

GROUNDWATER CLEANUP PLAN

EXECUTIVE SUMMARY

The NSW Environmental Protection Agency (EPA) issued Notice of Cleanup Action Notice No 1030236 on Orica on 26 September 2003. In accordance with condition 3B of the notice, Orica has completed a Groundwater Cleanup Plan (GCP) for submission to the Contaminated Sites Section of the EPA for its consideration and approval.

In preparing this GCP, it has become even more apparent that the NCUA has set very challenging requirements and time targets for completion of various aspects of remediation activity. Orica's response in this GCP has addressed all issues as completely as practicable in the time available. The response to the NCUA is necessarily complex as there are multiple options that need to be considered, and in many cases parallel implementation of options will be implemented pending key decisions.

A fundamental challenge in responding to the GCP is the management of parallel requirements to progress the bioremediation field trials to conclusion (a requirement under the existing Voluntary Investigation and Remediation Agreement [VRA]) whilst meeting the timing constraints of the NCUA and the requirement for use of hydraulic containment and *ex situ* treatment.

The project schedules that is presented is considered indicative only, given the available time and level of definition of the large number of project modules within the GCP

Considering the major elements of the NCUA in turn, the following discussion summarises the content of the GCP. This should however be considered in the context of the more detailed discussion in the body of the GCP.

1. Primary Containment Area (Block 2, Orica Southlands)**Requirement**

The NCUA requires:

- earliest establishment of hydraulic containment in this area (commencement and completion of works within 14 and 90 days respectively of all necessary approvals)
- maximum reduction of concentrations in this area (target 80% by 31 October 2005), including the use of *ex situ* treatment.

Plan

Orica has examined the options for short term and long term hydraulic containment and treatment. In summary:

- Orica proposes to conduct a trial of groundwater extraction and off-site disposal. The earliest this can occur will be approximately February 2004, using temporary equipment. Should trials be successful and a practicable cost negotiated, Orica will then construct a storage and tanker loading facility on Southlands for this as an ongoing measure. The capacity for this route is yet to be determined, but

GROUNDWATER CLEANUP PLAN

indicatively is of the order of 0.1 ML/d of groundwater, which is approximately 10% of the total hydraulic containment volume (but would target the highest concentration material). With approvals, permanent facilities are expected to be available in July 2004.

- Orica proposes an immediate feasibility study for the recommissioning of the former Vinyls Plant effluent stripping equipment. This will include the investigation of additional emission control equipment. If feasible, this option will allow the processing of approximately 0.3 ML/d of groundwater, with recovery of liquid phase chlorinated hydrocarbons for off site disposal. This requires a storage and tanker loading facility at Southlands (as above), and refurbishment of the former EDC storage tanks at the former Vinyls Plant for feed and (waste) product storage on Botany Industrial Park.

The preliminary schedule assessment is for this system to be operational in October 2004.

- The groundwater extraction requirement for hydraulic capture in the primary containment area is estimated as between 1 and 1.3 ML/d. The additional extraction to maximise reduction of contamination in the primary containment area is limited to approximately 1 ML/d to control adverse impacts on the regional aquifer (drawdown and subsidence risk).

Management of risk of subsidence is a major issue in the implementation of extensive hydraulic containment works.

- The preliminary schedule indicates that an *ex situ* treatment plant for treating this extracted groundwater will not be operational until August 2005. This is largely driven by the approvals and long delivery equipment durations.
- No options considered can achieve the NCUA requirement for operation within 90 days of all necessary approvals.
- The late date for commencement of full hydraulic containment and *ex situ* treatment significantly impacts Orica's ability to meet the 80% reduction target for contamination levels in the primary containment area.
- Bioremediation, if field trials of the active system (currently under construction) are proven successful, can be uprated to full scale contaminant containment in the primary containment area in a far shorter timeframe than indicated by *ex situ* treatment.
- Bioremediation field trials will be adversely affected by high rate groundwater extraction (i.e., full hydraulic containment) to the point where they may become of limited experimental validity.
- The effect of the late start-up of the *ex situ* treatment plant is to place reliance on effective secondary containment operation for a longer period.

