

THE CLEAN UP AND MANAGEMENT OF POLLUTED GROUNDWATER

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This Information Bulletin provides details on EPA's requirements and expectations for developing and implementing the clean up and management of polluted groundwater to ensure the protection of human health and the environment.

1 PROTECTION OF GROUNDWATER QUALITY IN VICTORIA

Groundwater is an important and often overlooked part of the environment. Groundwater discharges to surface water, supporting ecosystems (for example, rivers and wetlands) and is utilised for a range of beneficial uses including drinking, irrigation, stock and industrial uses.

The focus of groundwater quality protection is on the prevention of groundwater pollution, however, where groundwater has become polluted it must be cleaned up and managed to ensure the on-going protection of human health and the environment.

Where polluted groundwater has been identified, EPA Victoria's (EPA) role is to require clean up. If it is impracticable to clean up groundwater to the level needed to restore beneficial uses, EPA may accept that clean up to the extent practicable has occurred and that, subject to appropriate ongoing management, further clean up is not required. Polluted groundwater can be identified by investigations prompted either by application of

EPA's statutory tools (for example notices) and programs (for example environmental audits) or by investigations that do not directly involve EPA, such as corporate risk management programs and land sale agreements. Where polluted groundwater is identified but clean up has not been required by statutory means or by EPA programs, it is recommended that EPA be consulted regarding clean up/management strategy.

Any plan for clean-up and/or management of polluted groundwater should specifically address Sections 3 to 8 of this Information Bulletin. A generic procedure for the clean up and management of polluted groundwater is presented as Appendix 1. This Information Bulletin is primarily directed towards circumstances where investigations have found pollution to exist.

1.1 The State Environment Protection Policy (SEPP) (Groundwaters of Victoria) 1997

The *State environment protection policy (SEPP) (Groundwaters of Victoria) 1997* sets out a framework for the protection of groundwater quality in Victoria.

The *Groundwater SEPP* identifies the:

- segments of the groundwater environment according to total dissolved solids (TDS) (approximates the salinity of the groundwater);

- beneficial uses to be protected in each segment of the groundwater environment (for example, potable water supply, agriculture, parks and gardens, and maintenance of ecosystems); and
- groundwater quality objectives by which to measure the protection of these beneficial uses.

The *Groundwater SEPP* requires the protection of *existing* and *potential* beneficial uses of groundwater from pollution. Unless stated otherwise in this bulletin, the term ‘beneficial uses’ refers to both existing and potential uses.

A beneficial use may be considered ‘existing’ where there is a receptor (bore, spring, creek) in the vicinity of the site.

‘Potential’ beneficial uses are those that could be supported by the background groundwater quality. Some potential beneficial uses are more likely to be realised than others. A potential beneficial use of groundwater is considered ‘likely’ in circumstances including, but not limited to, where:

- groundwater is used in the same hydrogeological setting nearby or elsewhere in Victoria; and
- the existing and likely future land uses both at the site and in the vicinity of the site are compatible with the beneficial use.

Contamination is defined in the *Groundwater SEPP* as a change in water quality that produces a noticeable or measurable change in groundwater characteristics. Clause 10(3) of the *Groundwater SEPP* states that groundwater quality is to be maintained as close as practicable to background levels (that is, minimise change to groundwater quality).

Pollution of groundwater includes situations where groundwater quality is changed such that the groundwater is no longer suitable for a beneficial use. Such situations are defined as occurring where groundwater quality objectives for any protected beneficial use (referred to in Table 3 of the *Groundwater SEPP*) are exceeded or where there is otherwise a detriment to a beneficial use (for example, irrigation water becomes odorous to such an extent that it is no longer used).

The groundwater quality objectives for most beneficial uses of groundwater apply at any point in the aquifer from which groundwater could be abstracted for use via a bore. For the beneficial use ‘maintenance of ecosystems’, however, the objectives apply at the point of discharge to surface water (that is, prior to dilution and mixing with the surface water). Where contaminated groundwater present at a site could discharge to surface water, the quality of the discharging groundwater should not exceed the *Groundwater SEPP* objectives for ‘maintenance of ecosystems’.

