Parliamentary Standing Committee on Public Works

REPORT

relating to the proposed

MARALINGA REHABILITATION PROJECT, SA.

(Tenth Report of 1995)

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA
1995

The Parliament of the Commonwealth of Australia

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MEMBERS OF THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

(Thirty-First Committee)

Mr Colin Hollis MP (Chair)
Senator Paul Henry Calvert (Vice-Chair)

Senate	**House of Representatives**
Senator Bryant Robert Burns	Mr John Neil Andrew MP
Senator Shayne Michael Murphy*	Mr Raymond Allen Braithwaite MP
	Mr Russell Neville Gorman MP
	Mr Robert George Halverson OBE MP
	Hon. Benjamin Charles Humphreys MP

*Replaced Senator John Devereux on 10 February 1995

Committee Secretary:	Peter Roberts
Inquiry Secretary:	Michael Fetter
Secretarial Support:	Mahesh Wijeratne

EXTRACT FROM THE VOTES AND PROCEEDINGS OF THE HOUSE OF REPRESENTATIVES

No. 113 dated Wednesday 7 December 1994

5 **PUBLIC WORKS – PARLIAMENTARY STANDING COMMITTEE – REFERENCE OF WORK – MARALINGA REHABILITATION PROJECT, SA**

Mr Walker (Minister for Administrative Services), pursuant to notice, moved – That, in accordance with the provisions of the *Public Works Committee Act 1969*, the following proposed work be referred to the Parliamentary Standing Committee on Public Works for consideration and report: Maralinga rehabilitation project, SA.

Question – put and passed.

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

MARALINGA REHABILITATION PROJECT, SA

On 7 December 1994 the House of Representatives referred to the Parliamentary Standing Committee on Public Works for consideration and report to Parliament the proposed Maralinga rehabilitation project, SA.

THE REFERENCE

1. Between 1953 and 1963 Great Britain conducted several programs of nuclear warhead development trials at Maralinga and Emu, SA. Maralinga is 270km north-west of Ceduna; Emu a further 190km north-east of Maralinga. Detonations of 9 nuclear weapons and hundreds of 'minor trials' were carried out which dispersed radioactive materials. Former test sites are contaminated to various levels with plutonium and other artificially produced isotopes.

2. The proposed clean-up will reduce the radiological hazard at the test sites to enable Aboriginal traditional land use and transit of the test site area, reduce and possibly eliminate the need for control and surveillance of the sites and remove potential Commonwealth liabilities arising from contamination. It will also enable the land to revert to control of the South Australian Government which has indicated its intention to add the land to the Maralinga Tjarutja freehold land, pursuant to the *Maralinga Tjarutja Land Rights Act 1984.*

3. The majority of the works examined by the Committee will be undertaken at Maralinga and include:

- installation of a construction camp at Maralinga Village
- upgrading of essential site infrastructure
- construction of burial trenches
- collection of contaminated soil and placement in burial trenches
- stabilisation of material in selected debris pits and removal of contents from other debris pits to burial trenches

- general clean-up and surface restoration and revegetation of disturbed areas.

4. Work at Emu will involve the ripping up of roads to discourage access to the site. All work in the contaminated areas of the site will be undertaken under strict controls.

5. When referred to the Committee, the estimated cost of the project was $104.4 million at November 1994 prices.

THE COMMITTEE'S INVESTIGATION

Briefing

6. On 30 June 1994 the Committee was briefed by officers from the Department of Primary Industries and Energy (DPIE) and Australian Construction Services (ACS) about the proposal. The briefing covered investigation and planning which had been undertaken to date on the proposed rehabilitation and the timing of the reference, inspections and the public hearing.

7. Throughout its inquiry - on the inspections and the public hearing, the Committee had the benefit of advice from Australian experts who have been involved with the project since the mid-1980s. Experts from the UK Atomic Energy Authority and from the US Department of Energy accompanied the Committee on inspections and provided briefings at Maralinga and in Canberra.

Inspection of British atomic test sites, Monte Bello Islands

8. On 21 February 1995 the Committee travelled by helicopter from Karratha to the Monte Bello Islands. The islands had been the subject of a clean-up before the Commonwealth handed over jurisdiction of the islands to the Western Australian Government. The Committee undertook the following inspections at the Monte Bellos:

- overflew Trimouille Island and observed minor test debris resulting from weapons effects trials – on 3 October 1952 Great Britain's first nuclear weapon, of 25 kilotons, was detonated in the destroyer, HMS *Plym*, moored offshore from Trimouille Island

- on Trimouille Island, inspected the Ground Zero of the G1 warhead of 15 kilotons, which was detonated on 16 May 1956 on an aluminium tower. The Committee inspected the remains of test monitoring equipment and other test debris

- on Alpha Island, inspected the G2 Ground Zero and the remaining evidence of the detonation of a 60 kiloton nuclear warhead on 19 June 1956. This was the largest nuclear weapon detonated in Australia

- overflew the trials control building on Hermite Island.

Inspection of Maralinga British atomic test and trials sites

9. On 22 February 1995 the Committee undertook an extensive inspection of the forward areas around Maralinga which were used for atomic tests and trials. Mr Barry Wakelin MP (Member for Grey), accompanied the Committee on the inspections. The inspections included:

- at the Taranaki site - capped burial pits containing trace quantities of plutonium, burial trenches, the concrete cap on plutonium debris pit No. 1, and the personnel change room used by the workforce which constructed the clean road through the Taranaki area during site investigations

- near Roadside site - Debris Pit 23U containing trace quantities of plutonium

- along the Buna radial where radioactive emissions from plutonium contaminated fragments were demonstrated

- several major trials sites and their ground zero plinths

- the TM sites, Tietken's Plain "Cemetery" and plutonium contaminated pit 2U

- the Kuli site, including firing pads, burial sites and fragments of corroded uranium

- Pit 30 (DC & RB) which contain compacted former vehicles used in contaminated areas

- the existing infrastructure in Maralinga Village, including the site of the proposed project camp, water collection facilities and the water purification plant.

Public hearing

10. The Committee held a public hearing at Ceduna on 23 February at which representatives of DPIE and ACS presented a written submission and plans. A representative of the Maralinga Rehabilitation Advisory Committee (MARTAC) appeared with DPIE and ACS representatives.

11. Representatives of the following organisations also presented written submissions and appeared at the public hearing:

- Greening Australia (South Australia) Inc
- Maralinga Tjarutja
- Maralinga Rehabilitation Technical Advisory Committee (MARTAC)
- District Council of Ceduna
- Australian Radiation Laboratory
- Aboriginal and Torres Strait Islander Commission (ATSIC)
- Friends of the Earth.

12. Mr Barry Wakelin MP also appeared before the Committee at the public hearing.

13. Mr Bruce Church, former Assistant Manager (Environment, Safety and Health), Nevada Test Site, and currently consultant to the US Government on radioactive decontamination matters, briefed the Committee on 2 March 1995 in Canberra.

14. The Committee received written submissions from the following organisations and individuals:

- Mr R H Ashby

- Aboriginal and Torres Strait Islander Commercial Development Corporation
- Australian Heritage Commission
- Environment Protection Agency
- Greenpeace
- Tjutjunaku Worka Tjuta Inc.

15. A list of witnesses who appeared at the public hearing is at Appendix A.

16. The Committee's proceedings will be printed as Minutes of Evidence.

BACKGROUND

Location

17. Maralinga is in South Australia on the southern edge of the Great Victoria Desert and north of the Nullarbor Plain, about 270km north west of Ceduna. Maralinga Village is 40km north of Watson siding on the Trans Australia Railway. The main work site is at Taranaki, 40km north of the village. Emu is located about 190km north of Maralinga (see Drawings B-1 and B-2). The sites at Emu and Maralinga were chosen and surveyed by the late Len Beadell.

18. The area referred to as Maralinga (Section 400) is a prohibited area and is patrolled by Australian Protective Service (APS) officers based at Maralinga Village. North and east of Maralinga is the Woomera Prohibited Area. Traditional Aboriginal interests, represented by Maralinga Tjarutja, own the land around three sides of the test site.

History of atomic bomb tests and trials

19. Between 3 October 1952 and 19 June 1957 Australia was the scene for the detonation of 12 major nuclear devices. The first test took place at the Monte Bello islands off the coast of Western Australia. The next two tests were held a year later at Emu, in South Australia. A second series of tests were undertaken at Monte Bello in 1956. These included the largest bomb

tested in Australia. The remainder of the major and minor tests were undertaken at Maralinga; the last atomic bomb exploded on 9 October 1957. The 1958 moratorium on nuclear testing saw an end to nuclear weapons tests in Australia, but a number of so-called minor trials took place at Emu and Maralinga between 1953 and 1963 when the partial test ban treaty which halted atmospheric testing came into force. The first series of minor trials was codenamed *Kittens* and involved the testing of initiating devices for nuclear weapons. Five of these tests, which produced substantial amounts of short-lived radioactive fallout in the surrounding bush, took place at Emu in 1953 and more were fired at Maralinga between 1955 and 1961

20. As well as *Kittens*, there were other experimental trials at Maralinga codenamed *Tims*, *Rats* and *Vixen*. *Tims* tests investigated the flow and compression of materials and took place at Maralinga every year between 1957 and 1963 (with the exception of 1962).

21. The *Rats* weapons development trials were similar to *Tims* except that measurements were taken from within the devices instead of outside. *Rats* tests took place between 1957 and 1960.

22. Whereas the *Kittens*, *Rats* and *Tims* trials caused significant radioactive contamination, the *Vixen* trials were potentially the most dangerous held at Maralinga because of the scattering of radioactive plutonium.

23. The *Vixen B* series were 15 trials in which 22kg of plutonium was dispersed from a site known as Taranaki, using large amounts of conventional explosive to explode major parts of weapons. The trials were a series of safety experiments which were undertaken to ensure that nuclear weapons could not be accidentally triggered to produce a nuclear explosion whilst in storage or in transit.

24. At the end of the nuclear test program, Maralinga had been the site of seven major trials of nuclear weapons and about 580 minor trials. These trials left the range contaminated by radioactive and toxic materials.

25. There were several attempts by the British to clean up radioactive contamination at the Maralinga and Emu sites, the most recent and significant being *Operation Brumby* which took place between April-July 1967.

Maralinga Village

26. During the atomic tests Maralinga Village was a large establishment with a population approaching 3 000 during major trials and more than 100 buildings. Only a few buildings remain, including the hospital (occupied by the APS personnel), the VIP quarters, a bedding store, and the fire station which is now used for vehicle maintenance. Demountable buildings provide accommodation, toilet and ablution blocks, kitchen and messing, offices, stores and laboratories.

27. Services at the village include a telephone and facsimile line used by APS, a satellite dish for television reception, sewer and stormwater drainage, water supply, roads, and electricity supply from local generators.

Access

28. The most convenient form of access is by air to the Maralinga airfield. Goods can be delivered by rail to Watson siding, which was in poor condition and has recently been upgraded to handle the goods traffic for the project. Access by road is possible from the bitumen sealed Eyre Highway (which runs 100 to 150km south of the railway), via unsealed roads to Watson, then on a bitumen sealed road to Maralinga Village. Road access is also possible from the bitumen sealed Stuart Highway at Glendambo via an unsealed road to Watson.

Topography and environment

29. Much of the country around Maralinga consists of vegetated sand dunes, but the site chosen for the nuclear tests is a limestone and dolomite outcrop, which is partly covered by red sand and forms Tietkens Plain.

30. The environment is arid to semi-arid with variable rainfall averaging 200 mm annually. Climate ranges from cool winters to hot summers with temperatures frequently in excess of 40° C. The average January maximum temperature is just above 33° C and the average July maximum temperature is just below 18° C. Nights are relatively cool, typical of a desert climate.

31. Vegetation consists mainly of low open woodland with an under-storey of low scrubland. The woodland comprises acacia, including mulga, and low eucalyptus, with some casuarina. The scrubland is composed mainly of saltbush, bluebush and spinifex.

32. Fauna includes kangaroos, dingoes, bush turkeys, several varieties of lizard and snake, various marsupials, foxes, rabbits and an occasional camel. Birds are plentiful and include parrots, hawks and wedge-tailed eagles.

Royal Commission

33. South Australia's *Maralinga Tjarutja Land Rights Act 1984* gave freehold title of approximately 80 000km^2 of land around the 3200km^2 test site area to traditional land owners represented by Maralinga Tjarutja. They established an out-station on these lands at Oak Valley 140km north-west of Maralinga Village. Oak Valley is a centre for pursuit of the semi-traditional lifestyle on the Maralinga lands. This is based on many elements of the traditional lifestyle but involves increasing use of vehicles and hunting rifles.

34. In 1985 the Royal Commission into British Nuclear Tests in Australia recommended, *inter alia*, that:

- action should be commenced immediately to effect a clean-up of Maralinga and Emu to a level where they are suitable for unrestricted habitation by the traditional Aboriginal owners (Recommendation 3); and
- the British Government should meet the costs of rehabilitation (Recommendation 6).

35. The Technical Assessment Group (TAG) was formed in February 1986 to address technical matters stemming from the Royal Commission. Britain and Australia made broadly similar contributions to a three-year study program by TAG which developed a range of rehabilitation options and comparative costs. TAG's report was tabled in Parliament in November 1990. The Commonwealth Government agreed that TAG Option 6(c) was the preferred rehabilitation option for the Maralinga test sites and that a substantial contribution to meeting the cost of the rehabilitation works should be sought from the British Government.

36. In December 1993 the Australian and British Governments concluded an agreement under which Britain will pay £20 million in an *ex gratia* settlement of Australia's claims concerning the British nuclear test program in Australia. It was agreed that the £20 million would be paid in six annual instalments, the first, of £5 million, was made in December 1993.

THE NEED

37. DPIE submitted that there is a need to achieve a substantial reduction in potential radiological hazards at the Maralinga and Emu test sites to enable greater access to the area and to reduce or possibly eliminate the requirement for surveillance. It is intended that upon completion of the project the test site area can be returned to South Australian control for addition to the Maralinga Tjarutja freehold lands.

