital city	Section of route	Accident rate (accidents x 10^{-6}/vkt/year)[(1)]
SA/Adelaide	*Port Wakefield Road*	
	■ Adelaide–Port Wakefield	0.20
	■ Port Wakefield–Port Pirie	0.55
	■ Port Pirie–Port Augusta	0.50
	Stuart Highway	
	■ Port Augusta–Pimba (Woomera)	0.25
	■ NT Border–Pimba	0.35
NT/Darwin	*Stuart Highway*	
	■ Darwin–Katherine	1.05
	■ Katherine–Tennant Creek	0.50
	■ Tennant Creek–Alice Springs	0.20
	■ Alice Springs–SA Border	0.10
Queensland/Brisbane	*Cunningham Highway (Option 1)*	
	■ Ipswich–Goondiwindi	1.75
	Gore Highway (Option 2)	
	■ Ipswich–Goondiwindi	0.70
	Newell Highway	
	■ Goondiwindi–Dubbo	1.20
	Then Dubbo to repository as per NSW route via Great Western Highway, Mitchell Highway and Barrier Highway	
NSW/Sydney[(2)]	*Option 1*	
	Via Great Western Highway	
	■ Katoomba–Orange	1.12
	Mitchell Highway	
	■ Orange–Nyngan	1.22
	Barrier Highway	
	■ Nyngan–Broken Hill	0.50
	■ Broken Hill–Peterborough turnoff (SA)	1.45
	Peterborough turnoff–Port Augusta	2.45
	Then Port Augusta to repository as per SA route via Stuart Highway	
	Option 2	
	Via Hume/Sturt Highways	
	■ Mittagong–Wagga turnoff	0.70
	■ Wagga turnoff –Mildura	0.65
	■ Mildura–SA Border	1.00[(3)]
	■ SA Border–Lyrup	1.30
	Lyrup to Burra Road	1.30
	Barrier Highway	
	■ Burra–Peterborough turnoff	0.95
	Then to repository as per NSW Option 1 route	
	Option 3	
	Via Silver City Highway from Mildura (Wentworth) to Broken Hill	1.10
Victoria/Melbourne	*Option 1*	
	Via Calder Highway	
	■ Melbourne–Mildura	1.20[(3)]
	Then to repository as per NSW Option 2 route	
	Option 2	
	Via Western Highway	
	■ Melbourne–Horsham	1.20[(3)]
	Via Henty/Sunraysia Highways	
	■ Horsham–Mildura	1.40[(3)]
	Then to repository as per NSW Option 2 route	
Tasmania/Hobart	*Midland Highway*	
	■ Hobart–Launceston	0.35
	Bass Highway	
	■ Launceston–Burnie	0.50
	Then to repository as per Victorian Option 1 route	

(1) VKT = vehicle kilometres of travel
(2) Includes ANSTO facility
(3) Assumed — data not available
Note: Link from ACT via Barton Highway to Hume Highway in NSW at Yass
Source: Consultant analysis

TABLE 7.4 Estimates of truck accidents involving trucks carrying waste

Source of waste	Volume of waste (m^3)	No. of waste shipments[3]	Total distance travelled (km)	No. of accidents (in 1 year)
SA/Adelaide[1]	218	22	490	0.004
NT/Darwin	16	2	2600	0.002
Queensland/ Brisbane	45	5	2100	0.011
NSW/Sydney[2]	1,355	136	1580	0.208
Victoria/Melbourne	33	4	1290	0.006
Tasmania/Hobart	15	2	1610	0.003
Total	**1,682**	**171**		**0.234**

(1) Excludes waste material currently stored at Woomera
(2) Includes waste material from the ACT
(3) Rounded
Source: Consultant analysis

Accident Potential at Port Augusta

The section of national highway through Port Augusta would form a focus for the movement of all trucks carrying waste from the other states and territories, with the exception of the Northern Territory. The potential for accidents within Port Augusta is thus considered separately.

Traffic accident data sourced from Transport SA indicate a total of 26 accidents involving trucks over the period 1996 to 2000 (or five per year on average) over a 23 km section of the Princes Highway between the intersection of the Eyre and Stuart highways and the turnoff to Stirling North on the southern side of the city. This section of highway traverses the length of Port Augusta, including the bridge crossing of Spencer Gulf.

A simple analysis of traffic conditions through Port Augusta indicates that there would be almost negligible potential for increased accidents involving the trucks carrying the waste. This is illustrated at the bridge crossing as follows:

- total daily traffic at the bridge over the northern tip of Spencer Gulf is 14,000 (two-way)
- estimated daily truck movements at the bridge are 760 (two-way)
- potential daily movements of waste-carrying trucks would be in the order of less than 1 truck per working day. This represents less than 0.5% of daily truck movements.