Where groundwater has been polluted:

- Groundwater should be cleaned up such that the protection of beneficial uses (existing and potential) is restored. In some cases this will not be possible or feasible, however, in all cases polluted groundwater must be cleaned up to the extent practicable (as described in section 6.2)
- Clean up and management must address the full extent of groundwater pollution both on-site and off-site

- On-going management must continue until the protection of beneficial uses is restored (that is, the groundwater is no longer polluted).

2 THE ROLE OF EPA IN CLEAN UP AND MANAGEMENT OF POLLUTED GROUNDWATER

EPA implements the *Groundwater SEPP* through its statutory tools (such as, works approvals, licences and notices) as well as programs such as Environmental Auditing and through the provision of information to industry and the broader community.

Where EPA becomes aware of groundwater pollution, it may require clean up and/or management of polluted groundwater (consistent with this Information Bulletin) by notice under sections 31A/B and 62A of the *Environment Protection Act 1970*. Such notices are issued in accordance with EPA's Enforcement Policy (EPA Pub 384) after considering the degree and extent of pollution and likelihood of detriment posed to beneficial uses.

Where polluted groundwater is identified through a statutory environmental audit, EPA may use its statutory tools to give effect to the conditions of any Statement of Environmental Audit related to groundwater pollution, or to otherwise require clean-up.

Responsible parties are encouraged to inform EPA of groundwater pollution at the earliest opportunity to enable consistency and certainty in the outcome for the responsible party. Responsible parties, typically the polluter and/or occupier, are those responsible for the clean up and management of polluted

groundwater consistent with the abatement and clean up provisions of the *Environment Protection Act 1970*. If sought, EPA will provide advice on:

- whether source removal or groundwater clean-up has occurred to the extent practicable (see sections 4.1 and 6.2);
- risk assessment methodology used to derive groundwater quality objectives where there is no stated objective or where *Groundwater SEPP* objectives may be inappropriate (see section 5);
- clean up objectives (where they are above *Groundwater SEPP* objectives) (see section 6);
- the preparation and implementation of any plan to manage polluted groundwater (including agreeing to monitoring requirements, trigger levels, contingency plans, controls on groundwater use and periodic review of practicability of clean up) (see section 7); and
- when to cease clean up and management of polluted groundwater (that is, when beneficial uses are protected, see section 7.6).

Regardless of whether EPA is directly involved in clean up and management of polluted groundwater at or from a site, only EPA can determine:

- the segment to which groundwater in any aquifer belongs (clause 8, *SEPP - Groundwaters of Victoria*) and therefore the beneficial uses to be protected;
- whether a beneficial use specified in Table 2 of the policy does not apply (for example, where insufficient aquifer yield to sustain a beneficial use or background quality is detrimental to a beneficial use, or where a use is impracticable

due to one or more soil characteristics) (clause 9(2), *SEPP - Groundwaters of Victoria*);

- whether there is no unacceptable risk to any beneficial use of groundwater posed by a non-aqueous phase liquid (NAPL) present in an aquifer (clause 18, *SEPP - Groundwaters of Victoria*);
- whether groundwater has been cleaned up to the extent practicable (clause 19, *SEPP Groundwaters of Victoria*); and
- whether *Groundwater SEPP* objectives will be met at the completion of the project and no detriment to beneficial uses beyond the premises will occur for groundwater remediation projects involving the injection of uncontaminated water or the reinjection of treated water into the aquifer (clause 20, *SEPP - Groundwaters of Victoria*).

In order to gain a determination from EPA on these matters, the responsible party should:

- 1) Write to EPA providing relevant information, a scientifically reasoned opinion and seeking advice;
- 2) Await advice from EPA; and
- 3) Complete clean up/management in accordance with EPA advice or direction.

EPA can also advise on other regulatory requirements related to the clean up and management of polluted groundwater (see section 8).

Where polluted groundwater is identified and remains in place after clean up to the extent practicable has occurred, it is EPA's role to inform

relevant rural water authorities and make information available to the community in accordance with section 9 of this bulletin.

3 CHARACTERISATION OF THE GROUNDWATER AND AQUIFER(S)

Prior to any clean up and management (of polluted groundwater), groundwater and aquifer characterisation should be undertaken to assess the nature, extent and degree of pollution. It may also provide information about the groundwater and the aquifer that is useful in assessing the risk posed by the pollution and in design of clean-up activities. Note that where an imminent hazard is identified, some immediate clean up action will be necessary prior to the completion of groundwater and aquifer characterisation.