38. The former nuclear test sites at Maralinga and Emu are contaminated to various levels with plutonium and other artificially produced radioisotopes. Much of this contamination is considered to present an unacceptable risk to future users of the sites.

39. The Royal Commission concluded that treatment of the plutonium-contaminated areas at Maralinga in *Operation Brumby* was inadequate, based on wrong assumptions, and left the area in a more difficult state for any further clean-up. These areas are a potential hazard to visitors and represent a particular hazard to people following the semi-traditional Aboriginal lifestyle. Remedial action is required to give effect to the objectives of greater Aboriginal access to the test site area and reduced surveillance by the Commonwealth.

Hazards

40. Plutonium presents a health risk if it enters the body–if it is inhaled, swallowed or allowed into cuts and wounds. The plutonium at Maralinga is largely in the form of insoluble oxides and if retained in the lung gives a risk of lung cancer. In other parts of the body the greatest risks are of bone cancer or cancer of the liver. The ARL advised the Committee that outside of the body, plutonium and its associated americium, in the form and quantities present at Maralinga, are not a hazard to health.

41. Uranium in the two forms present at Maralinga presents a health risk only when it is in the body. ARL advised the Committee that much greater intakes would be required before the health risks were similar to plutonium. Uranium is chemically toxic.

42. Beryllium, which is not radioactive, is chemically toxic and the main health risks arise from skin absorption through direct contact. Dermatitis

and ulcers are caused. Inhalation of beryllium in a finely powdered form, causes respiratory diseases and can result in death.

43. Large numbers of contaminated fragments exist on or close to the surface at Taranaki, Wewak, TM100 and TM101. The ARL advised the Committee that handling of the fragments could result in the ingestion or inhalation of substantial quantities of plutonium, but it is not possible to attempt any general assessment of dose or risk. The ARL believes the fragments nevertheless pose a significant hazard as a source of injury and simultaneous contamination of the wound. With the possibility of greater access and risk of being souvenired, they pose a substantial risk and therefore cannot be allowed to remain.

44. The TAG study found that the Aboriginal semi-traditional lifestyle practised at an Aboriginal out-station is important in determining the potential hazard from radioactive contamination. Sleeping on the ground in wiltjas (brush shelters) and a range of activities that cause re-suspension of dust make inhalation the predominant exposure pathway for adults and children. Dosimetric modelling demonstrates that ingestion of soil is a significant potential exposure route for infants in the first year of life.

45. The geographic spread of contaminated sites over the 3200km^2 test site area presents difficulties in ensuring that there is no unauthorised access to the sites, particularly by tourists in four-wheel drive vehicles, which might give rise to future Commonwealth liability. Four-wheel drive tourism is becoming increasingly popular in the region increasing the possibility of unauthorised access to the test site area.

46. In addition to a need to reduce radiological hazards, DPIE submitted that there is a requirement under Australia's international obligations for prudent management of fissile radioactive material by providing improved disposal of uranium from the Kuli site. Any work at this location would be undertaken in consultation with the Australian Safeguards Office to ensure full compliance with the requirements of the Commonwealth *Nuclear Non-Proliferation (Safeguards) Act 1987.*

47. Apart from the radiological failings of *Operation Brumby*, this clean-up failed to remove large quantities of uncontaminated rubbish from the test site area giving the impression of abandonment rather than rehabilitation. DPIE believes there is a need to remove test site debris for disposal in new and existing excavations.

Australian Radiation Laboratory

48. The Australian Radiation Laboratory (ARL) surveyed the major and minor trials sites at Maralinga and Emu and advised the Committee that in many cases the sites have been adequately cleaned up or the radioactive materials used were of sufficiently short half-lives that they are no longer detectable. However, significant contamination concerns remain. The main areas of concern relate to Taranaki, Wewak and TM100/101.

49. At Wewak burnings and explosive dispersals of beryllium, uranium and plutonium occurred. The hazard remaining results from dispersed plutonium. At the site of the plutonium burning, the ground has been mixed by ploughing. ARL advised the Committee that the levels of plutonium contamination are acceptably low. Two explosive dispersals of about 570g of plutonium took place at separate sites and the surrounding area contains pieces of metal contaminated with plutonium. A temporary fence has been erected around most of the debris.

50. Explosive dispersals of about 600g took place at TM100 and TM101. The ARL advised the Committee that 500g of plutonium from TM101 was returned to the UK in 1979. There is, however, a high concentration of plutonium-contaminated fragments and smaller friable particles close to the firing sites. Temporary fences have been erected around these areas.

51. The ARL advised the Committee that the plutonium contamination at Taranaki is mainly in three forms:

- as fine dust
- as small sub-millimetre particles
- as surface contamination on larger fragments.

52. In the trials, the plutonium was dispersed in narrow plumes, the main ones extending to the west, north-west, north and north-east of Taranaki. The most extensive of these is the north-west plume.

MARTAC and consultative groups

53. In September 1993 the Minister for Primary Industries and Energy convened the Maralinga Rehabilitation Technical Advisory Committee

(MARTAC) to provide expert advice on a number of key issues relating to any clean-up at Maralinga. If remediation is undertaken, one of MARTAC's principal functions will be to provide advice on radiological protection of workers involved in remediation. Accordingly, MARTAC has a strong health physics representation.

54. A Consultative Group was established in 1986, including representatives of the Commonwealth and South Australian Governments and the traditional Aboriginal owners represented by Maralinga Tjarutja. This group has served as a forum for discussion of all matters concerning rehabilitation of former nuclear test sites. It has held extensive discussions on the proposed remedial action at Maralinga and Emu.

Options considered - comparative costs

55. A range of options for the clean-up of Maralinga and Emu together with indicative cost estimates and time scales was developed in some detail by the TAG and published in its report *Rehabilitation of Former Nuclear Test Sites in Australia* (1990).

56. These options ranged from fencing off the entire area to south of Maralinga Village, thereby releasing 1560km^2 (estimated to cost $13m) to soil removal and exhumation and re-burial of areas containing plutonium contaminated plumes and burial pits thereby releasing 3120km^2 (estimated to cost $648m). The Commonwealth preferred TAG Option 6(c), which was endorsed by the South Australian Government and by the Maralinga Tjarutja Aborigines (subject to a satisfactory response to their claim for compensation for denial of access to the area contaminated by the *Vixen B* plumes).

57. The adoption of option 6(c) is therefore very much a compromise worked out on the basis of:

- cost
- what is acceptable to the local Aboriginal people
- what is acceptable to the environment.

58. Higher cost options specifying removal of surface contamination from the entire area of the *Vixen B* plumes were rejected on the grounds of cost

and the uncertain environmental consequences of removal of vegetation over such an extensive area. Lower cost options were rejected because they would leave seriously contaminated areas that would virtually be a permanent liability for the Commonwealth and would be incompatible with future use of the sites sought by Maralinga Tjarutja.

59. The selected rehabilitation option is the lowest cost of the options developed by TAG that would enable resumption of access by Aborigines to all of the former test site area.

Consideration of options

60. Very early in its inquiry, the Committee focused attention on the practicalities of overcoming the contamination problem by fencing off the entire area. DPIE advised that the fencing option was rejected on a number of grounds:

- fencing would not stop intruders - legal advice obtained indicates that it is problematical whether any exclusion clause provided on signs would be legally enforceable. The erection of fences and signs can mitigate the Commonwealth's exposure to claims against radiation exposure, but cannot completely cover against it

- administrative control - the Commonwealth would be unable to guarantee the necessary corporate memory to protect the area for 24 000 years

- cost - fencing was costed at $20m and a need for surveillance would remain. Fences would have an expected life of about 100 years.

61. For these reasons, DPIE believes adoption of option 6(c) to be the cost-effective. It has the support of the SA government and the Maralinga Tjarutja. Upon completion of option 6(c) the SA Government will assume responsibility for the land and issue freehold title to the Maralinga Tjarutja.

Maralinga Tjarutja

62. The submission to the Committee from Maralinga Tjarutja advised that in January 1985, Maralinga Tjarutja, representing traditional

landowners, received freehold title to 80 000km^2 of land surrounding the former test sites in accordance with the South Australian Maralinga Tjarutja Land Rights Act 1984.

63. Maralinga Tjarutja is a member of the consultative group formed in 1986 to serve as a forum for discussion of all matters concerning the former British nuclear test sites in Australia. Through the consultative group Maralinga Tjarutja was involved in regular discussions with TAG scientists and state, Commonwealth and UK government representatives.

64. The consultative group was advised by the TAG assessment report that the semi-traditional lifestyle of the Maralinga Tjarutja people was important in determining the potential hazard to them from radioactive contamination. Maralinga Tjarutja considered the TEG report and its nine major clean-up options with the help of independent scientists from germany, the US and Australia. Maralinga Tjarutja commenced consideration of the options on the basis that, if practical, the entire test area should be cleaned up.

65. To achieve a full clean-up, topsoil would need to be removed from an area of 120km^2 with no assurance that such a large area could be successfully rehabilitated and protected from erosion. Maralinga Tjarutja concluded that the 120km^2 of the *Vixen* plumes should remain untouched and advised the Commonwealth that it would accept an Option 6(c) clean-up provided it received compensation for denial of access to the 120km^2 area and associated detriments.

66. In December 1994 the Commonwealth (represented by the Minister for Primary Industries and Energy – Senator the Hon. Bob Collins) and Maralinga Tjarutja (represented by Mr Archie Barton – Administrator of Maralinga Tjarutja) jointly announced that Maralinga Tjarutja's claims had been settled with a compensation package including $13.5m and a number of non-cash items. Settlement funds are to be invested in a trust account and applied to the development of resources and infrastructure for the traditional communities on the lands. Section 400, including Maralinga Village and the airfield, is to be returned to South Australian control and then to Maralinga Tjarutja upon completion of the clean-up. The Commonwealth would maximise training, employment and enterprise opportunities for Maralinga Tjarutja arising from the clean-up.

Committee's Conclusion

67. There is a need for remedial action to be undertaken at Maralinga to reduce the radiological hazards at the test sites sufficiently to enable Aboriginal traditional land use and transit of the test site area, to reduce and possibly eliminate the need for control and surveillance of the sites, and to remove potential Commonwealth liabilities arising from site contamination.

THE PROPOSAL

Description

68. It is proposed that plutonium contaminated soil at the Taranaki, Wewak and TM100/101 sites will be collected within areas endorsed by MARTAC and delineated on the ground by ARL. This soil will be disposed of in deep trenches adjacent to contaminated areas.

69. Shallow burial pits containing contaminated debris at the Taranaki site are expected to be treated by in situ vitrification (ISV) to reduce the pit contents to a leach and intrusion resistant vitreous mass. ISV was selected because of the risks inherent in excavation of large plutonium contaminated items from the Taranaki pits. Following successful completion of laboratory scale trials, field trials will commence at Maralinga in June 1995 to confirm the suitability of ISV. The ISV technique is being applied on a commercial basis in the United States.

70. Debris pits not proposed to be treated by ISV will be restored according to the level of hazard that they present. MARTAC has recommended a range of pit-specific treatments ranging from excavation and re-burial in an engineered trench (Pit 22 at TM101 and Pit 23 at Tietkens Plain Cemetery) to compaction, removal of surface debris, covering with soil and revegetation for pits considered by MARTAC to present the lowest potential hazard.

71. At the Kuli site where explosive dispersal of tonnes of uranium took place, action is required to provide suitable disposal for large uranium fragments currently being exposed through soil erosion. It is proposed that these fragments be collected and disposed of in a trench.

72. After completion of the rehabilitation works, an area of approximately 120km^2 containing part of the *Vixen B* plutonium plumes will still be unsuitable for continuous out-station occupation by semi-traditional Aborigines. This area will be delineated by boundary markers signifying that the area is suitable only for transit and hunting. The Maralinga Tjarutja Aborigines will be consulted on the most effective form of warning symbol. It is intended that Aboriginal workers will erect the boundary markers under the supervision of the project manager or the DPIE staff at Maralinga.

73. Revegetation will be undertaken to reduce erosion and encourage natural re-seeding in areas disturbed by rehabilitation works. The specific objectives for the revegetation program will vary according to the location under consideration. The main burial trenches at Taranaki, Wewak and TM100/101 will be revegetated to reduce water infiltration and erosion.

Site investigations

74. The project has undergone considerable and lengthy development. An aerial radiological survey of the sites was conducted in 1987, supplemented by field testing, to establish surface radiation levels.

75. Geotechnical investigations of a possible burial trench site north of Taranaki were completed in 1988, together with preliminary assessments of groundwater depth and quality.

76. Trenches were excavated at Taranaki, and boreholes were sunk at Taranaki, Wewak, and the TM100/101 sites in 1993, to collect soil and rock samples for ISV testing.

77. Detailed geotechnical investigations commenced in October 1994 at Taranaki, Wewak and the TM100/101 sites. The testing will provide bore logs necessary for assessing excavation conditions.

78. Other tests are in progress to check the solubility of the plutonium in rainwater and groundwater.

79. Colour aerial photography of the work site was completed in November 1994. This will lead to the production of contour maps to assist with design.

Components of works

80. The majority of the works will be undertaken at Maralinga and include:

- provision of a construction camp at Maralinga Village and upgrading of the village services
- upgrading of the general site infrastructure, including roads, sewerage, water supply, power, and the railway siding at Watson
- installation of forward area facilities
- delineation of the boundary within which contaminated soil will be removed
- construction of burial trenches for containment of contaminated material
- collection of contaminated soil and placement in the burial trenches
- Stabilisation of material in selected debris pits by in situ vitrification (ISV)
- removal of the contents from other debris pits to burial trenches
- general clean-up and surface restoration around other pits and selected areas
- installation of boundary markers
- revegetation of disturbed areas

81. Work at Emu will involve the ripping up of roads to discourage access to the site.

CONSTRUCTION CAMP AND INFRASTRUCTURE

Construction camp

82. A camp, designed to accommodate 80 construction workers, will be developed within the Maralinga Village (see Drawing B-3). The construction camp will comprise:

- demountable, four single room accommodation units
- associated mess, bar, shop, medical centre, laundries and ablution areas
- indoor and outdoor recreation and entertainment areas and sporting facilities; upgrading of the basketball, tennis and volleyball courts remaining from the test program, and the provision of an above-ground swimming pool and exercise equipment
- project administration offices and laboratories
- stores and fuel supplies
- maintenance workshops.

