

GROUNDWATER ATTENUATION ZONES

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The purpose of this information bulletin is to help the community and operators of waste disposal activities understand attenuation zones, provide guidance for the implementation of this policy provision (see section 2) and assist in the preparation of proposals for attenuation zones (see section 3).

1. INTRODUCTION

Victoria's *State environment protection policy (Groundwaters of Victoria)* was introduced in 1997. The policy (*Groundwater SEPP*) was established to protect the State's groundwater resources from pollution and applies throughout Victoria.

The *Groundwater SEPP* identifies the beneficial uses of groundwater to be protected (for example, maintenance of ecosystems, potable water supply), together with groundwater quality objectives (GWQOs) – physical, chemical and biological properties of groundwater – for each beneficial use. When GWQOs are maintained, beneficial uses are deemed to be protected.

For further information on beneficial uses and any other aspects of the *Groundwater SEPP*, refer to EPA publication 597, *Information Bulletin - State Environment Protection Policy (Groundwaters of Victoria)*.

Clause 17 of the *Groundwater SEPP* enables the Environment Protection Authority (EPA) to designate attenuation zones for particular activities, where no

practicable alternative exists to prevent impacts on groundwater quality. An attenuation zone permits exceedence of specified GWQOs within a designated area and is strictly implemented by EPA as a last resort. EPA will not permit an attenuation zone which extends beyond the premises which is the source of the contamination of groundwater.

1.1 What are 'Attenuation Zones'?

An attenuation zone is an area defined in a works approval, licence or notice issued by EPA, within which some or all of the GWQOs specified in the *Groundwater SEPP* are not required to be achieved. An attenuation zone permits exceedence of specified GWQOs within designated boundaries, provided that strict prerequisites are met. As a result, beneficial uses of groundwater beneath the premises may be sacrificed.

EPA may only designate an attenuation zone for the following activities:

- landfills receiving municipal wastes;
- wastewater irrigation;
- ash ponds; and
- evaporation basins (incorporated in Government approved salinity management plans).

These are necessary activities that provide a benefit to the broader community and yet may have adverse impacts on underlying groundwater quality, even when undertaken in accordance with best practice.

An attenuation zone is designed to be the last option for managing localised groundwater contamination resulting from existing or proposed activities that are conducted in accordance with best practice. In all cases, the attenuation zone is intended to ensure contamination is minimised and controlled. This is in accordance with the Groundwater SEPP policy provision 10(3), which states:

‘...water quality is to be maintained as close as practicable to background levels.’

1.2 What is ‘Attenuation’ ?

Attenuation is defined in the *Groundwater SEPP* as:

‘...the reduction in concentration of contaminants in a solution passing through a porous medium by natural mechanisms including removal by ion exchange, chemical precipitation, adsorption, filtration or biodegradation and hydrodynamic dispersion...’.

The behaviour of contaminants dissolved in groundwater is highly varied and is dependent upon the physical, chemical and biological properties of both the contaminant and the geological material/aquifer (soil and rock) the groundwater is flowing through. The processes that govern the attenuation of contaminants in groundwater are also often interrelated and may occur simultaneously.

1.3 Implications for Activities with the Potential to Impact Groundwater

EPA may, in the administration of works approvals, licences and notices under the *Environment Protection Act 1970*, require the owners and/or occupiers of premises (upon which one of the four

activities outlined in Section 1.1 occur) to consider applying to EPA to declare an attenuation zone for their premises or current activity. If appropriate, EPA may further amend a licence or issue a notice to include attenuation zone conditions.

Initially, a thorough investigation of underlying groundwater and any changes to groundwater quality caused by an existing activity is required (see section 3). This will also determine:

- whether an attenuation zone is necessary and justifiable;
- the likely extent of a zone; and
- any GWQOs that will not be met within the zone.

Any proposals to undertake a new activity with the potential to impact on groundwater quality must consider these impacts. For those proposing to conduct one of the four activities mentioned in section 1.1, an attenuation zone should be considered as part of a works approval application, but only as a last option for managing groundwater contamination. The application should demonstrate that all other means of managing groundwater contamination have been considered and deemed inadequate or inappropriate.

In a similar manner to where ‘mixing zones’ are designated for surface waters (refer to the SEPP Waters of Victoria clause 16), attenuation zones are designated as an approved discharge practice ensuring contamination is controlled and restricted to the minimum area practicable, employing best available technology.

In the absence of an attenuation zone, any activity that causes groundwater quality to exceed GWQOs

has caused pollution, which is an offence under the *Environment Protection Act 1970*.

2. HOW AND WHERE DO ATTENUATION ZONES APPLY?

The *Groundwater SEPP* clearly states the conditions under which EPA may designate attenuation zones.

Figure 1 summarises the prerequisites of the policy provision, identifies situations where EPA may consider permitting an attenuation zone and indicates where further relevant information is contained within this information bulletin.

2.1 Activities for which Attenuation Zones may be Permitted

The following text provides further information regarding each activity (for which an attenuation zone may be designated) and how an attenuation zone may apply.