Groundwater and aquifer characterisation involves collecting data to define:

- site geology and hydrogeology (for example: aquifer type and configuration; porosity type; identification of preferential pathways; and groundwater flow direction and velocity, including spatial and temporal variability of these parameters);
- the extent of the plume and the nature and spatial and temporal distribution of contaminants within the plume and surrounding media (for example: type and concentration ranges of the contaminant(s); contaminant phase distribution including non-aqueous phase distribution and partitioning between groundwater, aquifer material and

gas; contaminant transformation processes including transformation rate estimates; and sorption capacity); and

- the current and potential impact of contaminants on beneficial uses of the groundwater (for example, background groundwater TDS, other relevant groundwater quality indicators and aquifer yield data). This assists in determining the beneficial uses that apply to the groundwater and the potential for the plume configuration to change over time (for example, pumping from a nearby bore, and tidal or seasonal influences).

When combined with a thorough investigation of available clean up technologies (section 6.1), such characterisation assists in identifying practicable clean up options.

For detailed guidance on groundwater sampling, refer to EPA publication:

- Groundwater Sampling Guidelines (Publication 669).

4 SOURCE REMOVAL AND CONTROL

Possible sources of groundwater pollution include: unsealed storage or production areas; leaking product pipelines; historical waste disposal activities (for example pouring liquid waste into quarries/trenches); leaking underground petroleum storage systems; contaminated aquifer material (for example, soil or rock); and non-aqueous phase liquid (NAPL – for example petroleum products).

4.1 Source Removal

The removal or control of the source is a necessary first step in the clean up or management of polluted groundwater. Early actions taken to locate and remove or control the source may greatly reduce the extent of pollution and the risk posed to existing beneficial uses (and cost of clean up). It may not be possible to meet clean up or management objectives if there is a continuous supply of contaminants to the groundwater.

The presence of NAPL in contact with (for example floating on) groundwater is in itself pollution of groundwater. NAPL is also a source of further groundwater pollution by the dissolution of water soluble components of the NAPL into the groundwater.

The *Groundwater SEPP* requires that:

‘Where non-aqueous phase liquid is present in an aquifer, it must be removed unless the Authority [EPA Victoria] is satisfied that there is no unacceptable risk posed to any beneficial use by the non-aqueous phase liquid.’

In most cases, where NAPL is present in an aquifer it must be removed.

Examples of current source removal techniques include pump and treat, excavation and removal, flushing (*in situ*), soil vapour extraction and dual-phase extraction. References such as the USEPA publication ‘Treatment Technologies for Site Clean up: Annual Status Report’ provide a guide to available source removal/control technologies.

In some cases it may be impracticable to remove the source of groundwater pollution (for example, dense NAPL within complex subsurface geology). Section

6.2 discusses the factors considered by EPA in determining the practicability of groundwater clean-up. These apply equally to assessing 'practicability' of source removal. Any assessment that source removal is impracticable should be clearly documented to assist in discussion with EPA, referencing each of the factors set out in Section 6.2.

4.2 Source Control

Where complete source removal is impracticable, the source must be removed to the extent that is practicable and treatment/control measures must be implemented as follows.

- The source must be contained and/or treated, so that migration of polluted groundwater is minimised (on-site in most circumstances). Examples of containment technologies include the installation of a physical barrier system (such as capping or a slurry wall) or hydraulic containment.
- Source control must operate for the entire duration that the source is present. If the pollutant source degrades over time, the source control may cease only when the source no longer causes detriment to a protected beneficial use. If the pollutant source does not degrade, the source control must operate indefinitely, or until such time that technology is available to remove the source
- Any source control measure must be supported by groundwater quality monitoring that demonstrates that it protects the beneficial uses of the groundwater remote from the source (for example, at the site boundary).

Any source control measures proposed to be implemented should be clearly documented to assist in discussion with EPA.