Infrastructure

83. The water supply, sewerage facilities, drainage, roads, power and communications will be reused as much as possible. The water supply will be significantly upgraded with provision of new bores and a reverse osmosis treatment plant, replacement of the existing elevated tank and new reticulation to the camp.

84. Sewage will be treated in an "Envirocycle" type treatment plant with the effluent disposed of to an evaporation pond via the existing reticulation.

85. The roads within the village are in good condition and will not require any upgrading. A new generator and underground power reticulation to the camp will be provided. The existing generators will remain to service the existing parts of the village. A new telecommunications system using satellite

technology will be installed to provide communications within the project area as well as externally.

Airfield

86. The airfield and associated terminal building are in good condition and do not require any upgrading. Apart from its function as an airfield, the pavement is designed to collect rainwater and the runoff is directed by an aqueduct system to a dam from where it is pumped to large holding tanks. Only 5mm of rainfall is required for the water to be collected.

Rail

87. Watson railway siding on the Trans Australia Railway line is about 40km south of Maralinga. The siding is in disrepair and will be upgraded for the project. The siding will be used for the transfer of materials and equipment but its major use will be for the delivery of the significant quantities of fuel for operation of the ISV process.

Roads

88. The road from Watson siding to Maralinga Village and on to Taranaki, where most of the rehabilitation work will take place, is 80km long and is sealed. The 40km section from Watson siding to Maralinga Village is in good condition and should serve the project without major repairs. The section from Maralinga Village to Taranaki is in reasonable condition but deteriorates closer to Taranaki. About half of this section of road has a base course of bitumen stabilised sand which will turn to dust once the brittle seal is broken. It is proposed to resurface sections of the road from Maralinga Village to Taranaki to cater for the project traffic.

89. The main work areas of Taranaki, Wewak and TM100/101 are about 40km from the construction camp and they are about 20km apart by road. Also most of the smaller work areas are of similar distance from the construction camp. Accordingly forward area facilities will be established at the main work area of Taranaki, and partly relocated to Wewak and TM100/101 when soil removal at Taranaki is complete. These will include decontamination facilities for personnel and equipment, toilet and ablution facilities, office, first aid room, lunch room, laboratory accommodation, fuel storage, and facilities for routine servicing and maintenance of plant. These

facilities will be supplemented by mobile facilities at the other areas as required.

FORWARD AREA FACILITIES

Plant decontamination

90. The plant decontamination unit at Taranaki (see Drawing B-4) will be a steel formed, metal clad structure large enough to accommodate the largest earthmoving plant to be used on the project. It will have facilities for washing down the plant and for recycling the wash down water. Plant operating at other locations will use portable facilities to decontaminate parts requiring access for servicing. When repairs are required which cannot be handled in the field, the plant will be cleaned sufficiently to allow it to be transported or driven to the Taranaki facilities.

Personnel decontamination

91. A personnel decontamination unit will be provided at Taranaki with facilities for both sexes. It will include a first stage walk through shower, hand basins, radiation monitors for hands, feet and clothing, and an outer clothing change area. This will be followed by an area with used clothing bins, second stage showers and monitors and personal clothing lockers. There will also be a toilet area and a laundry for contaminated clothing. Mobile decontamination units will be provided at other sites.

DELINEATION OF BOUNDARIES

92. The three separate areas where contaminated soil is to be removed are at Taranaki, Wewak and TM100/101 (see Drawing B-5). The surface activity of these areas exceeds the limits proposed by the ARL and endorsed by MARTAC. The areas requiring removal of contaminated soil are being delineated by ARL. In the following table are current estimates of these areas and the likely associated volumes of soil.

Trial Site	Estimated Soil Area to be Removed km^2	Estimated Soil Volume to be Removed m^3
Taranaki	1.39	210,000
Wewak	0.04	6,000
TM100	0.12	18,000
TM101	0.06	9,000

BURIAL TRENCHES

Plutonium

93. The major radiological hazard at Maralinga is plutonium. The presence of plutonium can be identified by detection of americium-241 (a decay product of plutonium-241) and knowledge of the ratio of plutonium to americium at each site. These sites were treated during the final British clean-up, Operation Brumby. At Taranaki some of the contaminated areas were mixed to 100 mm depth by ploughing and localised areas of high contamination were covered with an additional 80 mm of clean soil. At Wewak contaminated soil was removed from selected areas. At TM100 and TM101, soil was mixed to 100 mm depth where required and the ground was levelled.

Burial trenches

94. It is proposed to construct three burial trenches, one near each of the contaminated areas at Taranaki, Wewak and TM100/101 (see Drawings B-6 and B-7). The trenches will be constructed to an approximate depth of 15m. The trench size will vary from site to site, with the largest trench at Taranaki being of the order of 200m long by 130 m wide. The proposed trench sizes, depths and protective cover thickness will undergo refinement during the design process.

95. The burial trenches will be located in uncontaminated areas, or areas with very low levels of surface contamination. Surface soils may be excavated by a variety of earthmoving equipment. The underlying rock will be blasted, or loosened by ripping using a bulldozer, with the loose material being picked up

by front end loader or excavator and trucked to stockpile. Access to the trench will be via a ramp. The excavated material will be stockpiled near the trench.

96. The contaminated surface soils will be delivered to the trenches by truck or scraper, deposited and spread in thin layers and watered before being compacted.

97. Waste materials from the exhumation of debris pits will be disposed of in a separate section of a burial trench. Separation is required to account for the much slower material placement rate expected for this waste material. Materials will be dumped from trucks or skips, then moved into place in the pit by bulldozer or front end loader and given nominal compaction under construction traffic. Placement will be in relatively thick layers of 1-2m.

98. On completion of placement of contaminated materials in each trench, the 5 m thick protective cover will be placed using the uncontaminated materials from the stockpile. Allowances will be made in final surface levels to compensate for the settlements expected as a result of the long term consolidation of the trench contents.

Debris pits

99. Clean-ups of the Maralinga range, carried out both during and subsequent to the operational usage of the facility, resulted in large quantities of materials being buried in debris pits. These pits are located throughout the site. The more contaminated material was buried at Taranaki.

Treatment

100. To rehabilitate these areas it is proposed to remove the contaminated soil to an average depth of 150 mm, and then generally to cover the surface with clean soil and revegetate the area. The contaminated soil will be buried in a trench under a minimum of 5 m of clean fill. The surface of the burial trench will also be revegetated.

101. There is a large proportion of rock close to the surface within some of these areas. It is not anticipated that the contamination will have penetrated into the rock to any significant extent. Where the soil cover is less than 150 mm thick, all of the overlying soil will be removed.

Clean-up target

102. The clean-up target for residual surface radiation varies between a measured 1.8 and 4.0 kiloBecquerel per square metre (kBq(^{241}Am)/m^2). The difference in acceptance criteria at the various sites is due to the differing ratios of plutonium to americium, and enhancement factors. The Becquerel is a unit of radioactivity, corresponding to one disintegration per second.

Monitoring

103. The ground surface will be checked by personnel from ARL after the soil has been removed, to confirm that the clean-up meets specified acceptance criteria.

Dust control

104. Previous clean-ups have been reviewed, including the US test sites at Nevada and the Enewetak and Johnston Atolls, at Palomares in Spain and at Chernobyl in the former USSR. From these and previous experience at Maralinga, dust control has been identified as a key factor in selecting any soil removal strategy. Generated dust increases the chance of contamination to operators, plant and clean areas, creating a more difficult and demanding operating environment. Dust generation may be controlled by watering.

Sequencing

105. Sequences for soil removal and replacement by clean soil have been examined. The chosen sequence is influenced by the locations of the burial trenches. Starting at the remote extremities and working towards the burial trench will reduce the potential for re-contamination of cleaned areas. The dirty roads between the contaminated area and the burial trench will be removed incrementally as the clean-up operations advance towards the burial trench.

Plant

106. Possible plant types for excavating, loading and transporting the contaminated soil have been evaluated. These include scrapers, bulldozers, excavators, front-end loaders, graders, modified road sweepers and soil skimmers. They have been assessed for operator safety, performance

effectiveness, cost, dust generating characteristics, maintenance needs and decontamination requirements.

107. When necessary, plant will be modified to minimise dust generation and cabins will be sealed and pressurised with High Efficiency Particulate Air (HEPA), filtered air intakes and outlets to protect the operators in accordance with personnel protection requirements. Any personnel on foot will wear protective clothing appropriate to their work activity.

IN SITU VITRIFICATION (ISV)

108. It is proposed to stabilise the contents of 21 debris pits at Taranaki using the in situ vitrification (ISV) process (see Drawing B-8). These pits contain material which is highly contaminated with plutonium.

109. The pits at Taranaki vary in area from 2.4 x 2.4m to 7.3 x 12.2m with depths of between 1.8m and 3m. They were covered with 300mm thick reinforced concrete slabs during *Operation Brumby.*

110. It is proposed to remove the slabs before commencing the ISV operation to improve the efficiency of the process. A large crane will be used to lift them off the pits. It will be necessary to cut the larger slabs into manageable sizes with a concrete saw prior to removal. The slabs could be disposed of in the burial trench or replaced on the pits after completion of the ISV process.

Description of ISV

111. ISV technology, developed by the Geosafe Corporation in the US, is designed to treat soils, sludges, sediments, and mine tailings contaminated with organic, inorganic and radioactive compounds. The organic compounds are pyrolised and reduced to simple gases which are collected under a treatment hood and processed prior to their emission into the atmosphere. Inorganic and radioactive contaminants are incorporated into the molten soil which solidifies to a vitrified mass similar to volcanic obsidian.

How the technology works

112. The ISV technology operates by means of four graphite electrodes, arranged in a square and inserted a short distance into the soil to be treated. ISV uses electrical current to heat, melt and vitrify the treatment material in place. A pattern of electrically conductive graphite containing glass frit is

placed on the soil in paths between the electrodes. When power is fed to the electrodes, the graphite and glass frit conducts the current through the soil, heating the surrounding area and melting directly adjacent soil.

113. Molten soils are electrically conductive and can continue to carry the current which heats and melts soil downwards and outwards. The electrodes are allowed to progress down into the soil as it becomes molten, continuing the melting process to the desired treatment depth.

114. When all of the soil within a treatment setting becomes molten, the power to the electrodes is discontinued and the molten mass begins to cool. The electrodes are cut near the surface and allowed to settle into the molten soil to become part of the melt.

115. The organic contaminants in the soil undergoing treatment are pyrolised and are reduced to simple gases. The gases move to the surface through the dry zone immediately adjacent to the melt, and through the melt itself. Gases at the surface are collected under a stainless steel hood placed over the treatment area and then treated in an off-gas treatment system. The off-gas treatment system processes the off-gas before releasing the cleaned gas through a stack.

116. DPIE advised that to melt a typical pit will require up to 3.5 MW of power, necessitating a generating capacity of 4.5 MW when account is taken of auxiliary equipment needs. The operation will run continuously for 7 to 10 days per melt, and the larger pits will require more than one melt. The generators will require about 50 000 litres of fuel per day and this will involve regular fuel deliveries and adequate site storage facilities. A support trailer will be provided by Geosafe to house the computers and other control and monitoring equipment.

Suitability of technology

117. The Committee, and a number of organisations (Friends of the Earth and Greenpeace) questioned the suitability of the ISV technology and the strategies which will be used if trials prove its unsuitability.

118. DPIE advised that the suitability of ISV is currently the subject of an assessment at Maralinga which started in 1993. First stage of the assessment involved sampling representative geology from around the burial pits at Taranaki. Material was obtained by using the clean roads constructed in the

fenced area. The material was then sent to Hanford in the US where trials into meltability of the material were conducted. The analysis of the results of the trials concluded that the samples produced good ISV product which conformed with other material that has been tested that is estimated to have a life of up to one million years.

119. The phase of proving the suitability of the ISV technology will involve conducting tests at Maralinga. Test pits, which simulate the 21 pits at Taranaki, will be constructed and subjected to a small-scale ISV plant. As confidence in the operation of the technology improves, some of these trials will involve the use of radioactive material including plutonium. When the ISV has cooled, the melt will be cored and examined to establish if the plutonium is contained in the body of the glassy mass, and not in bubbles at top or at bottom where there will be large amount of molten metal. The examination and assessment will be undertaken by Geosafe and the Australian Nuclear Science and Technology Organisation (ANSTO).

120. DPIE acknowledged that at this stage the technology has not been applied commercially to plutonium materials. There have been significant demonstration trials involving plutonium at US Department of Energy sites in Idaho and commercial operations involving other contaminants in Illinois and Utah. DPIE assured the Committee that a final decision on the suitability of the technology will not be made until it is proven that the glass which is produced encapsulates plutonium at required standards.

Contents of pits

121. The Committee questioned DPIE about the knowledge of and level of confidence concerning the contents of each pit. The Committee was assured that there exits considerable information about the contents of the pits. This information is based on studies of available UK reports and information compiled from British sources during preparation of the TAG interim report.

Fallback strategies

122. DPIE advised the Committee that should these ISV validation tests prove unsuccessful, alternative solutions, identified in the TAG studies, will need closer examination. DPIE consultants are undertaking a preliminary examination and costing of burial pit exhumation.