Landfills Receiving Municipal Waste

Municipal waste is defined in the *State environment protection policy (Siting and Management of Landfills Receiving Municipal Wastes)*:

‘...includes putrescible wastes – waste able to be decomposed by bacterial action – from manufacturing, commercial, processing and service industries and waste generated within residential dwellings, but does not include liquid wastes, night-soil, or grease trap waste’.

Existing landfills need to be managed in accordance with best practice, and proposed landfills (which includes new landfill cells in existing landfills) must be designed, constructed and managed in

accordance with best practice. For further information on best practice management and design for landfills refer to EPA publication 788, *Siting, Design, Operation and Rehabilitation of Landfills*.

Attenuation zones are not appropriate for prescribed waste landfills, and not necessary for solid inert waste landfills since, when operated in accordance with best practice, such landfills represent a much lower threat to groundwater quality.

Wastewater Irrigation

Wastewater irrigation is defined in EPA Publication 168, *Guidelines for Wastewater Irrigation* to be:

‘the application of...wastewater to land, to replenish moisture lost by evapotranspiration and to grow plants’.

The extent of an attenuation zone for wastewater irrigation may include the lagoon that is associated with the wastewater irrigation system, provided that it is managed in accordance with best practice. Best practice for this activity is covered in EPA Publication 168.

In the case of recently implemented wastewater irrigation systems, lagoons should be lined in accordance with best practice. In this instance, an attenuation zone should not be necessary for the lagoon section of the irrigation system.

Ash Ponds

Ash ponds are basins that receive hydraulically transported ash and saline water produced during electricity generation at coal fired power stations, for example those found in the Latrobe Valley and

Anglesea. Note, ash ponds may also receive small volumes of ash transported by truck.

The slurry of ash and water is usually both saline and alkaline. The ash water is primarily a sodium-sulphate-chloride water that can contaminate groundwater following infiltration (by seeping into the underlying geological material).

There is no formal documented best practice pollution prevention for this activity, however best practice for landfills receiving municipal waste (see section above) would be largely applicable.

Evaporation Basins

The provision for attenuation zones also applies to evaporation basins that are incorporated into Government approved salinity management plans. The *Groundwater SEPP* states evaporation basin:

‘...means a natural depression used, or artificial structure constructed, for the purpose of disposing of liquid via evaporation. Liquid is also lost from evaporation basins by infiltration into the ground’.

Evaporation basins are utilised in rural regions where salinity is a threat to effective and sustained use of agricultural land. Saline groundwater is pumped away from the agricultural land and into evaporation basins. Salts, left behind after some of the groundwater evaporates, infiltrate the soil profile and contaminate groundwater.

For further information on salinity management plans, please refer to the appropriate Department of Natural Resources and Environment office. For further information on best practice pollution prevention, design, construction and operation of evaporation basins, refer to *On-farm and Community Scale Salt Disposal Basins on the Riverine Plain* by

the CRC for Catchment Hydrology, CSIRO Land and Water, Murray-Darling Basin Commission.

Statutory Approval Process for Attenuation Zone Activities

Landfills receiving municipal waste, wastewater irrigation schemes and ash ponds are scheduled premises in accordance with the *Environment Protection (Scheduled Premises and Exemptions) Regulations 1996*. These premises require works approvals and licences, except where the regulations provide an exemption (for example, a municipal waste landfill serving less than 5000 people). In accordance with section 20A of the *Environment Protection Act 1970*, for licensed premises, proposals for an attenuation zone should be in the form of an application for a licence amendment.

Evaporation basins are not scheduled premises under the *Environment Protection (Scheduled Premises and Exemptions) Regulations 1996*, and therefore are not subject to the works approval or licensing process. Where necessary, groundwater attenuation zones for evaporation basins will be designated by EPA in a notice pursuant to the *Environment Protection Act 1970*.

For proposed (or extensions to existing) activities, proponents should seek the advice of their local council regarding planning requirements.