5 THE ROLE OF RISK ASSESSMENT IN CLEAN UP AND MANAGEMENT OF POLLUTED GROUNDWATER

Whenever groundwater quality is changed such that it exceeds the relevant groundwater quality objectives, it is polluted and must be cleaned up. A site specific risk assessment, using a method acceptable to EPA, may play an important role in the clean up and management of polluted groundwater, as the nature and timing of the clean-up activities may be influenced by the risk posed by that pollution. Risk assessment is appropriate in the following circumstances:

- to determine the degree of existing exposure and therefore influence the practicability and the urgency of clean up activities (see section 6.2);
- where EPA advises that risk assessment derived groundwater quality objectives are appropriate (for example, where groundwater quality objectives for organic toxicants for the beneficial use 'stock watering' default to criteria derived for drinking water to protect human health); and
- to derive clean up objectives where clean up to restore beneficial uses is demonstrated to be impracticable.

Where risk assessment derived objectives are intended to be used, the methodology and key

assumptions should be clearly documented to assist in discussion with EPA.

6 CLEAN UP OF POLLUTED GROUNDWATER

The goal for any clean up of polluted groundwater is to restore the protection of beneficial uses of the groundwater both on-site and off-site. Restoration of the beneficial uses of groundwater is achieved when the groundwater quality objectives of the *Groundwater SEPP* are met. (See section 5 of this bulletin if contaminants are present for which there are no groundwater quality objectives in the *Groundwater SEPP*.)

Where clean up to meet *Groundwater SEPP* objectives is not practicable (section 6.2), alternate clean up objectives should be derived (that reflect clean up to the extent practicable) considering the extent and degree of pollution, likelihood of detriment to beneficial uses and the efficiency of the selected clean up technology. Clean up objectives for 'maintenance of ecosystems' should be derived for a site such that *Groundwater SEPP* objectives are met at the point of discharge to a surface water body (see section 1.1).

6.1 Selection of Groundwater Clean Up Technologies

Clean up technologies should be assessed for their ability to meet clean up objectives, resulting in the most effective and practicable technology(s) being selected.

Effective clean up technologies are identified following:

- the collection and analysis of groundwater and aquifer characterisation data (see section 2); and
- extensive review of groundwater clean up technologies.

Examples of groundwater clean up technologies include pump and treat systems, air sparging, air stripping with activated carbon adsorption and permeable reactive walls. Some suggested further reading on groundwater clean up technologies is included in section 10.

Some groundwater clean up technologies will involve discharge to surface water, land and/or air. These must not pollute the receiving environment and the regulatory requirements related to such discharges are discussed in section 8.

6.2 The Practicability of Clean Up of Polluted Groundwater

Polluted groundwater should be cleaned up such that the protection of beneficial uses is restored. Where acceptable to EPA, groundwater may be cleaned up to the extent practicable. EPA's role is to determine the practicability of clean up and any on-going management measures necessary if it is impracticable to clean up groundwater to restore beneficial uses. Where it is thought that it is impracticable to clean up polluted groundwater to restore beneficial uses, EPA should be consulted.

In determining the practicability of clean up of polluted groundwater, EPA will take into account technical, logistical, and financial considerations.

- **Technical** considerations include the physical ability to remove the pollution within a reasonable timeframe. For example the chemical and physical properties of the pollutant(s), the groundwater and aquifer characteristics and the availability of technology(s) capable of effectively removing the pollution from the aquifer
- **Logistical** considerations include access to the site, availability of materials and infrastructure and the disposal of wastes
- **Financial** considerations include the cost of clean up, including equipment, installation, maintenance and waste treatment.

The clean up measures adopted shall be cost-effective and commensurate with the significance of the environmental issues being addressed (including but not limited to consideration of the likelihood of beneficial uses being realised). These considerations will be made with due consideration of approaches adopted for other sites.

Clean up of groundwater to restore the protection of beneficial uses should occur within a *reasonable timeframe*. The following considerations assist in defining 'reasonable timeframe':

- the adequacy of interim measures to protect existing and likely beneficial uses of groundwater until the protection of beneficial uses is restored (for example, reliability of groundwater use controls during the clean up process);

- whether clean up will be achieved before pollution migrates off-site, and/or affects existing beneficial uses; and
- community views on the timing and extent of clean up (particularly if the plume is off-site).