123. The fallback strategies identified by TAG were:

- grouting - DPIE believe this is not a good option because of uncertainty about the degree of penetration in injecting grout into the burial pits

- placing concrete sheet piles around sides of pits to make them more stable

- exhuming the contents of the pits and burying the debris in deep burial trenches

124. In terms of the comparative effectiveness, the alternatives will be inferior to the ISV process for the following reasons:

- a requirement for more intensive surveillance of pits

- a requirement for maintenance of works such as more substantial capping

- they would involve intrusion into the existing pits

- works would require a very intensive health physics operation.

Synroc

125. The Committee questioned technical experts about the possibilities of using Synroc technology to encapsulate the contaminated areas. The Committee was advised that it would not be possible to apply the of synroc technology at Taranaki. Synroc technology has been developed to encapsulate high level radioactive waste arising from reprocessing spent nuclear fuel under highly controlled conditions. It is not a technology amenable to in situ application. Expert witnesses indicated that it is possible to influence the chemistry of the ISV melt by adding more silica as the melt develops. The concentration of plutonium in the Taranaki pits is far less than the concentration of radioactivity in high level waste.

Steel

126. The Committee questioned DPIE about the effects of the ISV technology on steel, bearing in mind that the burial pits contain plutonium-encrusted steel fragments and possibly larger steel items. DPIE advised that based on tests

undertaken in the US, ISV has been shown to be amenable to melting steel and this steel goes to the bottom of the melt.

Maralinga Tjarutja

127. Maralinga Tjarutja advised the Committee that it accepts the project is appropriate and suitable to meet the Option 6(c) clean-up. Nevertheless, it was submitted that ISV is not far beyond the experimental stage, and may not be as successful as indicated, nor as cost-effective. Therefore, any variation from Option 6(c) will need to be discussed with Maralinga Tjarutja.

Committee consideration

128. The ISV technology has been applied commercially, but not to the encapsulation of radioactive waste. The results of trials in the US appear to be promising. Final decisions on whether to proceed with ISV will only be made after careful examination of the results of trials undertaken at Maralinga. This is expected to occur later this year. Should the trials prove to be successful, a decision can then be made about proceeding with the larger scale ISV treatment of pits at Taranaki. Should the results prove to be inconclusive, a complete re-examination of alternative strategies will need to be made. It is important from the point of view of public perceptions, that independent verification of the trials and the results is undertaken. It is only within a framework of independent auditing, and reporting, that the Committee can have any confidence in the ability of the technology to achieve the stated aim of the project.

Committee's Recommendations

129. An independent audit of the results of the in situ vitrification trials of material containing plutonium should be undertaken by competent experts not associated with the project.

130. If the results of the review indicate the in situ vitrification process provides encapsulation and mixing of material to prescribed standards, the process can be extended to fullscale treatment of burial pits at Taranaki.

131. If the results of the in situ vitrification trials are inconclusive, or do not provide results to prescribed standards, the further direction of the project should be reviewed.

DEBRIS PITS NOT TREATED BY ISV

Extent

132. The majority of the pits contain only nominally contaminated debris and soil (see Drawing B-9). During the Committee's inspection and at the public hearing there was some discussion about the number of pits at Maralinga. The Committee was assured that the UK authorities accurately recorded the location, size and treatment of the burial pits involving significant radioactive contamination. The location of dumps containing uncontaminated, or slightly contaminated debris, such as 87,000 star pickets, were not listed. Research suggests that it is likely that more rubbish pits will be located during the project.

Treatment

133. These pits will be treated by a variety of methods ranging from recontouring to total exhumation, the latter requiring full health physics control.

134. The remainder of the pits are to be treated to the extent of tidying up the surface by removal and reburial of exposed debris, or compaction of the debris and restoration of the area. Soil importation will be required at some pits to restore the surface to its natural level.

Special treatment areas

135. Some areas at Maralinga and Emu requiring rehabilitation are relatively small and unique in their requirements for treatment. These have been designated Special Treatment Areas and the proposed rehabilitation strategies for these areas are described below.

136. The large crater resulting from the ground level detonation of a nuclear device at Marcoo was subsequently used as a repository for much material and debris from the surrounding area. The crater was finally filled with about 1.5 m of soil. Metal debris is spread across the site to a radius of about 100 m and this will be collected and buried at a suitable location.

Kuli

137. Trials at Kuli resulted in considerable quantities of uranium being dispersed over a wide area. Although much was collected, the area will be cleared again in order to satisfy nuclear safeguards requirements. Teams will collect the fragments, under appropriate health physics direction and working within grids to ensure complete coverage. The collected materials will be buried in a deep trench. In addition, one of the pits at Kuli contains up to 7 tonnes of depleted and natural uranium. This uranium will be recovered and buried deeper at another location.

138. The XA Road leading to the Kuli site will be ripped up and revegetated from the TM50 turn off. The road from the XA Road past the TM50 site to the Dirty Dobo Road will also be ripped and revegetated. Roads at Emu will be ripped up. These measures will be taken to discourage access and reduce the chance of casual discovery of the sites.

Shallow burial trenches

139. Friends of the Earth and Greenpeace opposed the use of shallow burial trenches. Both organisation favour above-ground storage to allow for on-going monitoring of the waste and retrieval should the need arise. They pointed to a number of other countries adopting this strategy.

140. DPIE advised that above-ground storage would be inappropriate for the plutonium contaminated burial pits at Taranaki. The material is not in a form in which it could be readily packaged and placed in above-ground stores. The plutonium is coated on items such as steel beams and plates, lead and barytes bricks and buried in pits four metres deep. The volume of material to be collected from the plumes at the three locations would require the construction of an earth-mound or an engineered structure of monumental proportions.

Committee's Conclusion

141. Based on the evidence submitted to the Committee, the burial of contaminated soil and other debris appears to be the more appropriate solution compared with above ground storage.

BOUNDARY MARKERS

142. After the rehabilitation work has been completed, certain areas will still be unsuitable for permanent occupation in a semi-traditional Aboriginal lifestyle. These areas will be designated by boundary markers which will not restrict access to the land, but will carry signs advising that the area inside the markers is not suitable for permanent occupation. The total length of the boundary will be of the order of 100km and its alignment will be determined by the ARL during the course of the project. Where possible, the boundary markers will follow the inside edge of existing roads and will consist of signs on galvanised steel posts spaced at about 50 metre centres.

REVEGETATION

143. Areas left denuded of vegetation by the proposed works, together with those debris pits and special treatment areas requiring restoration, will be revegetated after application of topsoil, except possibly for areas where underlying rock is exposed by contaminated soil removal. These areas may be left with the natural rock exposed.

144. There are a number of factors in the Maralinga area which limit the options for revegetation. These include low and unreliable rainfall, shallow soils with low fertility, rabbits which could graze out young seedlings, and very saline groundwater which is unsuitable for irrigating plants.

145. Revegetation of the contaminated soil removal areas and associated locations will require the spreading of suitable topsoil material up to 200 mm thick over the areas to be revegetated. The topsoil will be won from a local borrow area. Seed for the revegetation will be locally collected from native species. The direct seeding method using machinery is preferred over the more traditional method of raising and planting seedlings. Direct seeding is less expensive, does not require a follow-up watering program and has been used successfully in environments similar to Maralinga.

146. Mr R H Ashby, a private citizen, indicated that the revegetation program may run into problems. The removal of soil will remove vegetation and latent viable seeds in the soil. He raised the question of the source of suitable topsoil to replace the soil which is to be removed, the potential for any replacement soil to be blown away and the success of any replanting. He suggested that rock and rougher larger material could be spread to hold smaller soil particles

and seed by breaking the effect of wind, thereby preventing topsoil loss and movement.

147. DPIE advised that it was originally intended that either excess soil from burial trenches, or borrow soil taken over a relatively small area, should be used to cap areas where soil has been removed. Further soil testing has shown that use of soil capping material at Taranaki may not be possible due to the salinity of the proposed borrow soil, especially at depth. If suitable borrow pits cannot be obtained locally without clearing large areas, recapping of the Taranaki area would be undesirable. Revegetation efforts would then concentrate on areas of the site where at least some soil remains. Pockets of vegetation would aid in the long term revegetation of the entire site by reducing soil erosion by wind and by trapping wind-blown soil and organic matter.

148. Greening Australia South Australia Inc, indicated in a submission that it has the experience and unique expertise in broadacre revegetation in arid areas which could be applied to the Maralinga project. Under the One Billion Trees Program the organisation has direct seeded over 600 demonstration sites on 3200ha in South Australia. It believes direct seeding to be the most appropriate for revegetating Maralinga areas after the earthworks have been completed.

149. Greening Australia also submitted that the Oak Valley Maralinga Tjarutja community could be trained in seed collection and believes it is well placed as a training provider to do this.

150. DPIE advised that South Australia State Flora has prepared a detailed report on revegetation options. The report and the Commonwealth's settlement of Maralinga Tjarutja claims recognises the opportunities for participation in revegetation works.

PRECAUTIONS AGAINST CONTAMINATION

Australian Radiation Laboratory

151. ARL is responsible for regulating radiation protection and its contribution to the project takes several forms:

- the development of a policy document Policy on *Radiation protection practices in the rehabilitation of former nuclear weapons test sites at Maralinga*. This document sets down the procedures, practices and standards required to limit occupational and public radiation exposure during the project. It is based on a nationally accepted code of practice for radiation protection in the handling of radioactive ores updated to take into account the most recent recommendations of the International Commission on Radiological Protection

- monitoring of the workforce - a highly-sensitive whole body monitor has been acquired

- establishing the boundaries of the plutonium-contaminated soil which is to be removed. A mobile monitoring vehicle has been developed, equipped with a highly-sensitive americium detector mounted on a pivot boom which can be extended forwards and to a height of 4-5m. ARL advised the Committee that the vehicle and the system have proven to be very reliable. ARL expect to be able to provide definitive boundaries by mid-1995

- as an auditor - ARL will examine each area after the soil has been removed and verify that residual levels do not exceed values defined as acceptable

- examination of some locations to ensure that no 'islands' of contamination exist which exceed defined criteria.

Risks

152. This project is unusual in that the risk of radioactive contamination by plutonium requires strict adherence to a system of work procedures, which are being prepared for all work to be undertaken in the contaminated areas. The procedures are devised to minimise the uptake of radioactivity by ingestion, inhalation or entry through open wounds. All activities in contaminated areas will be subject to health physics control, involving regular monitoring of all personnel and equipment.

Precautions

153. Personnel working in contaminated areas will wear protective clothing and breathing apparatus as appropriate to the task being undertaken. The cabins of construction plant will be sealed and pressurised with ventilation provided through HEPA filters.

Monitoring

154. Personnel and plant are required to be monitored and if necessary decontaminated prior to departing from the contaminated work areas. Construction plant is also to be monitored and decontaminated as necessary prior to servicing or maintenance, and prior to its removal from the site.

Health physics

155. Health physics deals with the protection of people from the harmful effects of ionising radiation. It is, in effect, the study and administration of radiological protection.

156. A health physics regime is being developed to ensure compliance with the ARL Policy Document and international recommendations. The health physics regime will identify the radiological status of each work area. The potential hazard will then be assessed and appropriate radiation safety measures instigated to protect the workforce. The radiation safety measures will keep radiation doses from the operations to employees and the public within relevant internationally agreed limits. The ALARA (as low as reasonably achievable) principle will be applied to minimise dose levels. This approach is in accordance with the recommendations of the International Commission on Radiological Protection (ICRP).

Radiation safety measures

157. The health physics strategy for ensuring minimum possible radiation doses to employees and the public involves:

- selection of work methods that minimise the contact of personnel with the radioactive environment. The use of plant will be maximised in preference to personnel working in the open.

- radiological hazard associated with all operations will be assessed by suitably qualified and experienced personnel, with the resulting assessment being documented.

- based on the assessments of the hazards, controls and precautions will be developed to ensure that the required standards of radiological safety are met. These controls and precautions will be documented in detailed health physics procedures covering all operations involving a radiological hazard.

- all health physics procedures are subject to review and approval by ARL before implementation.

- suitably qualified and experienced personnel will be employed on site to administer the health physics procedures.

- the training requirements of all personnel will be assessed. Training appropriate to the work and hazard will be given by the health physics staff. The training courses will be approved by ARL.

- a comprehensive system of record keeping will be established to document the radiological status of the various operations at the site.

- the health physics regime will ensure constant monitoring of the working environment to give early warning of departures from acceptable standards. The regime will be developed to ensure that corrective action can be taken before standards are breached.

Procedures and controls

158. Health physics procedures will be written to cover all work involving radioactive material. They will be in sufficient detail to enable their application by the health physics staff at site in an effective and consistent manner. Each procedure will detail the working methods, and document the means for applying and controlling the health physics work. They will detail the record keeping requirements and ensure non-conformances are recognised and corrective action taken.

159. It is recognised that, because of the developmental nature of the project, some procedures may have to be revised during the course of the project. This will ensure that the health physics regime will be constantly tailored to the project requirements. Regular quality audits will be undertaken to ensure that practices are carried out in accordance with documented procedures.

160. Procedures will cover aspects such as:

- personal air sampling

- designation of areas
- clearance of items from designated areas
- radiological area surveys
- health physics laundry procedures.

161. Hazards reports will also be developed. These will assess the radiological hazards associated with each area or mode of operation. They will be used as a basis for the health physics procedures, ensuring that the level of potential hazard is addressed.

Checks and records

162. In the Maralinga project, personnel will fall into one of three formal designations; designated radiation worker, non-designated worker and member of the public. These designations are consistent with internationally accepted standards and are referred to in the ARL Policy Document.

163. Workers will be designated as radiation workers if they are required to work in radioactive controlled areas. Designated radiation workers will have their dose records formally kept and will be subject to regular medical surveillance.

164. Non-radiation workers will not routinely enter radioactive controlled areas.

Equipment modifications

165. The purpose of modifying the earthmoving plant is to provide radiological protection for the work force to ensure that "worker dose" is as low as reasonably achievable. Based on an assessment of the hazards a plant modification strategy has been developed which is designed, by a combination of elimination and exclusion, to minimise the risk of a worker receiving a radiation dose.