With appropriate transport plans in place, it is expected that there would be minimal risk of accidents involving the trucks carrying the waste.

By way of comparison, WMC Limited have been shipping uranium oxide concentrate through Port Augusta since 1986, and currently have two or three truck movements of this material per week. Over this period, there has not been a single accident or incident involving these WMC trucks (either in Port Augusta or elsewhere along the route from Roxby Downs to Port Adelaide).

7.6.4 Emergency Services

In the unlikely event of a radiation-related accident or incident, emergency response is a matter for the relevant state or territory emergency services and is covered by existing emergency planning arrangements in accordance with the transport code. In most emergency situations, the police, ambulance, fire services and state emergency services (SES) are the first responders. The fire services maintain specialised hazardous materials (HAZMAT) teams trained to deal with chemical, biological and radiological incidents.

In addition, the Commonwealth can provide assistance on request from the states. This assistance is provided through requests from the state SES to Emergency Management Australia (EMA). ARPANSA and ANSTO also maintain trained radiation emergency response teams that can provide assistance on request from the state authorities.

The emergency response plans and procedures of each state for dealing with accidental radioactive waste spillage during transport are covered below.

South Australia

The Department of Human Services (DHS) has overall responsibility for managing emergency responses for any incidents involving spillage/leakage of radioactive materials in SA.

The emergency response to an incident in SA is outlined in *The Blue Book: Emergency Response to a Leakage or Spillage of a Hazardous Material during Transport, Storage or Handling*, published by the SA Government (South Australian Hazardous Materials Standing Committee 1997).

In the event of an incident involving the distribution of radioactive material, the emergency services response is coordinated/managed via the following sequence of activities:

Response

1. Typically the incidence of the distribution of radioactive material would be notified via the 000 emergency phone number, managed by the SA Ambulance Service.
2. Following the initial phone contact, emergency services would be contacted as follows:
   - Within the metropolitan area, the Metropolitan Fire Service (MFS) would be alerted. They would immediately respond to the call, travel to the incident location and make an assessment of the nature of the incident.
   - If the incident took place outside of the metropolitan area, then the Country Fire Service (CFS), coordinated via the SES, would respond similarly.

   The MFS/CFS would initially cordon off the site. SA Police would be in attendance to control vehicle/person movements within the environs of the site and to act as the overall coordinating authority.
3. In the event of a radioactive material incident, the MFS/CFS would contact the DHS, which has responsibility under the response plan to provide expert technical advice. A designated DHS representative would be dispatched to the site, where they would:
   - use appropriate radiation scanning equipment to assess the nature of the incident and type of material, the extent to which the scene should be cordoned off and how the spillage should be treated and the site rehabilitated
   - coordinate with the MFS/CFS to commence a containment and clean-up process.

DHS has a team of 8–10 senior staff experienced in responding to such incidents. This team is rostered to be on a 24-hour response. Response to incidents would vary according to the remoteness of the incident. It is expected that the following times would be typical for more remote incidents:

- initial response by the police and SES/CFS personnel: within 1 hour
- response by DHS specialists: up to 3 hours depending on site remoteness
- response by CFS units having specialised equipment for containing the spillage and for rehabilitating the site: typically up to 2 hours following the DHS site assessment.

Training and Equipment

Training of response staff is provided as follows:

- The nominated DHS staff receive professional training in the handling of radioactive material, and in the use of radiation detection equipment. They undertake in-house training awareness courses, and are familiar with the protocols under which responses are managed. Typically they respond to 2–3 incidents per year.

- The MFS/CFS staff receive routine training in the clean-up of hazardous material spills, including radioactive material. They rely on the expert advice of the DHS personnel in the event of a radioactive material incident.

Equipment available for managing a response to radioactive material incidents comprises the following:

- DHS staff have appropriate radiation detection equipment to determine if radioactive material has been distributed.
- MFS and (selected) CFS staff have comprehensive equipment to handle spillage clean-ups. These include protective suits and handling equipment including containers and other containment devices. All such equipment is brought by the MFS/CFS to each incident. It is noted that not all CFS units have the required equipment, especially those small units in small country towns. Such equipment may need to be brought from further afield.

The CFS advised that the contamination suits are used mainly for chemical spills, and their suitability for radioactive material distribution may depend on the level of radioactivity encountered.

