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## DEFENCE SITE MARIBYRNONG

# Remediation Action Plan - Audit Areas 2 to 6

**Submitted to:**  
Department of Defence  
Defence Support Group  
Environmental Remediation Program

REPORT



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# Executive Summary

## Context for RAP

This *Remediation Action Plan* (RAP) has been written in the context of obtaining agreement on the scope and nature of the remediation of the Defence Site Maribyrnong. This RAP incorporates into a single narrative information drawn from the Framework Document, Stage 1 Gap Analysis reports, Target Audit Outcome Plan (TAOP), Remediation Options Feasibility Assessments (ROFAs) and the remedial solution design information. The RAP also considers site constraints, statutory requirements and practical functionality, and outlines a program for the implementation compatible with the project objectives.

## Introduction and Scope

The Defence Site Maribyrnong (DSM) is currently owned by the Commonwealth Department of Defence (Defence). It is located on Cordite Avenue, Maribyrnong, approximately 10km north-west of central Melbourne and encompasses an area of approximately 127 hectares.

The DSM site is surplus to Defence requirements. As such, the Commonwealth intends to remediate and dispose of the site in accordance with Commonwealth legislation and policy and where practical, meet the intent of Victorian State requirements. The site will be disposed to Places Victoria for redevelopment under a Priority Sale agreement and will include a mix of residential, open space, commercial and ancillary uses. Decommissioning, demolition and remediation of the site will be undertaken with the objective of obtaining a Certificate, or more likely a Statement, of Environmental Audit pursuant to Section 53X of the Victorian Environment Protection Act 1970. The appointed Environmental Auditor ('the Auditor') for DSM is Mr. Anthony Lane of Cardno LanePiper Pty Ltd.

The remediation of DSM represents one of the most complex remediation projects ever undertaken in Australia. The complexity is due to:

- a) the characteristics of the site such as its sensitive location adjacent to the Maribyrnong River, its heritage significance and the extent of built infrastructure;
- b) the complexity of some of the contamination risks including explosive, chemical, hazardous materials and radiological risks;
- c) the long history and multiple manufacturing uses leading to uncertainty in the history of some areas; and
- d) the size of the site and the associated number of issues to be resolved.

DSM has been divided into the six Environmental Audit Areas. This *Remediation Action Plan* (RAP) covers Audit Areas 2, 3, 4, 5 and 6 (approximately 90% of the area of DSM). It excludes Audit Area 1, which has been shown to be different (based on historical uses and contamination status) to the remainder of the DSM site and consequently is under an alternative accelerated remediation and disposal strategy.

The scope of this RAP is to provide a single narrative on the proposed remediation of the site, in order to allow sufficient works to be undertaken to meet the objective of issuance of a Certificate or Statement of Environmental Audit and consequently divestment and re-development of DSM. The RAP is also intended to act as a communication tool to relevant stakeholders. This RAP therefore:

- Considers site constraints, statutory requirements and practical functionality, and outlines a program of implementation compatible with the Project objectives;
- Addresses issues such as criteria and their application, assessment densities, validation densities and QA/QC in accordance with the Framework Document;



- Includes remediation goals developed through a risk assessment process, materials tracking and validation protocols to control the works;
- Identifies key potential impacts (including dust, water quality, noise and traffic management) and appropriate control measures;
- Establishes contingency plans to address project risks;
- Establishes validation protocols for both the remediation works and the subsequent confirmation of the achievement of the remediation objectives.

### Background

Audit Areas 2 to 6 encompasses the majority of the DSM site and covers the site of the former Explosives Factory, Maribyrnong (EFM) and Defence Science and Technology Organisation (DSTO) establishments and part of the Land Engineering Agency (LEA).

The land covered by Audit Areas 2 to 6 includes 504 current buildings, 117 blast mounds, 2 levees, 30 km of paths and roads, 5.4 km of tramways and 174 km of mapped utilities. The buildings and infrastructure in this area of DSM were used primarily for explosive manufacturing, munitions filling, precursor chemical manufacture, power generation, waste treatment and waste disposal, administration and services and research and development activities.

The majority of the site is located on generally level ground adjacent to the Maribyrnong River with the eastern part of the site rising approximately 15 m to the highpoint of Remount Hill. The site was acquired by the Commonwealth in 1908 for the manufacture of cordite and expanded significantly over the next 50 years to produce precursor explosives and munitions components.

The site is subject to a Heritage Management Plan (GML 2007) and has significant social, cultural and heritage values that need to be protected as part of the remediation.