166. As a large proportion of the radioactivity occurs in the smaller particles of the contaminated soil, controlling the dust raised by plant will reduce the risk of personnel inhaling contamination. The strategy also provides protection to the plant operators by modifying plant cabs to exclude radioactive

contamination. This will be achieved by sealing and pressurising the cab with filtered fresh air to exclude ingress of any airborne contamination. The cab will require modification to the door seals to provide additional protection, and modification to the ventilation system to include HEPA filters and a fan capable of handling the required duty. Because the cabs of modern earthmoving plant are designed to be well sealed and air conditioned, these modifications will be relatively straightforward. The cab will be fitted with a monitor which will sound an audible alarm if radioactive contamination is detected.

167. Inherent in the modification strategy is the need to keep the cab free of contamination. To ensure that contamination is not brought into the cab by the operator, a system for entering and exiting the cab under clean conditions will be devised. Health physics monitoring and any necessary decontamination of the cab will be carried out regularly.

168. As part of the strategy of minimising the radiological risk to maintenance personnel, all plant will be decontaminated as necessary before it is serviced. The regular decontamination of the plant is recognised as "good radiological protection practice" and will make the task of decontaminating plant for release off site at the end of the project that much easier because of the experience gained.

Occupational health and safety

169. Occupational health and safety (OH&S) is the responsibility of every employer and employee. This responsibility is further enforced by Commonwealth and State legislation.

170. An OH&S Strategic Plan is being prepared to provide a general framework around which the health and safety of site personnel can be achieved. It also sets the OH&S policy guidelines under which each subcontractor is responsible for producing its own OH&S Plan. It covers measures to guard against conventional hazards in addition to radiation hazards.

171. A safety assessment will be required for each major operation. This will enable a relative ranking to be made of the risks, both conventional and radioactive related, and an indication of any risks which are greater than desirable. It will also consider safeguards which would counter the hazards.

Information on safeguards will then be used to decide on the optimal approach to risk reduction.

Committee's Conclusions

172. Based on the evidence presented, including advice from technical experts both from Australia and overseas, personnel work practices to be applied during the clean-up appear to be adequate.

173. The proposed clean-up can be implemented under an effective radiological protection regime to ensure that exposure to radiation is kept within internationally accepted limits. This regime will include thorough training of workers to make them aware of the potential radiological hazards involved in the clean-up operation.

174. Detailed procedures covering all aspects of work in contaminated areas will be developed for approval by the Australian Radiation Laboratory, the regulatory body for the project.

WORKFORCE AND INDUSTRIAL RELATIONS

175. The workforce will be housed in single rooms in demountable buildings providing a comfortable standard of accommodation. A camp manager will provide catering and cleaning services. A range of amenities including exercise facilities will also be provided.

176. The more significant issues for the workforce will be the remote location, the extremes of climate, the long working hours, and the nature of the work which will sometimes demand the wearing of protective clothing and constant supervision. There will be a number of varying work rotations. It is expected that the majority will work 21 days on and 7 days off, with a standard day of 10 hours.

177. A co-operative industrial relations climate is of critical importance to the successful completion of the project. It is proposed that the workers will be covered by an enterprise agreement which is currently being negotiated. This agreement will be certified by the Industrial Relations Commission.

LOCAL IMPACT

178. Employment numbers will be around 80 people over about four to five years. Much of the materials and services will be sourced out of Adelaide.

179. The Maralinga Tjarutja are involved in the project through representation on the Consultative Group. It is proposed that members of the local Aboriginal community be given the opportunity to gain employment during the project through sub-contract work, particularly in the revegetation program and on the erection of boundary markers.

180. Maralinga Tjarutja advised the Committee that prospects for Aboriginal employment have been canvassed and the Commonwealth and Maralinga Tjarutja have agreed that attempts to maximise opportunities would be attempted.

ENVIRONMENT AND HERITAGE

Environment

181. The Environment Protection Agency (EPA) advised the Committee that DPIE referred a Notice of Intention (NOI) for the Maralinga Rehabilitation Project to the EPA on 23 September. The EPA provided comments on the NOI on 24 November. In summary, the EPA response was supportive of the project as a whole, but requested that environmental commitments be clearly defined and separately listed. In addition, further information was requested relating to environmental rehabilitation goals, baseline environmental surveys, intended monitoring and reporting, the nature of flora rehabilitation, details of equipment hygiene programs and details of procedures for on-going removal of solid contaminants. Further information was provided by DPIE subsequently. At the time of the public hearing a decision on whether to require the preparation of a Public Environmental Report or an Environmental Impact Statement had not been made.

182. On 24 May the Minister for the Environment, Sport and Territories (Senator the Hon. John Faulkner) advised the Minister for Primary Industries and Energy (Senator the Hon. Bob Collins):

- the EPA had examined the NOI and the consultation processes involved in the development of the project

- the EPA had assessed the potential environmental impact of the proposal and indicated that it is satisfied that appropriate measures are in place to deal with the radiological and toxic decontamination of the sites, to manage the clean-up of radiological wastes, and to minimise the possibility of any adverse environmental impact.

183. In the light of the EPA advice the Minister determined that neither an Environmental Impact Statement no a Public Environmental Report is required for the purpose of achieving the objectives of the Environment Protection (Impact of Proposals) Act 1974.

184. The Minister did, however, make the following recommendations:

- an environmental management plan, for release as a public information document, be developed by DPIE in consultation with the EPA

- DPIE ensure that the rehabilitation project is conducted in a manner consistent with the undertakings given in the NOI

- DPIE ensure that as planning for the project proceeds and strategies for the rehabilitation become clearer, the EPA be kept informed of the decisions taken, particularly those relating to the environmental management plan.

185. The Committee understands the recommendations will be adopted by DPIE.

Heritage considerations

186. DPIE prepared a Conservation Management Plan which identifies items of possible heritage interest. These include the pattern of roads established for the test program and buildings of the British testing era in the village. Advice to the Heritage Commission under Section 30 of the *Heritage Commission Act* mentions that, apart from ripping roads to the Emu ground zeros and to the Kuli site at Maralinga, these roads and buildings will not be affected by the rehabilitation program.

187. The Australian Heritage Commission advised the Committee that timely consultation had taken place with DPIE on the implications of the

rehabilitation project for the national estate values of the Maralinga and Emu areas. The former Maralinga Village and Forward area, and the former Emu Village site and range were entered in the Register of the National Estate in 1991.

PROJECT DELIVERY

Project team

188. The project is being conducted in two phases under the control of DPIE. ACS was appointed in April 1994 to provide detailed engineering and project management services. In Phase 1, ACS heads a team of subconsultants which includes:

- AEA Technology of the UK - to manage the radiological aspects of the project such as preparation of health physics procedures, design of the remediation works, and modifications to equipment for work in contaminated areas

- ANSTO - to assist in the preparation of health physics procedures and provide health physics services at the site.

189. DPIE has contracted Geosafe Corporation of the USA to determine the applicability of its ISV technology and process to contaminated burial pits at Taranaki. Subject to establishing the feasibility of ISV at the site, it is proposed that Geosafe be contracted to apply ISV to the Taranaki pits.

190. Phase 2 will be the implementation phase and ACS will let subcontracts for the following elements:

- establishment of the construction camp

- management of the construction camp

- removal and burial of contaminated soil and debris at the Maralinga site

- provision of health physics services

- provision of support services to Geosafe (contingent on the satisfactory outcome of the ISV trials)

191. ARL is responsible for regulatory control of all work at the site that has a radiological component. During the course of the project it is expected that this role will be formalised when ARL is constituted as the Australian Institute for Radiation Protection.

Delivery

192. Delivery of the works under ACS control will be by conventional systems with tenders called on the basis of design documents. Contracts will be a combination of lump sum and schedule of rates as appropriate.

193. ACS will engage a major earthmoving contractor to undertake the bulk of the works on site, including the trench excavation and backfill, soil removal, pit exhumation and restoration and revegetation. Minor subcontracts will be let for supply and installation of the construction camp, upgrading of roads and services, camp management and provision of boundary markers.

PROGRAM

194. The first works to be undertaken will be the establishment of the construction camp with associated infrastructure. This is scheduled for completion in October 1995.

195. Scheduling of the main works was developed from consideration of the need to minimise the duration of the overall project implementation phase, whilst building in an adequate time allowance to accommodate the requirements of the extensive safety procedures associated with working in the contaminated areas.

196. The sequence of works is illustrated in Drawing B-10 and will be as follows:

- excavation of the Taranaki burial trench - October 1995 to June 1996

- the removal of contaminated soil at Taranaki and its disposal into the trench; followed by trench excavation, and removal and disposal of contaminated soil at TM100/101 and Wewak; final capping of the trenches with clean material and revegetation - completion - September 1998

- exhumation and surface restoration of debris pits - progressively - September 1997 to May 1998

- ISV process will commence at Taranaki when the area has been cleared of contaminated soil and adequate safety can be ensured. DPIE estimate the ISV treatment of the 21 pits at Taranaki will take two years - completion by late 1999

- revegetation will be timed to occur in the most favourable season, late winter/spring; it is planned to commence in August 1997 and is planned to be undertaken progressively as areas are restored

- project completion - end of 1999 with the removal of the construction camp.

COST ESTIMATE

197. When referred to the Committee the cost estimate for the Maralinga Rehabilitation Project was $104.4m at November 1994 prices.

Expenditure to date

198. The Committee was advised that studies undertaken under the guidance of TAG cost $6m. Expenditure on geological testing and further studies, such as ISV sampling, amounts to $5.5m and is included in the cost estimate of the project.

Confidence of cost estimates

199. DPIE submitted that normally, on conventional construction projects, costs may be compared with similar relevant projects. The rehabilitation of Maralinga is unique in Australia and there is no similar project against which to compare scope and cost levels.

200. The Committee was advised that costings are been based on proposed work methods, estimated material quantities and estimated productivity rates for equipment and personnel. At the public hearing the Committee questioned DPIE about the confidence of the costings. The Committee was advised that the cost estimate at the time of the TAG studies was $101m, plus or minus

30%. The Government sought narrower bands of confidence in the accuracy of the estimates. Accordingly, the Committee was advised, the current assessment of the cost is $104m with confidence bands ranging from minus 5% to 15%. DPIE attribute the developmental nature of the project and the following factors to the need to provide for uncertainties in the costings:

- the extensive regime of safety requirements on productivity rates of workers and construction plant has been estimated, but this will only be finally determined when work commences on site

- the depth and thus the quantity of contaminated soil to be removed to ensure that acceptable clearance levels are achieved has been estimated as an average figure based on previous site records; the actual quantities will only become known when measurements are taken during the clean-up operations

- rock is at shallow depth throughout much of the site from which soil is to be removed; this will dictate the type of removal operation to be employed. Limited information is available on the thickness of the soil layer overlying the rock and this will be investigated further during the design process.

201. The estimate includes for ISV treatment of 21 debris pits.

202. A cost control system has been established which will allocate the project budget to individual work packages. Evolving designs will be costed and compared with the package budgets to maintain control of costs within the project budget.

British contribution

203. DPIE considers that the £20 million ex gratia payment obtained from the UK under the terms of the 1993 settlement to be the best outcome Australia could expect. Britain has made it clear that it considers the settlement to be full and final.

204. The background to the settlement was explained by DPIE and its advisers which pursued Australia's claims. Achievement of settlement was described as being hampered by severe jurisdictional difficulties and by the Commonwealth, in 1968 following the *Operation Brumby* clean-up, releasing Britain from its obligations for further clean-up of the test sites. Britain's acceptance of the

jurisdiction of the International Court of Justice in the Hague was qualified in a way which put Australia's claims against the UK beyond the jurisdiction of the Court, the only jurisdiction within which Australia could practically pursue its claim. In these circumstances, negotiations with Britain over its obligation to make a substantial contribution to the cost of the clean-up were protracted and difficult. Britain was reluctant to acknowledge its moral responsibility for the condition of the test sites or to address the substance of Australia's technical and legal arguments for a British contribution.

Monitoring of project

205. The Committee will monitor the progress of this project and expects to be briefed by DPIE as the project develops.

Committee's Recommendation

206. The Committee recommends the Maralinga rehabilitation project proceed at an estimated cost of $104.4 million at November 1994 prices.