MFS have trained personnel, the necessary protective clothing (breathing and protective clothing) and containment equipment (200 and 360 L drums) at 18 major cities and towns around South Australia. Locations relevant to the shipment of waste material to the repository are:

- Adelaide
- Berri
- Burra
- Loxton
- Peterborough
- Port Augusta
- Port Pirie
- Renmark
- Whyalla.

The CFS has trained firefighting staff in most main country towns in South Australia. HAZMAT brigades, trained and equipped to handle hazardous material spills including radioactive materials, are located in only a limited number of regional centres. Along the proposed transport routes, these centres are:

- Burra
- Jamestown
- Port Wakefield
- Stirling North
- Waikerie
- Woomera
- Yunta.

Emergency Clean-up and Rehabilitation Programs

No formal protocols are in place for the clean-up/rehabilitation of radioactive material distribution. This is largely as a consequence of the potentially wide range of types of incidents. There are procedures in place, however, for differing events. Each specific incident is assessed on its own merits by DHS experts on the scene, who then determine a range of clean-up and rehabilitation treatment programs depending on the nature of the incident. These programs would differ according to the type of material, the level of radioactivity, and the extent of the distribution of radioactive material. The highly variable nature of potential incidents effectively precludes the prescription of detailed programs.

Australian Capital Territory

The ACT Emergency Response Plan deals with incidents involving hazardous substances and radioactive materials. The Radiation Safety Section (RSS, Department of Health, Housing and Community Care) maintain an on-call technical advisory service capable of responding to radiation emergencies, and provide timely technical advice and resources in relation to hazards associated with materials involved in such incidents.

Response

1. The police or ACT Fire Brigade is the first point of contact.
2. The fire brigade would coordinate the response and be responsible for inner perimeter control and notification of other relevant agencies, such as RSS in the case of radioactive substances. They would secure the incident site until the radiation adviser arrives.
3. The RSS would assess the nature of the incident and define what treatment is required, and would be responsible for containment, in collaboration with other relevant agencies.

Typical response times to incidents are:

- initial response by fire brigade: within 10 minutes
- response from the RSS: within 1 hour.

Training and Equipment

There are 260 officers and firefighters in the ACT Fire Brigade. They are located at seven fire stations, two joint emergency services complexes, communications and headquarters.

Staff are trained at EMA in Mt Macedon and all necessary equipment is kept in an emergency vehicle maintained by the RSS. Emergency response exercises are held regularly but response to radiation emergencies has not been tested within the last five years.

Emergency Clean-Up and Rehabilitation Programs

The RSS is responsible for rehabilitation of any incidents involving radioactive materials.

New South Wales

The NSW State Disaster Plan (DISPLAN) and relevant sub-plans, NSW Hazardous Materials Emergency Sub-plan (HAZMATPLAN) in particular, details emergency response procedures for hazardous and radioactive material incidents.

The Radiation Control Section of the Environment Protection Authority (NSW EPA) manages radiation control in New South Wales. Emergency response obligations are managed through a memorandum of understanding with the Hazardous Materials Unit (HAZMAT) of the NSW Fire Brigade (NSWFB).

Response

1. First response to an incident would be by HAZMAT (NSWFB) who responds to all incidents involving hazardous materials (including radioactive material); if assistance was required they would call the EPA. This occurs whether it is a metropolitan or regional area. The NSWFB’s role includes containment of any hazardous materials involved.
2. The NSW Police Service would assume control of the emergency site, in support of NSWFB, and coordinate the support required by the HAZMAT Controller.

3. The EPA would attend the scene but would not have the authority to control the scene; rather they would provide assistance and advice. The scene would be managed by HAZMAT.
4. The Roads and Traffic Authority and Ambulance Service would provide assistance with traffic management and injuries at the emergency site, respectively.

HAZMAT has a 24-hour incidents response line.

Training and Equipment

NSWFB has 330 fire stations throughout the state, protecting the public of NSW by providing emergency response vehicles, equipment and personnel 24 hours a day, 365 days per year. They respond to approximately 112,000 emergency incidents a year, of which over 12,000 are spillages, leaks or other HAZMAT incidents.

HAZMAT stations, located at Greenacre (Sydney), Newcastle and Wollongong, are staffed by 90 firefighters. Eight additional units are located in major regional centres, and provide 24-hour emergency response service to any hazardous materials incident within the state. Through training and experience, the firefighters attached to the units are able to provide expert advice and operate specialised hazardous material equipment.

There are 17 response vehicles, which carry a wide range of specialised equipment used to render safe any hazardous materials incident.