### Soil Assessment

Extensive soil assessments have been undertaken at DSM over the last 10 years by several consultants. For Audit Areas 2 to 6, 2,344 soil assessment locations have been assessed and 7,183 soil samples analysed for a broad range of analytes.

A review of the previous soil assessment data has been undertaken and gap analysis reviews completed to assess the appropriateness of the dataset. These gap analysis reviews have been documented for each Audit Area within an *Assessment, Remediation and Validation: Stage 1 Gap Analysis* report. An outcome of this gap analysis review has identified additional assessment works which are required to meet the assessment framework outlined in the *Framework Document*. It has also ranked the proposed additional soil assessment locations to identify those locations which may potentially have a greater influence on remediation design.

The current Stage 1 soil dataset has been used to define the remedial works presented in this RAP and to formulate the likely potential land uses outlined in the Target Audit Outcome Plan (TAOP).

### Groundwater Assessment

To allow the assessment of groundwater conditions, the DSM site has been separated into 3 groundwater regions (Groundwater Areas A, B and C). The groundwater data collected to date for these three areas has been assessed and interpreted in separate *Groundwater Assessment Stage 1 Gap Analysis* reports.

Over the past 10 years, 161 monitoring wells have been sampled within Audit Areas 2 to 6. With most monitoring wells sampled on multiple occasions resulting in a total of 883 groundwater samples being collected and analysed. This groundwater monitoring data has identified the following groundwater conditions:



- **Groundwater Area A** (predominantly covering Audit Areas 1 and 2) – The groundwater data for Groundwater Area A indicates limited evidence of groundwater contamination. With the exception of nitrate and hexavalent chromium (potential off-site sources), it is considered that the protected beneficial uses of groundwater are unlikely to be precluded. It is therefore considered that a Clean Up to the Extent Practicable (CUTEP) determination is unlikely to be required for Area A.
- **Groundwater Area B** (predominantly covering Audit Areas 3 and 4) – Groundwater monitoring data has indicated four main groundwater plumes within Groundwater Area B.
  - **Plume 1** occurs in the **Northern Corner** of Groundwater Area B and mainly consists of RDX and TCE.
  - **Plume 2** occurs in the **Central Zone** of Groundwater Area B and mainly includes TCE, CTET, perchlorate, nitrate, sulphate, and to a lesser extent, chloroform and benzene.
  - **Plume 3** occurs in the **Southwest Zone** of Area B and mainly consists of TCE, CTET, nitrate, sulphate, and to a lesser extent, benzene.
  - **Plume 4** occurs along the southern boundary of Groundwater Area B and mainly includes hexavalent chromium and to a lesser extent, nitrate.

The presence of volatile contaminants such as CTET, chloroform, PCE, TCE, 1,1,2-trichloroethane, 1,1-dichloroethane, 1,2-dichloroethane and benzene in the above groundwater plumes presents a potential vapour risk to some possible future land uses in these areas of the site.

- **Groundwater Area C** (predominantly covering Audit Areas 5 and 6) – Groundwater contaminant plumes have been identified predominantly within the southern half of Groundwater Area C. These are predominantly present at low concentrations across a broad area and consist of co-mingled diffuse plumes with localised higher concentrations of metals, TNT, nitroaromatics, perchlorate, sulphate, nitrate and ammonia and localised concentrations of RDX and CTET.

Groundwater within sections of the site is therefore considered to be polluted in accordance with the SEPP (Groundwaters of Victoria). Groundwater Areas B and C are considered to be source sites for the groundwater pollution and if the beneficial uses of groundwater can't be restored, a CUTEP determination will be required by EPA prior to completion of the 53X Environmental Audit for these areas.

### Beneficial Land Uses

Defence has indicated that the project aim is to remediate DSM to achieve Certificates or Statements of Environmental Audit. There is currently no stated expectation of land use other than recognition that the proposed land use would include a mix of commercial/industrial, residential and public open space land use.

Identification of appropriate beneficial land use options is an iterative process involving consideration of the consolidated dataset for Audit Areas 2 to 6, the results of remediation and validation, heritage considerations, the potential end land uses required by Places Victoria and the potential residual risks.

Golder has prepared a preliminary Target Audit Outcome Plan (TAOP) for Audit Areas 2 to 6 by reviewing the site data against criteria considered protective of sensitive site uses to eliminate areas of the site that would appear from the existing information to be unlikely to be suitable for sensitive uses and by considering areas where the soil and groundwater contamination may restrict the ability for sensitive uses either due to potential vapour risks or due to the possible need for ongoing monitoring or management of groundwater.