CONCLUSIONS AND RECOMMENDATIONS

207. The Committee's conclusions and recommendations and the paragraphs in the report to which each refers are set out below:

		Paragraph
1.	**There is a need for remedial action to be undertaken at Maralinga to reduce the radiological hazards at the test sites sufficiently to enable Aboriginal traditional land use and transit of the test site area, to reduce and possibly eliminate the need for control and surveillance of the sites, and to remove potential Commonwealth liabilities arising from site contamination.**	**67**
2.	**An independent audit of the results of the in situ vitrification trials of material containing plutonium should be undertaken by competent experts not associated with the project.**	**129**
3.	**If the results of the review indicate the in situ vitrification process provides encapsulation and mixing of material to prescribed standards, the process can be extended to fullscale treatment of burial pits at Taranaki.**	**130**
4.	If the results of the in situ vitrification trials are inconclusive, or do not provide results to prescribed standards, the further direction of the project should be reviewed.	131
5.	Based on the evidence submitted to the Committee, the burial of contaminated soil and other debris appears to be the more appropriate solution compared with above ground storage.	141

6. **Based on the evidence presented, including advice from technical experts both from Australia and overseas, personnel work practices to be applied during the clean-up appear to be adequate.** 172

7. **The proposed clean-up can be implemented under an effective radiological protection regime to ensure that exposure to radiation is kept within internationally accepted limits. This regime will include thorough training of workers to make them aware of the potential radiological hazards involved in the clean-up operation.** 173

8. **Detailed procedures covering all aspects of work in contaminated areas will be developed for approval by the Australian Radiation Laboratory, the regulatory body for the project.** 174

9. **The Committee recommends the Maralinga rehabilitation project proceed at an estimated cost of $104.4 million at November 1994 prices.** 206

Colin Hollis MP
Chair

8 June 1995

APPENDIX A

WITNESSES

CAMPBELL, Mr Malcolm Warren, Executive Director, Greening Australia South Australia Inc., State Tree Centre, Brookway Drive, Campbelltown, South Australia

CHAMBERLAIN, Mr Garth Henry, Project Manager, Australian Construction Services, Sirius Building, Furzer Street, Phillip, Australian Capital Territory

COLLETT, Mr Andrew Clive, Legal Adviser, Maralinga Tjarutja, 170 South Terrace, Adelaide, South Australia

DAVOREN, Mr Patrick John, Manager, Rehabilitation and Radioactive Waste Policy Section, Commonwealth Department of Primary Industries and Energy, C3 L2 W4, Edmund Barton Building, Barton, Australian Capital Territory

DAVY, Mr Desmond Robert, Convenor, Maralinga Rehabilitation Technical Advisory Committee, 68A Algernon Street, Oatley, New South Wales

FELLINGHAM, Dr Lorimer Robert, Site Remediation Manager (AEA Technology), Consultant to Australian Construction Services, Sirius Building, Furzer Street, Phillip, Australian Capital Territory

IRVINE, Mr Anthony John, Chief Executive Officer, District Council of Ceduna, 44 O'Loughlin Terrace, Ceduna, South Australia

LOKAN, Dr Keith Henry, Director, Australian Radiation Laboratory, Lower Plenty Road, Yallambie, Victoria

PARKER, Mr Michael John, Health Physics Manager (AEA Technology), Subcontractor to Australian Construction Services, Furzer Street, Phillip, Australian Capital Territory 2606

PARKINSON, Mr Alan, Engineering Adviser to the Department of Primary Industries and Energy, 24 Gillespie Street, Weetangera, Australian Capital Territory

PREECE, Mr Richard James, Manager, Social and Cultural Branch, Aboriginal and Torres Strait Islander Commission, Sun Alliance Building, 45 Grenfell Street, Adelaide, South Australia

PUCKRIDGE, Mr Malcolm John, Mayor, District Council of Ceduna, 44 O'Loughlin Terrace, Ceduna, South Australia

RAWSON, Mr Robert Norman, Assistant Secretary, Uranium & Nuclear Policy Branch, Department of Primary Industries and Energy, C3 L2 W4 Edmund Barton Building, Barton, Australian Capital Territory

ROSENBAUER, Mr Robert William, Assistant General Manager–Operations, Australian Construction Services, 169-171 Gladstone Street, Fyshwick, Australian Capital Territory

SCHWARZ, Mr Leon Howard, Chairman, Ceduna Together Against Crime, 28 McKenzie Street, Ceduna, South Australia

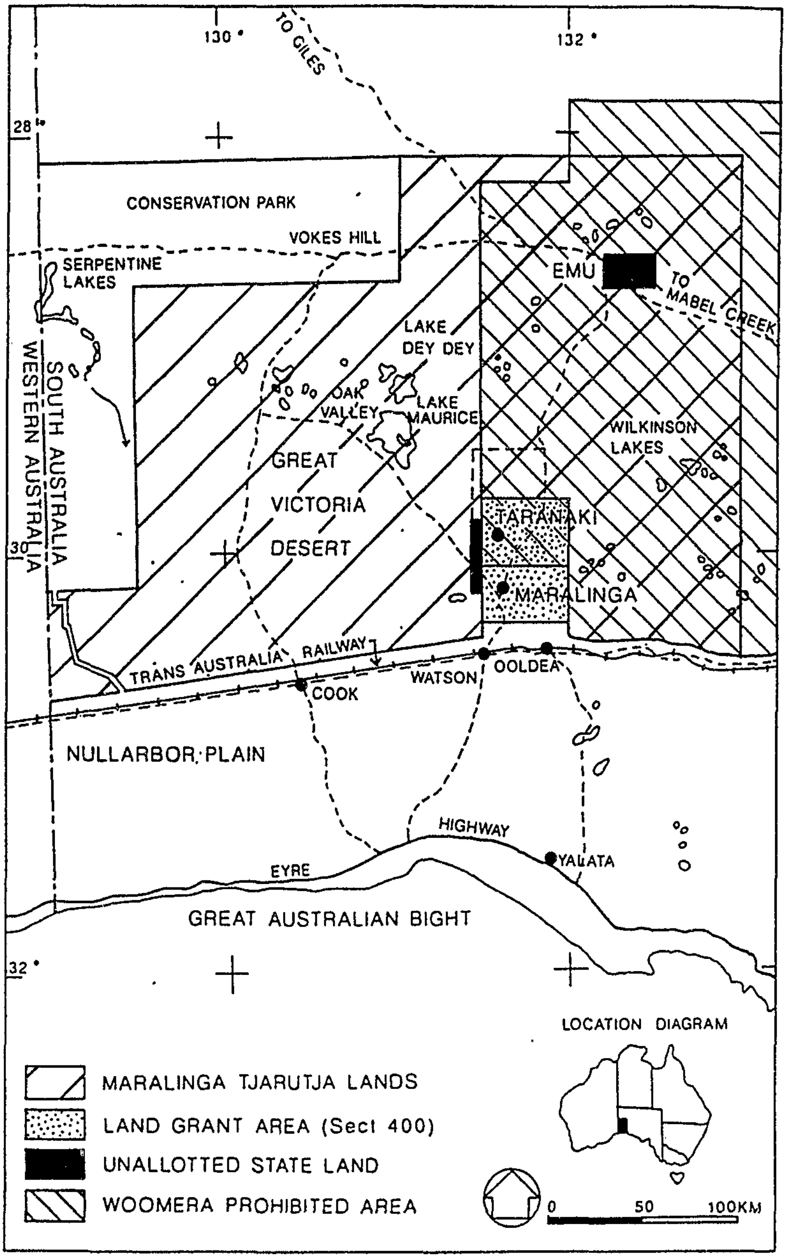
SWEENEY, Mr David, Research Officer, Friends of the Earth, 312 Smith Street, Collingwood, Victoria 3066

WAKELIN, Mr Barry, MP, Federal Member for Grey, Parliament House, Canberra, Australian Capital Territory

WARE, Mr Robert, Acting Administrator, Maralinga Tjarutja, Ceduna, South Australia

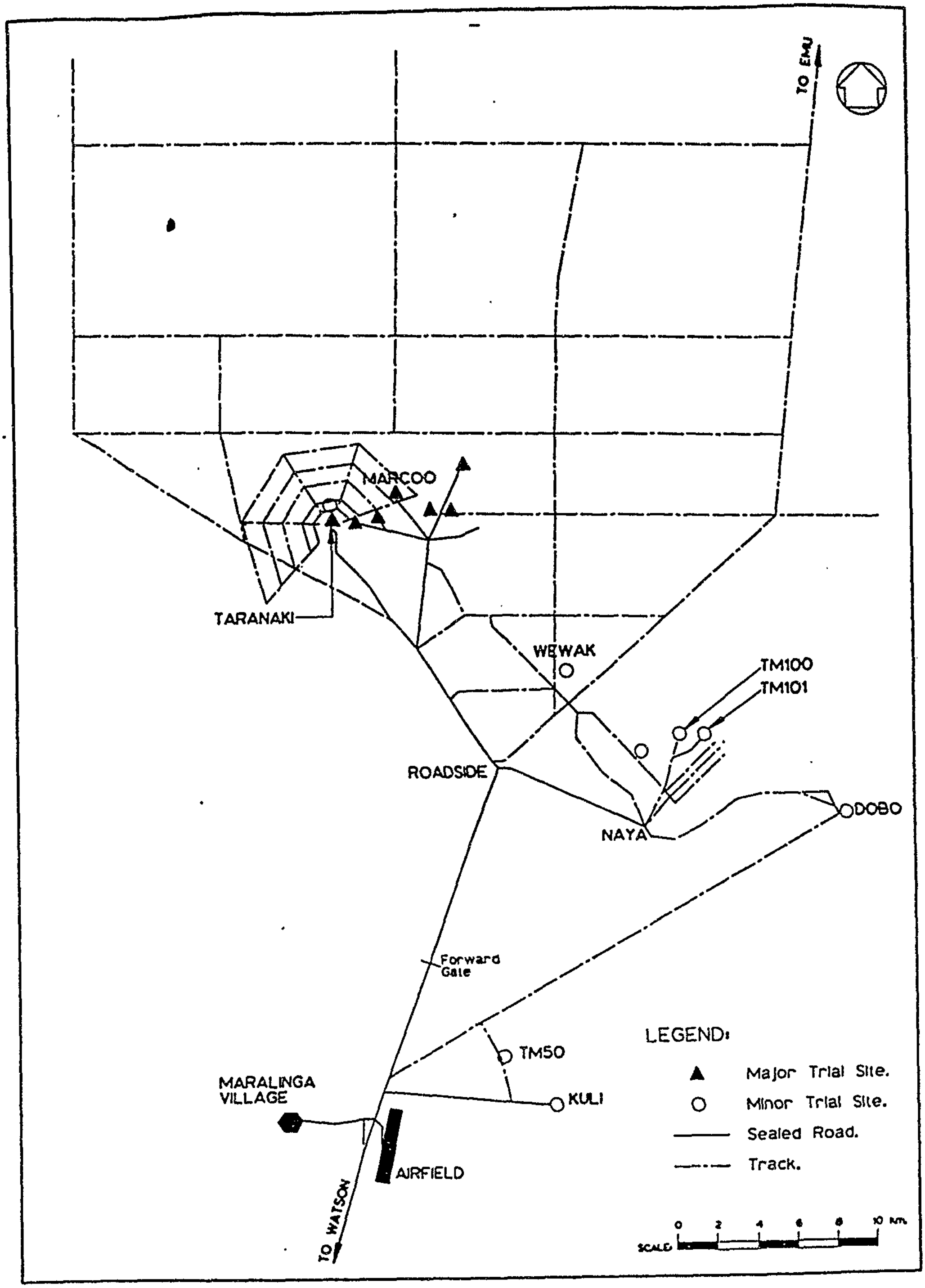
APPENDIX B

DRAWINGS



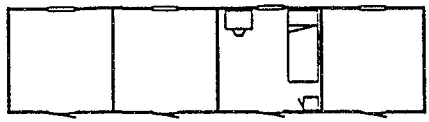
MARALINGA REHABILITATION PROJECT

MARALINGA AND EMU AREAS
IN SOUTHERN AUSTRALIA

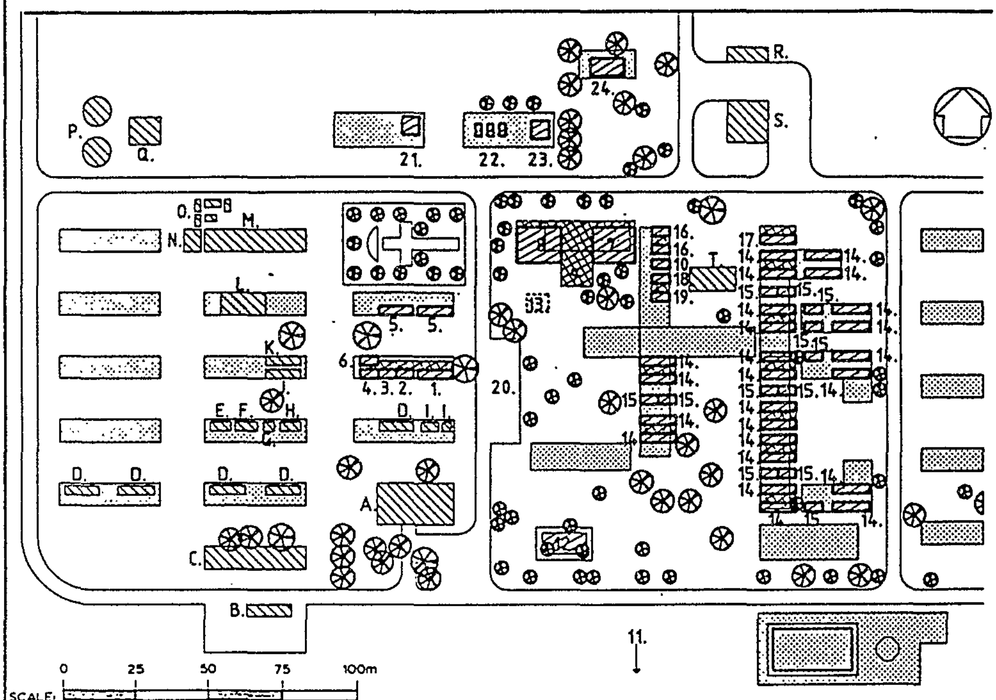


MARALINGA REHABILITATION PROJECT

MAJOR & MINOR TEST SITES
& MAIN FEATURES



4 PERSON ACCOMMODATION BLOCK - 12m x 3m



LEGEND

- EXISTING BUILDING.
- PROPOSED BUILDING
- EXISTING SLAB
- VERANDAH
- SIGNIFICANT EXISTING TREE

NOTE.
REHABILITATION SUB-CONTRACTORS COMPOUND AND TENNIS COURTS ARE NOT SHOWN.