Shorter timeframes to clean up pollution are warranted where there is greater likelihood of detriment to existing and likely beneficial uses of groundwater. A strong preference is afforded to options that result in clean up in a shorter period of time. This reduces the risk of harm arising from use of the groundwater. The most effective and timely groundwater clean up may be provided by a combination of individual technologies.

If it is thought that clean up to meet groundwater quality objectives (*Groundwater SEPP*) is impracticable:

- the evaluation of practicability should be clearly documented against each of the criteria set out in the previous text box and Appendix 2 for consideration by EPA;
- clean up to the extent that is practicable is still necessary to minimise the impact on beneficial uses;
- groundwater pollution and the use of groundwater should be managed (in accordance with section 7) so there are no detrimental effects on existing, or potential, beneficial uses of the groundwater; and
- the practicability of groundwater clean up should be periodically reassessed.

The process for gaining a determination from EPA on 'clean up to the extent practicable' is provided in Section 2 of this bulletin. A list of information to be

included in such a submission to EPA is included in Appendix 2.

7 MANAGING POLLUTED GROUNDWATER

When clean up to protect beneficial uses is not practicable (or where clean up has not yet occurred or is currently occurring), polluted groundwater should be managed to ensure the protection of human health and the environment. Management of polluted groundwater includes the following key components:

- clean up objectives (that reflect clean up to the extent practicable) (see section 6);
- groundwater monitoring;
- trigger levels;
- a contingency plan;
- controls on the use of polluted groundwater, including the provision of information to ensure that affected landholders or subsequent landholders are aware of the polluted groundwater and the beneficial uses that are precluded; and
- periodic review of the practicability of groundwater clean up (to meet the *Groundwater SEPP* objectives) where this has previously been determined to be impracticable.

The preparation and implementation of any plan to manage polluted groundwater should incorporate these key components. EPA should be consulted in the preparation of such a plan.

7.1 Groundwater Monitoring

Clean up and/or management of polluted groundwater must be accompanied by a groundwater monitoring program. This should specify such details as the location and frequency of sampling, as well as measurements (that is, groundwater elevation and analyses) necessary to evaluate whether clean up/management is performing as required. The groundwater monitoring program should provide for:

- monitoring of the groundwater elevation in each bore, enabling the determination of groundwater flow direction and rate that may indicate changes in any risks posed;
- monitoring of the spatial and temporal variation in pollutant distribution, including detecting any unexpected expansion in the plume;
- verification of the effectiveness of groundwater clean up and management and detect changes in environmental conditions (for example, hydrogeological, geochemical and microbiological) that may reduce the effectiveness of the clean up technology;
- verification of the attainment of clean up objectives (that is, protection of beneficial uses or objectives that reflect clean up to the extent practicable);
- confirmation that beneficial uses of groundwater are protected outside the plume;
- detection of new releases of contaminants to the environment that could impact on the effectiveness of the clean up/management; and

- identification of any potentially toxic and/or mobile transformation products from the clean up process

The frequency of groundwater monitoring must be determined on a site-specific basis and include consideration of the:

- extent of pollution;
- contaminant type and properties;
- local and regional hydrogeology (for example, flow direction and rate);
- presence of existing beneficial uses of groundwater in the vicinity of the plume; and
- quality of existing groundwater elevation and quality data.

The frequency of groundwater monitoring should be adequate to detect potential changes in the site conditions, while allowing sufficient time to implement contingency plans to protect receptors if an unexpected change occurs. For example, quarterly sampling of each bore may be considered sufficient to establish consistent trends in groundwater quality for a site where pollution remains on-site, groundwater flow velocity is low (less than 10m a year) and there are no existing uses precluded by the pollution.

Refer to EPA publication 'Groundwater Sampling Guidelines' (Publication 669) for guidance on sampling groundwater.

7.2 Trigger Levels

A groundwater monitoring program should include 'trigger levels' that indicate if the current clean up technology is not meeting, or will not meet, clean up

objectives. Trigger levels specify a concentration of contaminant(s) that is unacceptable at a critical location. These 'triggers' may signal unsatisfactory performance of the clean up/management by indicating:

- insufficient reduction in contaminant concentration;
- increase in contaminant concentration (possibly indicating a new release); or
- migration and/or expansion of the plume.

Where trigger levels are exceeded, a contingency plan should be implemented that ensures clean up objectives are attained (see section 7.3).