GROUNDWATER CLEANUP PLAN

2. Secondary Containment Area (Foreshore Road/Botany Golf Course)

Requirement

The NCUA requires establishment of a secondary containment area for contamination that has migrated, or may migrate, from the primary containment area by 31 October 2004.

Plan

Orica has examined options for achievement of this and propose parallel implementation of bioremediation and hydraulic containment/*ex situ* treatment projects. The decision on the success or failure of bioremediation for more widespread application is critical to management of these projects.

Orica proposes:

- A passive bioremediation barrier along Foreshore Road. The preliminary schedule indicates that this can be in place in late October 2004, based on EPA approval of bioremediation field trials success.
- An active bioremediation barrier on Botany Golf Course. The preliminary schedule indicates that this can be in place in mid November 2004, based on EPA approval of bioremediation field trials success.
- If bioremediation trials are unsuccessful, secondary containment would be achieved in the short term by use of the effluent strippers at the former Vinyls Plant (if feasible), and in the long term by *ex situ* treatment plant (assumed at Botany Industrial Park). These options will be progressed in parallel with bioremediation.
- As for the primary containment area, the *ex situ* treatment plant is not expected to be operational until approximately August 2005. This is significantly later than the NCUA target and means that some high concentration material will have passed the secondary containment area. Contingency planning for this eventuality requires discussion between Orica and EPA.

If the *ex situ* treatment plant can be constructed significantly more quickly, the ability to start hydraulic containment may be limited by construction of the transfer pipeline to Botany Industrial Park. This is driven by issues of easement creation and the construction duration.

3. Dense Non-Aqueous Phase Liquid (DNAPL) Identification, Containment and Removal

As Orica has previously advised, it does not understand the aggressive stance taken in the NCUA on investigation and removal of DNAPL, rather than focusing on DNAPL source containment. The insistence on this being achieved within a relatively short timeframe is also not fully understood and inconsistent with the state

GROUNDWATER CLEANUP PLAN

of technology in this field. Assuming contaminant containment is complete, the human health and ecological risks should be controlled. Requirements for source removal should then recognise the considerable technical difficulties involved in locating and removing sources.

3.1 DNAPL Identification

Requirement

The NCUA requires Orica to identify all source areas on Orica and Orica Southlands property to the extent practicable by 31 May 2004.

Plan

Orica has presented a detailed summary of past DNAPL investigations, and the options, issues and risks associated with this activity.

Orica remains extremely cautious about the intrusive investigation of DNAPL source areas, most notably since we consider that the mobilisation of the Central EDC Plume resulted from such activity.

Hence a staged approach to each inferred source area is proposed, and detailed proposals are presented for initial investigations of each area. The extent of secondary investigations will depend on the results of these initial investigations.

The extent of work will be constrained by management of risks and the available time under the NCUA.

3.2 DNAPL Containment

Requirement

The NCUA requires containment of identified DNAPL source areas by 30 November 2004. Orica has interpreted this as all major source areas, irrespective of the identification of DNAPL, as this is understood to be the intent of the notice.

Plan

In all cases there are several options for contaminant containment, including bioremediation barriers, permeable reactive barriers (primarily reactive iron barriers) and hydraulic containment and *ex situ* treatment. Wherever practicable, Orica propose to implement *in situ* technologies to achieve the objectives of the NCUA. Again, the success or otherwise of the bioremediation field trials is critical to determination of the way forward.

The options for each major source area are summarised below.