EXISTING BUILDINGS

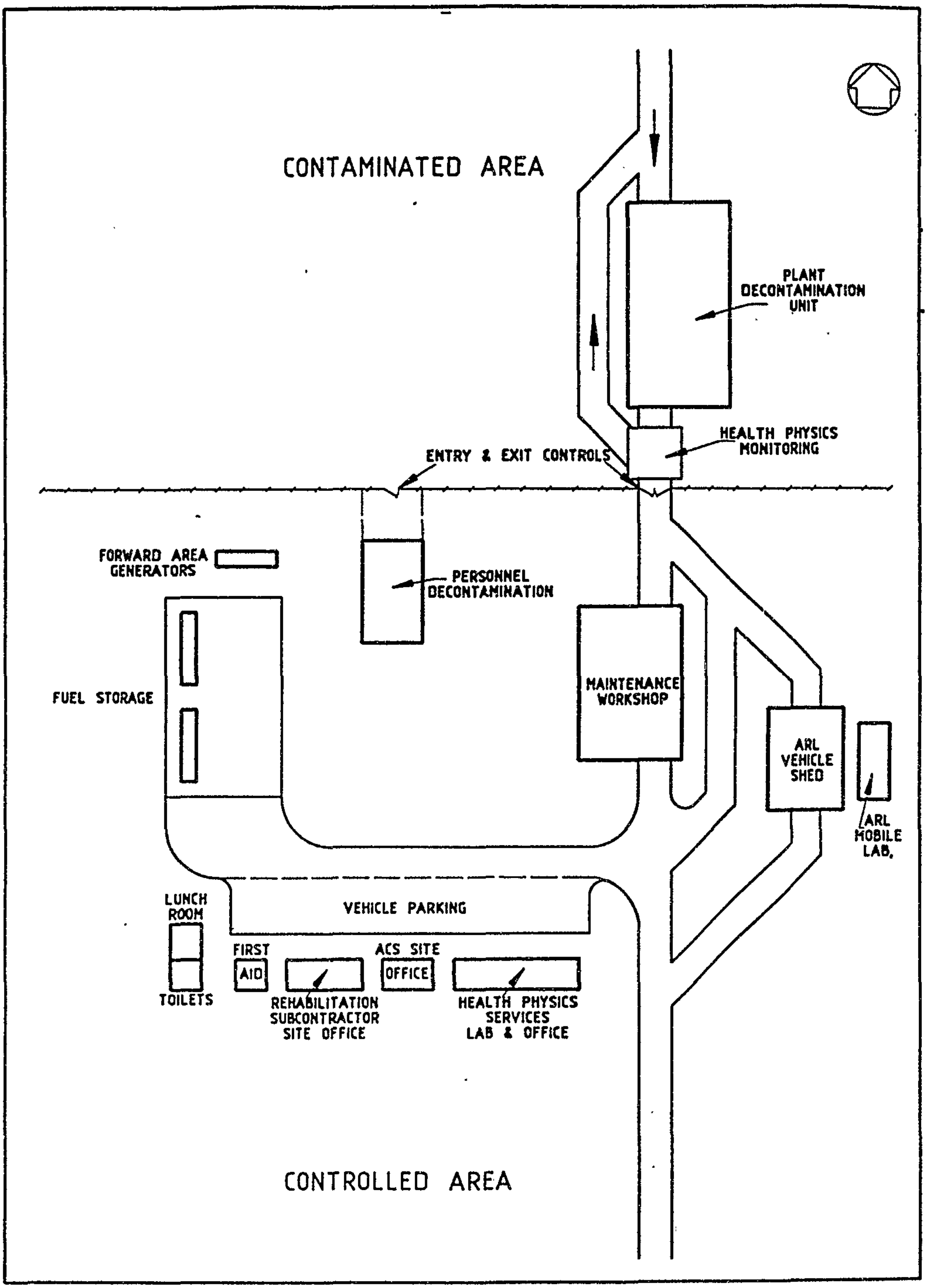
A. APS HEADQUARTERS.
B. TELECOM ACCOM DEMOUNTABLE.
C. VIP BUILDING.
D. OPIE ACCOMMODATION DEMOUNTABLE.
E. MALE ABLUTION DEMOUNTABLE.
F. LAUNDRY/FEMALE DEMOUNTABLE.
G. DRY FOOD STORE DEMOUNTABLE.
H MESS DEMOUNTABLE.
I OPIE OFFICE DEMOUNTABLE.
J ANSTO LABORATORY
K. ARL LABORATORY.
L. GENERATOR SHED.
M. BEDDING STORE.
N. HEAT BANK SHED.
O. DIESEL FUEL TANKS.
P. GROUND LEVEL WATER TANKS.
Q. ELEVATED WATER TANK.
R. STORAGE SHED.
S MAINTENANCE WORKSHOP. (FIRE STATION)
T. FLAMMABLE STORE. (TO BE RELOCATED)

PROPOSED BUILDINGS

1. ACS OFFICE.
2. MEETING ROOM.
3. HEALTH PHYSICS OFFICE.
4. TOILET BLOCK.
5. REHAB. SUB-CONTRACTOR OFFICE.
6. HEALTH PHYSICS STORE AND WORKSHOP.
7. MESS.
8. RECREATION ROOM.
9. BBQ AREA.
10. TOILET BLOCK.
11. TENNIS AND BASKETBALL COURTS.
12. SWIMMING POOL.
13. CAMP FIRE AREA.
14. ACCOMMODATION BLOCK.
15. ABLUTION BLOCK.
16. CAMP OPERATORS OFFICE.
17. MEDICAL CENTRE.
18. LINEN STORE.
19. BEDDING LAUNDRY.
20. CARPARK.
21. CAMP OPERATORS MAINTENANCE WORKSHOP.
22. FUEL STORAGE AND DISPENSARY.
23. OIL AND GREASE STORE.
24. ELECTRICAL GENERATION PLANT.

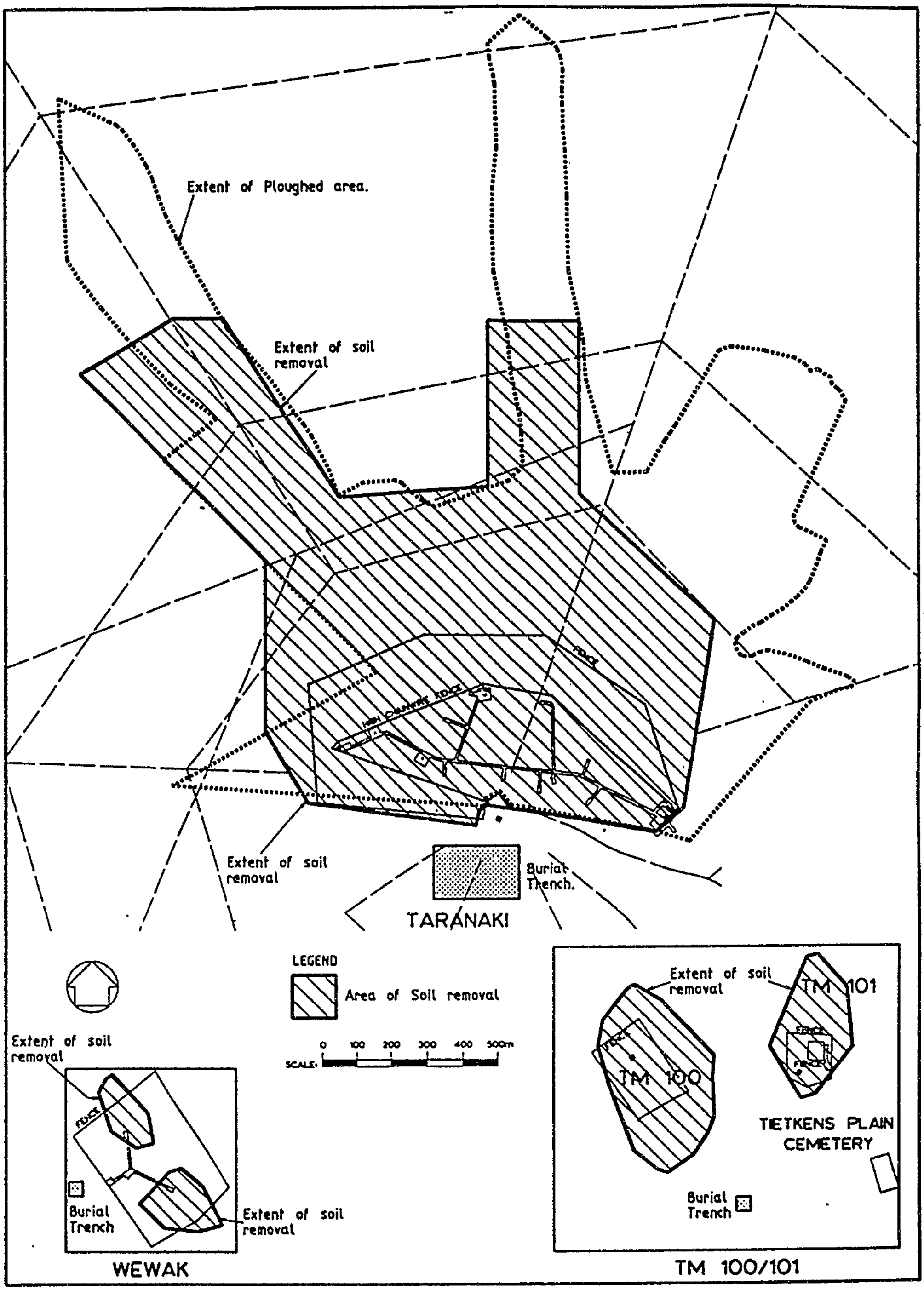
MARALINGA REHABILITATION PROJECT

CONSTRUCTION CAMP



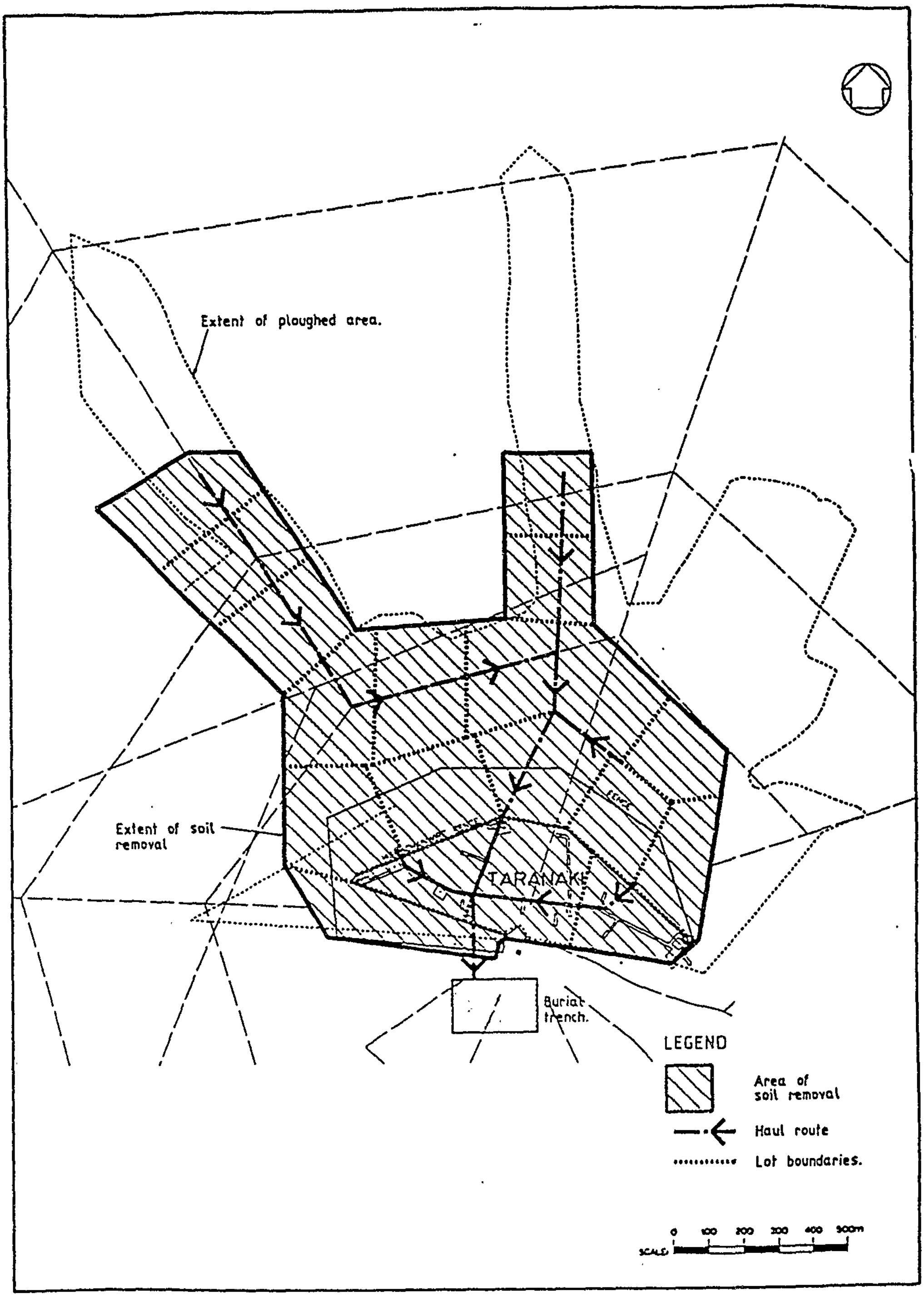
MARALINGA REHABILITATION PROJECT

DIAGRAM OF TARANAKI
FORWARD AREA FACILITIES

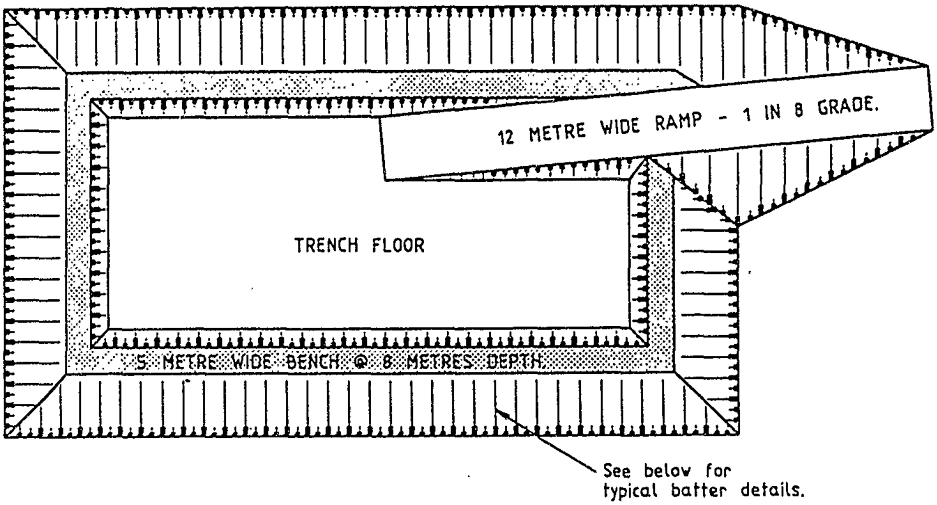


MARALINGA REHABILITATION PROJECT

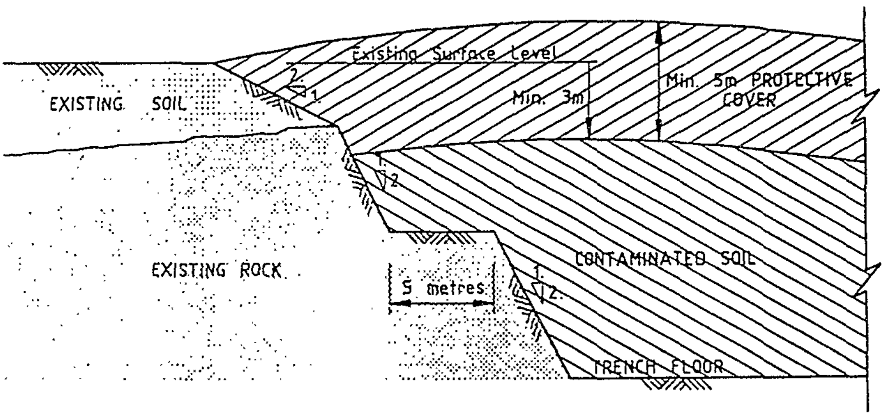
CONTAMINATED SOIL REMOVAL AREAS



MARALINGA REHABILITATION PROJECT
TARANAKI
POSSIBLE SOIL REMOVAL,
SEQUENCE & HAUL ROUTES.