7.3 Contingency Plan

A contingency plan is a description of the response in the event of 'trigger levels' being reached. It may involve the implementation of an alternate clean up technology or simply a modification of the selected clean up technology. Contingency plans should be prepared at the time of the initial technology selection and should be flexible, allowing for the incorporation of new information (for example, advances in clean up technologies or toxicological data used to estimate the risk to groundwater receptors).

7.4 Controls on the use of Polluted Groundwater during Clean up/Management

The use of polluted groundwater (both on and off-site) should be prevented (where appropriate) and/or information should be made available to

potentially affected parties indicating the beneficial uses precluded by pollution.

The prevention of use of polluted groundwater may include:

- controls on groundwater use and bore construction; and
- placing covenants on land titles of affected premises for information.

Note that the following legal requirements apply to the provision of information to subsequent owner/occupiers, including information about polluted groundwater:

- the occupier of any premises on whom a notice has been served (by EPA) under sections 31 A/B (pollution abatement) and 62A (clean up) which is still in force must notify any person who proposes to become an occupier of that premises as to the requirements contained in the notice and the steps if any that have been taken to comply with that notice (s 60A *Environment Protection Act 1970*);
- where a Statement of Environmental Audit has been issued (by an environmental auditor appointed by EPA) with respect of any premises and a Certificate of Environmental Audit has not been issued subsequent to the statement, the occupier of the premises must provide a copy of the statement to any person who proposes to become the occupier of the premises (s 53ZE *Environment Protection Act 1970*);
- a vendor should provide information in relation to polluted groundwater at the time of sale of land. Legal obligations for information

provision arising from a contract for the sale of land are set out in section 32 of the *Sale of Land Act 1962*.

In all cases, any person who becomes aware of groundwater pollution at and from a premises should inform EPA and any other parties who may be affected (for example, the owner/occupier of any premises under which polluted groundwater occurs or is expected to occur).

EPA may assist in the dissemination of information by identifying a 'groundwater quality restricted use zone' (see section 9).

7.5 Periodic Review of the Practicability of Clean Up of Polluted Groundwater

Where clean up to restore the protection of beneficial uses is determined to be impracticable, periodic review of the practicability of groundwater clean up (to meet *Groundwater SEPP* objectives) should be undertaken. This involves an assessment of information including:

- research of new/updated (and available) clean up technologies;
- data from the groundwater monitoring program (for example, geochemical data, plume/contaminant migration, contaminant concentrations and transformations); and
- updated assessments of the risk posed to existing and potential beneficial uses of the groundwater, both on-site and off-site (for example, toxicological data).

7.6 When can Management of Polluted Groundwater Cease?

Management of polluted groundwater (including quality monitoring) should continue until the beneficial uses of groundwater on and off-site have been restored.

Evidence of the contraction or stabilisation of a plume of polluted water is not an acceptable basis to cease monitoring and management of the plume as this does not guarantee that the beneficial uses of the groundwater are, and will continue to be, protected.

8 REGULATORY REQUIREMENTS RELATED TO CLEAN UP AND MANAGEMENT OF POLLUTED GROUNDWATER

Some groundwater clean up technologies will involve discharge to aquifers, surface water, land and/or air. Discharges during groundwater clean up must not pollute the receiving environment.

The discharge activity may require a licence or works approval from EPA. Information on these requirements can be found in the *Environment Protection (Scheduled Premises and Exemptions Regulations) 1996*.

Where a pilot study is proposed to be conducted to test a new clean up technology that will ultimately produce a discharge that requires a licence or works approval, EPA may consider a research, development and demonstration project (RDD) application pursuant to section 19D of the *Environment Protection Act 1970*.

8.1 Clean Up Involving Discharges to an Aquifer

Clean up technologies such as 'pump and treat' may involve the continual treatment and return of polluted groundwater to the aquifer, with the level of pollution being reduced at each treatment cycle.

Other clean up technologies involve the discharge of water to the aquifer containing substances with contaminant reducing properties (for example, nutrients to assist the growth of bacteria that degrade some contaminants).