Given that at the time of this RAP there is no agreed development plan in place, the preliminary TAOP identifies only the most sensitive land uses outcomes that could be feasibly and economically achieved through remediation. In developing the TAOP, three land use categories have been considered, which is consistent with the approach to the establishment of contamination criteria. These three land use categories are a) commercial/industrial, b) open space and c) residential. The TAOP does not indicate how the site will be developed but rather the most sensitive land uses that will be allowed as part of any development.



It should be noted that the TAOP will evolve as remediation proceeds and more information is obtained. If the remediation process outlined in this RAP is unable to deliver practical and economic remediation to allow issuance of a Statement of Environmental Audit for the land use proposed in the TAOP, then consideration of alternative less sensitive land use may be considered.

The TAOP land uses have formed the basis for the expected remediation volumes and types outlined in this RAP.

### Remediation Requirements

There are currently 504 buildings present within Audit Areas 2 to 6. As part of the remediation of the site outlined in this RAP, up to 80% of these buildings and features may be demolished. The exact number of buildings and features to be demolished is still to be finalised and is dependent on heritage and contamination constraints. Of the 504 current buildings, there are 38 buildings representing an 'Exceptional' or 'High' heritage significance and 224 with a 'Moderate' heritage significance (based on the Heritage Management Plan). As part of the approach to manage the heritage legacy of the site it is currently proposed to retain all of the 'Exceptional' and 'High' heritage significance buildings (assuming that they are safe to be retained and meet the objectives of the Environmental Audit) and greater than 30% of the 'Moderate' ranked buildings. The selection of the 'Moderate' buildings will in part be based on an assessment of contamination levels and location, further heritage considerations, building condition, structural stability, adaptation opportunities and future requirements for the building within the development.

In addition to the heritage listed buildings, there are also heritage listed features such as transport features (e.g. sections of metal tram tracks and the Drying House Tram Platform) and blast mounds and features associated with heritage listed buildings.

The delivery of the remedial works outlined in this RAP will need to be cognisant of not only the above building and feature heritage issues but will also need to consider broader cultural heritage and flora and fauna values of the site.

The proposed remedial works outlined in this RAP also cover the removal of sections of the utility and transport infrastructure. The utilities highlighted for removal due to likely contamination issues include predominantly the sewer, effluent, drainage network and parts of the water reticulation system. The removal of this infrastructure will necessitate the requirement to re-grade the site and design and construct a temporary stormwater management system. This temporary stormwater management system will not only operate during the site remediation but also post remediation until a long term drainage system for the site can be installed as part of the development. The amount of road infrastructure to be removed will consider contamination issues, short term environmental management requirements and long term access considerations.

There are currently 117 blast mounds and 2 levees present at the site. Some of these mounds require remediation but the remainder, where not required to be retained for heritage purposes, will be considered as an on-site borrow source for backfill material.

Based on the soil assessment data and a consideration of aesthetics, there are currently 308 identified soil remediation excavations nominated within this RAP (lowest estimated remedial scope), with the expectation that further excavation will be nominated based on validation data.

### Assessment of Soil Remediation Volumes

Based on the soil assessment data presented in the *Assessment, Remediation and Validation: Stage 1 Gap Analysis* reports, 308 remediation excavations have been initially nominated. These remediation excavations have an excavation volume of approximately 96,000 m<sup>3</sup>. The majority of the contaminated material associated with these remediation excavations (approximately 80%) is driven by metal, asbestos and comingled PAH contamination, generally classified as Class 3 and Class 4 material.

In addition to the contaminated material generated from the nominated remediation excavations, further contaminated and non-contaminated material will be generated from excavations associated with services, transport features, material under demolished building and non-building features as well as some of the





materials generated from building demolition. The volumes of materials generated from these types of excavations is approximately 255,000m<sup>3</sup>, of which 90% is estimated to be suitable for on-site re-use as backfill (either pre or post treatment).

In addition to soil remediation excavations, additional contaminated and non-contaminated wastes streams will be generated as part of the demolition process.

### Remediation Options Feasibility Assessment - Soils

The majority of the soil contamination currently identified at the site is related to metal and asbestos contamination, with lesser volumes of material contaminated with PAH, explosives, hydrocarbons and solvents. The waste types requiring remediation include Category A, B and C Prescribed Industrial Waste as contaminated soils, asbestos waste and various building materials and general demolition waste.

Based on the remediation options assessment outlined in the Soil ROFA a number of remediation options have been nominated. The primary remediation option for the majority of the contaminated material generated as part of the remediation is onsite disposal within an Engineered Facility. This option of an Engineered Facility enables a tailored design for the site specific contamination, providing a long-term sustainable solution and is cost effective.