GROUNDWATER CLEANUP PLAN

Inferred Source Area	Proposed Containment Technology	Comments
Former EDC Storage Tanks/Vinyls Plant	Bioremediation Or Hydraulic containment and <i>ex situ</i> treatment	Parallel implementation until bioremediation field trials verdict obtained. Concentrations of EDC at source area are decreasing so passive bioremediation now possible. Concentrations from Vinyls Plant site yet to be fully established. Barriers may be required immediately downgradient of source zone(s), but also may need another containment line to control ingress of shallow groundwater from Central EDC Plume into Springvale Drain. Need for additional containment driven by surface water monitoring against ANZECC (2000) guidelines and any consequent toxicity testing.
Former Solvents Plant/Former TCE Plant/ Effluent Overflow Area (including Block 1 of Southlands)	Reactive Iron Barrier Or Reactive Iron Barrier and downgradient bioremediation barrier	Strong source zones in this area. Reactive iron barrier (RIB) proposed after completion of current work programme (dissolved metals, alternate alignments, depths and emplacement technology evaluation). Completion in March/April 2004 will make completion by 30 November 2004 problematic, if not impossible. Propose to install only RIB and evaluate performance, if necessary install downgradient bioremediation barrier to remove EDC and other CHCs. Allow space between RIB and Nant St for installation of bio barrier such that doesn't influence Springvale Drain.
Former CTC/PCE Storage Tanks (Alkatuff Plant)	Reactive iron barrier and/or Bioremediation barrier; Or Hydraulic containment and <i>ex situ</i> treatment	Parallel implementation until bioremediation field trials verdict obtained. CTC and CFM are potentially inhibitory to bioremediation, so may need a short reactive iron barrier upgradient of bioremediation barrier. Will

GROUNDWATER CLEANUP PLAN

Inferred Source Area	Proposed Containment Technology	Comments
HCB Drum Store/HCB Re-Drumming Pad	Bioremediation Or Hydraulic containment and <i>ex situ</i> treatment	require microcosm studies to establish need for RIB. Parallel implementation until bioremediation field trials verdict obtained.
Former Open Area Drum Store/Anderson Street Car Park and Presses Lane	Bioremediation or Hydraulic containment and <i>ex situ</i> treatment	Parallel implementation until bioremediation field trials verdict obtained.

The preliminary schedule indicates the following containment project delivery:

- Bioremediation barriers can be operational in October 2004, assuming EPA approval of the success of bioremediation field trials
- Reactive iron barrier installation for Block 1 and CTC/PCE storage area (if required) can be operational in April and February 2005 respectively. Detailed engineering implementation of these projects will hopefully lead to delivery of earlier completion for these projects.
- *Ex situ* treatment timing is as detailed previously for the primary and secondary containment areas.

3.3 DNAPL Removal

Requirement

The NCUA requires DNAPL removal from identified source areas to the extent practicable by 31 October 2005.

Plan

Orica has detailed the range of technology options available. Further work is required to determine which options will be considered in detail. To some degree this is dependent on the results of DNAPL identification activity.

The extent to which Orica can meet the NCUA objective in this area cannot yet be determined.

4 Monitoring

Requirement

The NCUA requires implementation of a comprehensive monitoring program within the defined area (the Groundwater Protection Zone 1 as defined by DIPNR in August 2003) to:

GROUNDWATER CLEANUP PLAN

- monitor changes in concentrations of the substances in the contaminant plumes; and
 - monitor changes in the spatial distribution of the contaminant plumes in the subsurface; and
 - gauge groundwater levels to assess effectiveness of hydraulic containment; and
 - monitor contaminant concentrations in groundwater and surface water discharges to Botany Bay and Penrhyn Estuary for comparison against the *Australian and New Zealand Guidelines for Marine and Fresh Water (2000)* trigger values for protection for slightly to moderately disturbed ecosystems,
- with reporting to EPA at least every 90 days.

Plan

A detailed monitoring programme has been proposed which Orica believes delivers these objectives. Additional monitoring locations are proposed. The requirement for additional investigation for data acquisition for remedial action design will create more potential monitoring locations.

Issues with the interpretation of, and the measurement protocols for assessing conditions against, the ANZECC (2000) guidelines have been presented. An early baseline study of the condition of Penrhyn Estuary against these guidelines is proposed that may result in additional remediation modules.

The monitoring and reporting schedule for 2004 is shown on the preliminary schedule. For simplicity, a quarterly, rather than 90 day, reporting cycle has been assumed.