The specialised equipment carried includes:

- breathing apparatus
- chemical protective clothing
- gas detection units
- oxygen resuscitators
- compressed air and oxygen cylinders
- containment and recovery equipment
- absorbents and neutralisers
- radiation meters
- laptop computer (containing a chemical database).

In addition to land-based incidents, NSWFB is also responsible for spillages on inland waterways including creeks, lakes, drains and others. To assist in combatting incidents on water, the HAZMAT unit maintains a rigid hulled inflatable boat at Greenacre. This vessel responds to combat waterway spills, deploy booms, take readings or samples and carry out other duties.

A Breathing Apparatus and HAZMAT Training Centre is located within the Alexandria Campus of the NSW Fire Brigade Training College. The centre provides training to all members of the brigades throughout the state in the use and application of breathing apparatus and hazardous materials response.

A mobile breathing apparatus and HAZMAT training and response vehicle facilitates training and servicing in country areas.

The NSW EPA Radiation Control Section has radiation monitoring and response equipment available to cover incidents involving alpha, beta, gamma and neutron emitting sources of radiation.

The Radiation Control Section also participates in emergency response exercises held by ANSTO. Major ANSTO exercises are held approximately every two years, with lower scale complementary exercises held on a more regular basis. These exercises involve a number of participants, such as NSWFB, NSW Ambulance Service and the NSW EPA.

Emergency Clean-Up and Rehabilitation Programs

The EPA Radiation Control Section would control the environmental monitoring (in consultation with the HAZMAT Controller), the disposal of any radioactive waste and the clean-up and rehabilitation of the accident scene and affected land. Generally, if an owner can be identified they are responsible for the clean-up.

The Roads and Traffic Authority provides clean-up assistance to NSWFB, NSW EPA and Health Services as required on its roads.

Northern Territory

Northern Territory Counter Disaster Plans exist at local and regional level. Radiation incidents are not specifically covered in the plans but the relevant agencies are listed. The NT Police is the control agency for all emergency situations.

Safe transport of radioactive materials, including transport emergencies, has primarily been the responsibility of the duly authorised transport provider.

Response

1. The police are the first point of contact and would notify the appropriate response agency.
2. The Fire Service would respond at the scene of the incident. They, however, have limited capability.
3. The NT Police and Radiation Health Section of the Territory Health Services would assess the nature of the incident and define the treatment required.
4. Due to limited resources, Defence and ARPANSA would be asked to assist with containment.

Typical response times to incidents are:

- metropolitan area: within 10–15 minutes
- regional areas are reached at approximately 100 km/h.

Training and Equipment

All staff at main fire stations are trained in hazardous materials response. Some monitoring equipment is held by the NT Emergency Service in Darwin. Large incidents would require Defence and ARPANSA equipment and facilities.

No radiation emergency response exercises have been held due to the low probability of major radiation transport incidents and insufficient resources available to the NT radiation regulation agency.

Emergency Clean-up and Rehabilitation Programs

Defence and ARPANSA would be asked to assist with any rehabilitation and clean-up associated with radiation incidents.

Queensland

The State Radiological Disaster Plan details emergency response procedures for radioactive incidents. Radiation Health of the Department of Environment and Health (Queensland Department of Health) is the overarching authority on radiation and responsible for radioactive incidents. They are available on 24-hour call for advice on radiation-related accidents. All radioactive material transport licensees have their own Radiation Protection Plans.

Response

1. If an incident involved radioactive material transport licensees, they would contact Radiation Health and instigate the State Radiological Disaster Plan. If the police were notified, they would inform either Response Advice for Chemical Emergencies (RACE) or Radiation Health for advice on chemical and radioactive materials, respectively.
2. The police are the overall controller at an emergency scene and would rely on guidance from Radiation Health or RACE. Radiation Health would be called out to the scene if radioactive materials were involved. The fire brigade would provide assistance where needed.
3. Radiation Health would advise the police on managing the incident site, while the Queensland health services would manage any injuries or health issues.

Typical response times from the emergency services for the majority of incidents within metropolitan areas would be within a few minutes. RACE or Radiation Health response times would depend on where the incident occurred. Should an incident occur within an isolated rural area, local physicist expertise would be called upon from the nearest hospital or related facility.

Training and Equipment

Radiation Health and RACE have radiation monitoring and protection equipment for dealing with hazardous materials. Both Radiation Health and RACE are located in metropolitan Brisbane. Emergency services are located in all cities and most rural towns.

The emergency services undergo periodic training in response procedures. Particular attention has been given to training prior to the Goodwill Games, held in 2001. Future training exercises have not yet been planned but are likely to occur.