Clean up technologies that involve discharge to an aquifer must comply with Clause 20 of the *Groundwater SEPP*. This clause allows the re-injection of treated groundwater to an aquifer, as part of a groundwater clean up project. Under these circumstances EPA must be satisfied that there will be no detriment to any beneficial use beyond the premises boundaries and that groundwater quality objectives will be met upon completion of clean up. Section 2 provides information on how to seek this determination from EPA prior to commencing clean up.

9 GROUNDWATER QUALITY RESTRICTED USE ZONES

Groundwater quality restricted use zones (GQRUZs) are referred to in Clause 19 of the *Groundwater SEPP* (as amended March 2002). GQRUZs (previously known as Polluted Groundwater Zones) are areas of aquifers that have been identified by EPA where one or more beneficial uses of the groundwater are precluded by pollution. GQRUZs may be of local or regional scale and may relate to a specific or diffuse source. EPA may identify an area as a GQRUZ where

it has determined that clean up to the extent practicable has occurred.

EPA will provide information (for example, location, approximate degree and extent of pollution within the GQRUZ) to the groundwater resource manager and relevant rural water authority. EPA may also provide relevant information to other affected parties, Catchment Management Authorities (CMAs) and Local Government.

In accordance with clause 19 of the *Groundwater SEPP*, EPA will require polluted groundwater within GQRUZs to be cleaned up to the extent practicable and the periodic reassessment of practicability of clean up. EPA will maintain a list of GQRUZs.

Irrespective of whether a GQRUZ has been identified by EPA, polluted groundwater, where clean up to protect those beneficial uses is not practicable, should be managed in accordance with this Information Bulletin.

Other publicly available information that may relate to polluted groundwater includes:

- the Priority Sites Register, a register of all sites for which EPA requires action relating to site contamination. This action may include clean up and/or management of polluted groundwater. (For further information on the priority sites register, refer to EPA publication 735); and
- a list of sites for which Statements of Environmental Audit have been issued by environmental auditors appointed by EPA. Statements of Environmental Audit may indicate that the quality of groundwater at or from a site may preclude one or more beneficial uses and

include the auditor's opinion concerning any clean up and/or management necessary.

10 SUGGESTED FURTHER READING

- EPA 2000, *Groundwater Sampling Guidelines*, EPA Publication 669, EPA Victoria.
- Victorian Government 1997, 'State environment protection policy (Groundwaters of Victoria)' *Victoria Government Gazette No. S 160*, Government Printer, Melbourne, December 1997.
- USEPA 1999, *Treatment Technologies for Site Clean up: Annual Status Report (Ninth Edition)*, United States Environmental Protection Agency, EPA-542-R99-001, April 1999.
- USEPA 1998, *Abstracts of Remediation Case Studies - Volume 3*, United States Environmental Protection Agency, EPA-542-R98-010, September 1998.