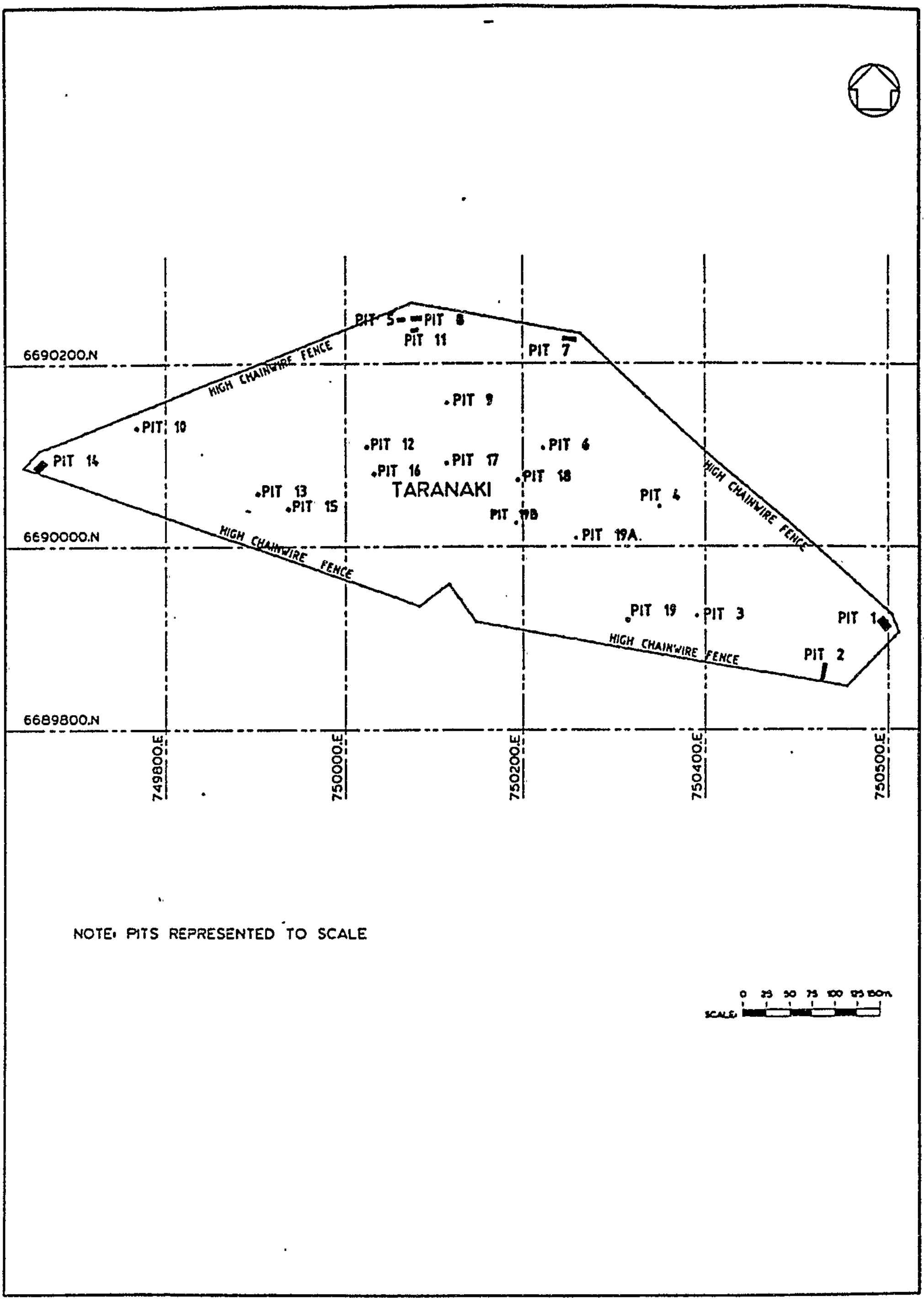
PLAN OF TRENCH
NOT TO SCALE



TYPICAL TRENCH SIDE SLOPES
AND BURIAL OF CONTAMINATED SOIL

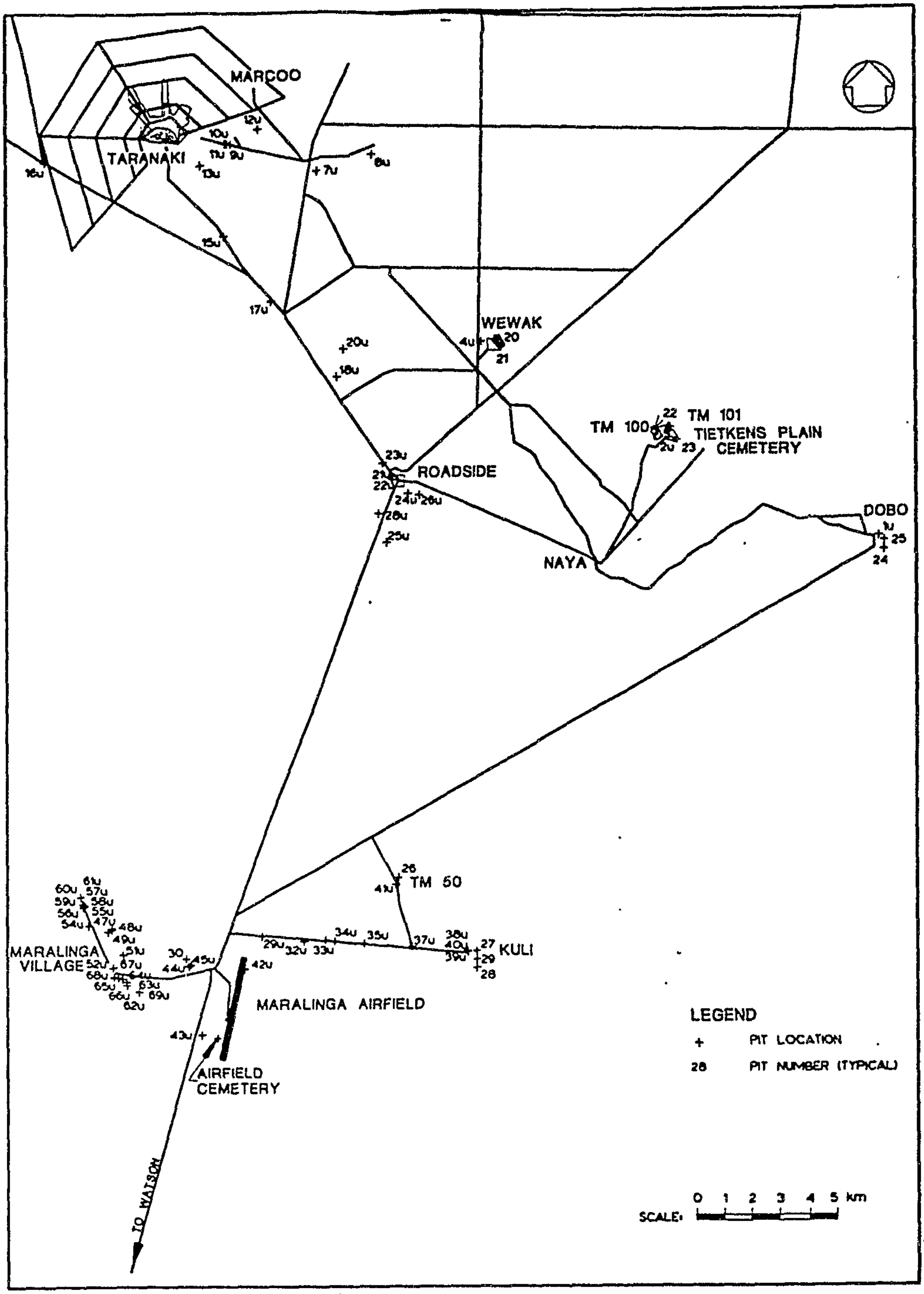
MARALINGA REHABILITATION PROJECT

TYPICAL BURIAL TRENCH



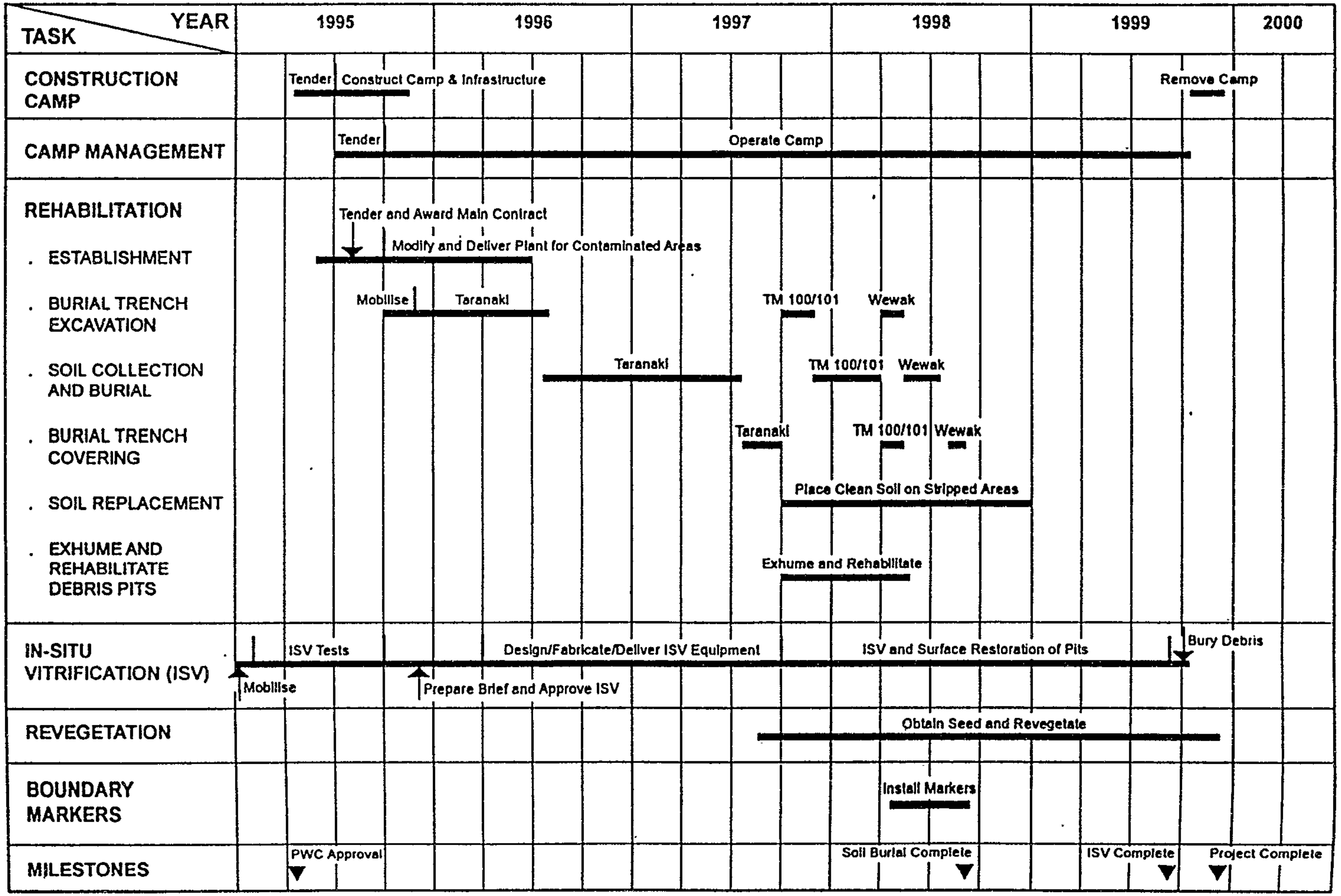
MARALINGA REHABILITATION PROJECT

INNER TARANAKI
DEBRIS PITS FOR ISV TREATMENT



MARALINGA REHABILITATION PROJECT

LOCATION OF
DEBRIS PITS NOT TREATED BY ISV



MARALINGA REHABILITATION PROJECT PROPOSED IMPLEMENTATION SCHEDULE