Irregular emergency response training exercises are held for Radiation Health officers in relation to the nuclear powered warship.

Emergency Clean-up and Rehabilitation Programs

Radiation Health is authorised by EPA Queensland, in accordance with the *Radiation Safety Act 1999* (Qld), to be responsible for containment and rehabilitation of any radiation incident.

Queensland is in the process of developing a document for rehabilitation procedures relating to affected land, in accordance with the *Environmental Protection Act 1994* (Qld).

Tasmania

The emergency response within Tasmania is documented as part of the Tasmanian Hazardous Materials Emergency Plan of the State Emergency Services. The Tasmania Fire Service is the lead combat authority for all hazardous materials accidents. The Department of Health and Human Services (DHHS) (Public and Environmental Health) is notified of any hazardous materials incidents.

Response

1. All incidents involving radioactive materials should be reported to the Tasmania Fire Service as the first point of contact, who would then complete a HAZMAT Action Guide.
2. The Tasmania Fire Service would contact DHHS.
3. The Tasmania Fire Service would be responsible for the rescue of personnel, advising ambulance and hospital personnel of possible radioactive contamination procedures, evacuation and isolation of the area, notifying the DHHS of particulars of the incident and radioactive materials, and securing the area until arrival of a relevant officer from the DHHS.

4. The Brigade Chief would assess the seriousness of the incident and pass control over to the Region Disaster Controller, should the situation be deemed appropriate. If the situation were thought to be very serious, the Region Disaster Controller would recommend to the Director of Emergency Services that a state of alert, emergency or disaster be declared.
5. The Tasmanian Hazardous Materials Management Committee (THMMC) is activated during exceptional, protracted hazardous materials emergencies and when consolidated technical advise may be required. Once activated, THMMC would advise the Region Disaster Controller on the technical aspects of the emergency.

Typical response time in the majority of incidents by the Tasmania Fire Service is less than 10 minutes.

Training and Equipment

Chemists, relevant specialists and laboratory facilities for use in the management of hazardous materials emergencies are available at the following organisations:

- Workplace Standards Tasmania
- Department of Primary Industry, Water and Environment
- DHHS
- University of Tasmania.

Exercises involving responses to hazardous materials incidents and emergencies involving release of radioactive materials are held at least once a year.

Emergency Clean-up and Rehabilitation Programs

The Region Disaster Controller must consider potential clean-up and disposal problems at an early stage. Different materials would require different clean-up methods. DHHS would determine the means of collection, transport and disposal of all radioactive materials.

The Waste Management Section (Department of Primary Industry, Water and Environment) would coordinate rehabilitation of the environment due to damage caused by hazardous materials emergencies.

In cases where the THMMC or Regional Disaster Planning Group has been activated, the Region Disaster Controller would convene a debrief on the emergency within one week, during which all THMMC members would submit a detailed report on their organisation's role in the emergency. The State Emergency Service would then make recommendations for improvements to this plan for discussion by the THMMC within four weeks of the debrief.

Victoria

The emergency response within Victoria is documented as part of the Public Health Emergency Management Plan. The Radiation Safety Unit, responsible for administrating the Health (Radiation Safety) Regulations, controls all uses of ionising radiation in Victoria. The unit has a 24-hour response capacity.

Response

1. Initial calls would be received by the police (Division 4).
2. The police would notify the duty officer at the Radiation Safety Unit, who would determine the exact location, extent of damage, number of people exposed and type and extent of exposure.
3. The Unit Manager or deputy would notify the Manager Health Protection, Assistant Director Public Health, Emergency Coordinator, relevant regional director(s) and the Media Unit.

4. An emergency incident report would be completed. The Assistant Director Public Health Branch and the Emergency Coordinator (in consultation with the Chief Radiation Officer, deputy and/or duty officer) would evaluate the situation and the action required.
5. The Chief Radiation Officer, deputy or delegate would assume the role of incident controller and activate call-out procedures, brief unit staff and participating organisations, and delegate tasks.
6. The Chief Radiation Officer, deputy or delegate would ensure that procedures continue until a stand-down announcement is given.

Training and Equipment

The Radiation Safety Unit has specialist radiation monitoring equipment to assess radiation exposures and measure radioactive contamination.

Emergency Clean-up and Rehabilitation Programs

The fire department handles any materials and clean-up under the advice of the Department of Human Services.

The recovery phase following an incident may require follow-up action. There are no specific actions detailed in the Emergency Management Plan for post clean-up procedures. The type and extent of the follow-up action required would vary depending on the specific circumstances of the incident.