Based on the volume models, the potential volume of waste that could be placed in an Engineered Facility is currently expected to be between 160,000 m<sup>3</sup> and 360,000 m<sup>3</sup>. A conceptual design for the Engineered Facility has been documented in the *Design Report – Engineered Facility* (Golder 2013gg). This conceptual design includes a preliminary concept location within the northern peninsula section of the DSM site (Audit Area 6). The conceptual design also outlines the likely minimum design standards for the Engineered Facility (*Best Practice Guidelines for Landfills Accepting Category C Prescribed Industrial Waste* for landfills accepting immobilised (treated) Category C waste). These guidelines stipulate that landfills accepting Category C immobilised waste must include at least primary (upper) and secondary (lower) composite liners, and primary and secondary leachate detection and collection systems.

Secondary remediation technologies will also be required to treat specific contamination issues related to explosives, non-explosive organic compounds (PAH, TCE, OCP), leachable metals and waste materials (asbestos, nitrocellulose and solid waste). These contaminated materials have various treatment or disposal options currently available to them within the remediation market. Therefore the selection of the treatment option(s) will be defined during the tendering process to ascertain the most effective treatment / disposal option(s) currently available for the project.

The Soil ROFA also considers the use of additional remedial options as part of the overall approach, these included the separation of wastes (e.g. collection of surface asbestos, mechanical separation of waste types etc.) and optimisation of material re-use in less sensitive areas and the recycling of materials such as concrete.

### Remediation Options Feasibility Assessment – Groundwater

As part of the preparation of this RAP, Groundwater Remediation Option Feasibility Assessments (Groundwater ROFAs) have been prepared for Groundwater Areas B and C. These Groundwater ROFAs assessed the most effective remedial approaches to mitigate the groundwater issues present at the site. The outcome of these Groundwater ROFAs is outlined below.

#### Groundwater Area B

Based on the Groundwater ROFA for Area B (western section of the DSM site covering predominantly Audit Areas 3 and 4) the evaluation of the benefit of groundwater remediation to mitigate vapour intrusion risk and/or risk to primary contact recreation and ecosystem in the Maribyrnong River resulted in the following outcomes:

- In the **Central Zone (Plume 2)**, the higher level of risk and the considered practicability for enhanced bioremediation triggers the requirement for an assessment of the factors that could improve the site-specific understanding of the practicability of this technology. These further works need to consider the



relatively long clean-up time (possibly in the order of 5 to 10 years as a minimum) and therefore evaluate the factors which influence the clean-up time (such as biodegradation kinetics, groundwater flow velocities, source strength). These further works also need to assess the practicability of the remediation technique from a vapour intrusion risk perspective.

Whilst ranked as less practicable in comparison to enhanced bioremediation, in-situ chemical oxidation/reduction may provide an alternative remediation approach for the Central Zone. This is predominantly due to the shorter clean-up time typically associated with this technology. This technology also requires further understanding of the site specific factors that will influence clean-up time.

- In the other impacted groundwater zones (**Plumes 1, 3 and 4**) the Groundwater ROFA indicates that further works are unlikely to result in a substantial change in the practicability scores and the relatively low levels of risk identified. Therefore it is considered that the implementation of remediation to mitigate the risks to beneficial uses of groundwater would be of limited benefit in comparison to implementation of ongoing management measures. Management measures should be implemented through conditions on Statements of Environmental Audit and if required via a Site Contamination Management Plan or Groundwater Quality Management Plan. These management measures may include:
  - Management of the potential vapour intrusion risk through planning of the development, subject to outcomes of further site specific risk evaluation.
  - Control of the extractive use of groundwater.
  - Monitoring of groundwater (if required) with establishment of action criteria at key locations to confirm that the risks posed stay within acceptable limits. The nature and extent of such a monitoring program is dependent of the final assessment of groundwater conditions and the significance of the risk posed to a receptor.

### Groundwater Area C

The outcome of the Groundwater ROFA for Area C (northern section of the DSM site covering predominantly Audit Areas 5 and 6) identified that ongoing management measures should be developed to manage the groundwater pollution as a more practical alternative to active remediation. These management measures should be implemented through conditions on Statements of Environmental Audit and would be similar to those outlined above for Groundwater Area B.

### Remediation Framework and Project Risks

This RAP has outlined a framework for the procurement, management and validation of the proposed remediation works. It has also analysed the potential project risks and proposed management measures applicable to those identified project risks.

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