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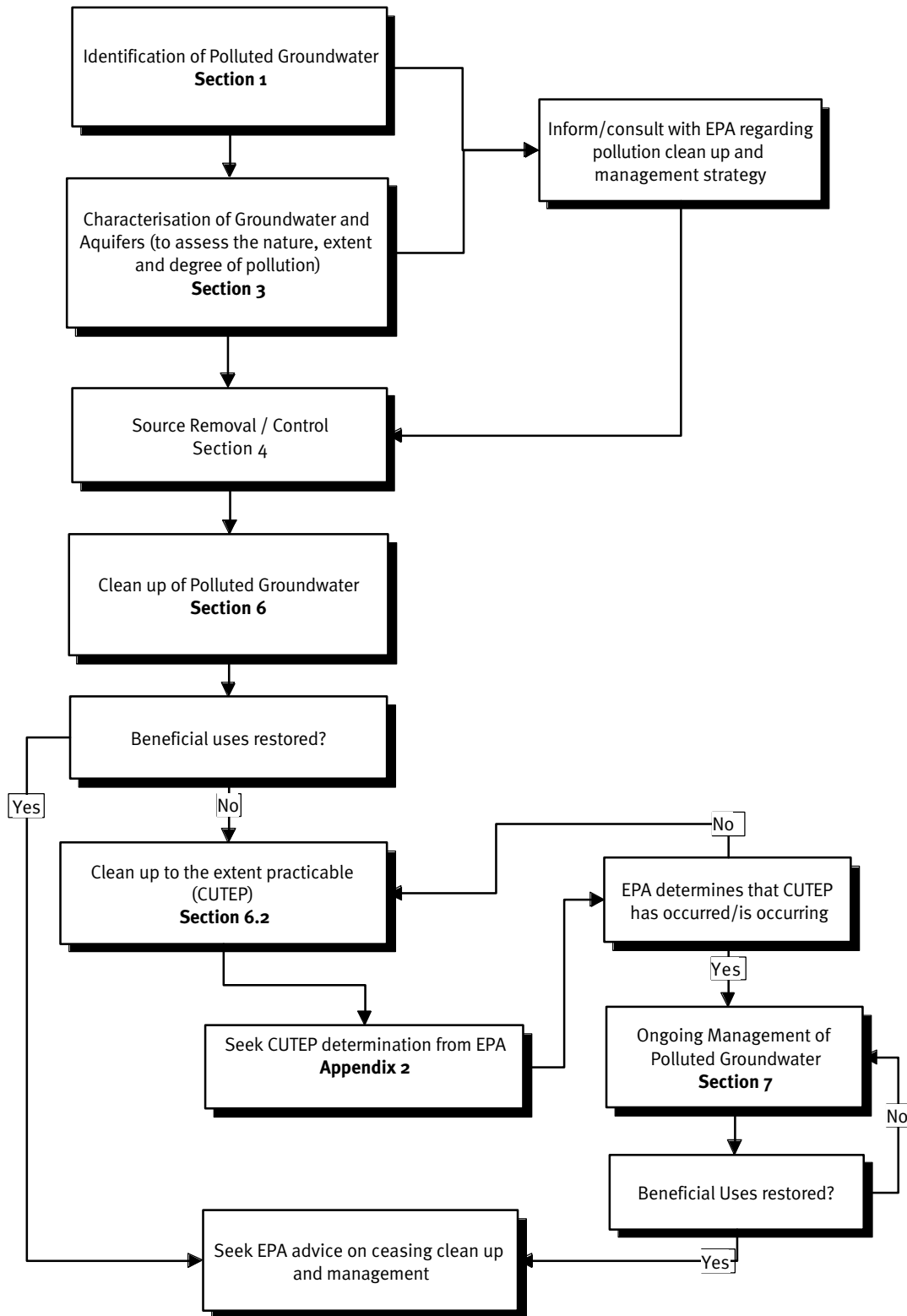
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APPENDIX 1: RECOMMENDED PROCEDURE FOR CLEAN UP AND MANAGEMENT OF POLLUTED GROUNDWATER



**APPENDIX 2:
INFORMATION TO BE INCLUDED IN A
CLEAN UP TO THE EXTENT
PRACTICABLE SUBMISSION TO EPA.**

Executive summary

Background

- Site Description
- Site history

Hydrogeology

- Regional
- Local (site)
- Evidence that hydrogeological assessment has adequately characterised contaminant distribution (including background and off-site), transport and fate

Condition of the site prior to clean up

- Degree and extent (area/volume) of contamination before clean up

Clean up

- Clean up measures undertaken, including indication of cost effectiveness

Condition of the site following clean up

- Degree and extent (area/volume) of contamination remaining after clean up

Is groundwater polluted? (based on condition of the site following any clean up works conducted to date)

- Background TDS

- Segment (Table 1 of SEPP, Groundwaters of Victoria)
- Beneficial Uses to be protected (Table 2 of SEPP, Groundwaters of Victoria)
- Groundwater quality objectives (Table 3 of SEPP, Groundwaters of Victoria)
- Protected beneficial uses precluded by the polluted groundwater

Demonstration of clean up to the extent practicable

- Technical, logistical and financial considerations (for a number of further clean up options,) that clearly demonstrates their practicability or otherwise
- Demonstration that clean up undertaken is commensurate with the significance of the pollution (including but not limited to comment on likelihood of potential beneficial uses being realised)
- Expected timeframe for restoration of beneficial uses for each option considered
- Comment on 'reasonableness' of this timeframe

On-going management of polluted groundwater

- Groundwater monitoring
- Trigger levels
- Contingency Plan
- Controls on beneficial uses precluded by pollution
- Periodic review of practicability of groundwater clean up.

Conclusion and recommendation