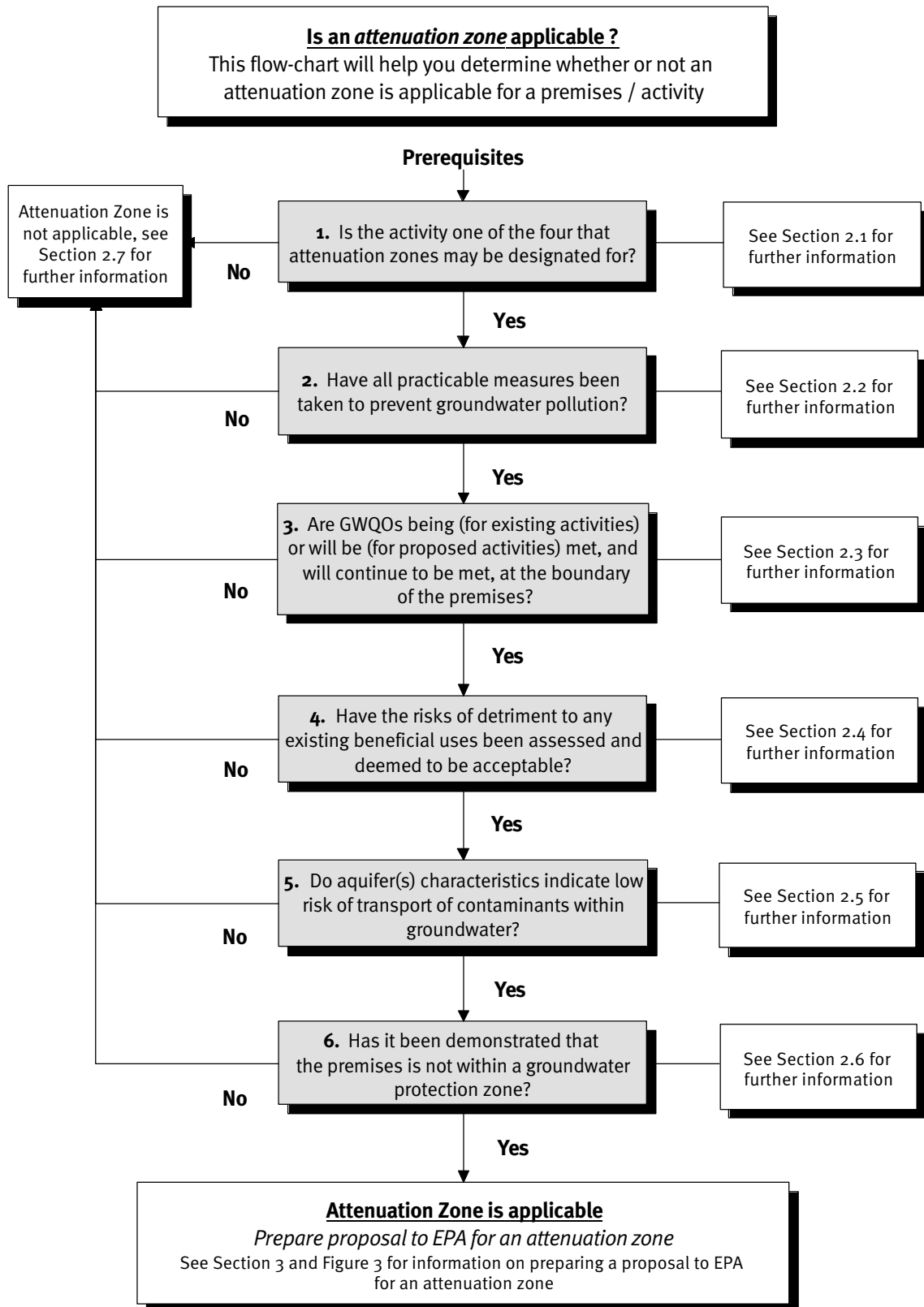


Figure 1: Flow-chart of the prerequisites to be met for an attenuation zone

2.2 Practicable Measures for Pollution Prevention

For an attenuation zone to be designated by EPA 'all practicable measures must have been taken to prevent the pollution of groundwater (on and off-site)'. Firstly, in accordance with the Industrial waste management policy (Waste Minimisation), all measures should be taken to avoid and minimise waste production which may lead to pollution.

Generally, practicable measures are the best available environmental practices, engineering and technologies that are feasible for the industry sector to implement. Practicable measures that prevent and minimise pollution may include:

- designing, operating and managing the activity to be conducted in accordance with best practice whenever possible; and
- engineering measures to contain, control and minimise any adverse impacts of the activity.

In determining whether a pollution prevention measure is practicable, EPA will consider technical, logistical and financial factors. Proposed activities must be conducted in accordance with best practice. These are generally referred to in the discussion on best practice for each activity in section 2.1. Practicable measures for pollution prevention at existing activities will be considered on a case by case basis.

These measures may also incorporate some monitoring of the environmental performance of the activity, in order to facilitate early detection of any likely causes of groundwater contamination or pollution, and the preparation of a contingency plan

to be implemented in the event of GWQOs failing to be met at the attenuation zone's boundary.

2.3 Are GWQOs Met at the Premises Boundary?

The *Groundwater SEPP* requires that GWQOs must be met at the boundary of the premises in order for EPA to consider designating an attenuation zone.

In order to minimise the extent of aquifer in which pollution occurs (and therefore the beneficial uses that are compromised), attenuation zones must be as small as possible. The maximum extent for any attenuation zone is limited to the 'boundary of the property upon which the activity takes place'. This is to protect the environmental quality of adjacent properties and to ensure that the costs of environmental degradation are not externalised through the detriment of beneficial uses of groundwater at other properties.

Contamination and Pollution of Groundwater

The *Groundwater SEPP* defines contamination as:

'...a change in water quality that produces a noticeable or measurable change in its characteristics.'

That is, a change from background groundwater quality, which is also defined in the *SEPP*.

Pollution of groundwater is 'defined' by section 39 of the *Environment Protection Act 1970* as where groundwater quality is changed causing a detrimental impact on beneficial use (that is, GWQOs are exceeded).

Allowable Extent of an Attenuation Zone

Figure 2 shows an acceptable attenuation zone scenario, where contamination is migrating, but GWQOs are not exceeded, beyond the zone

boundary. In this scenario, the attenuation zone boundary is located within the premises boundary, and contamination does not migrate beyond the premises boundary.

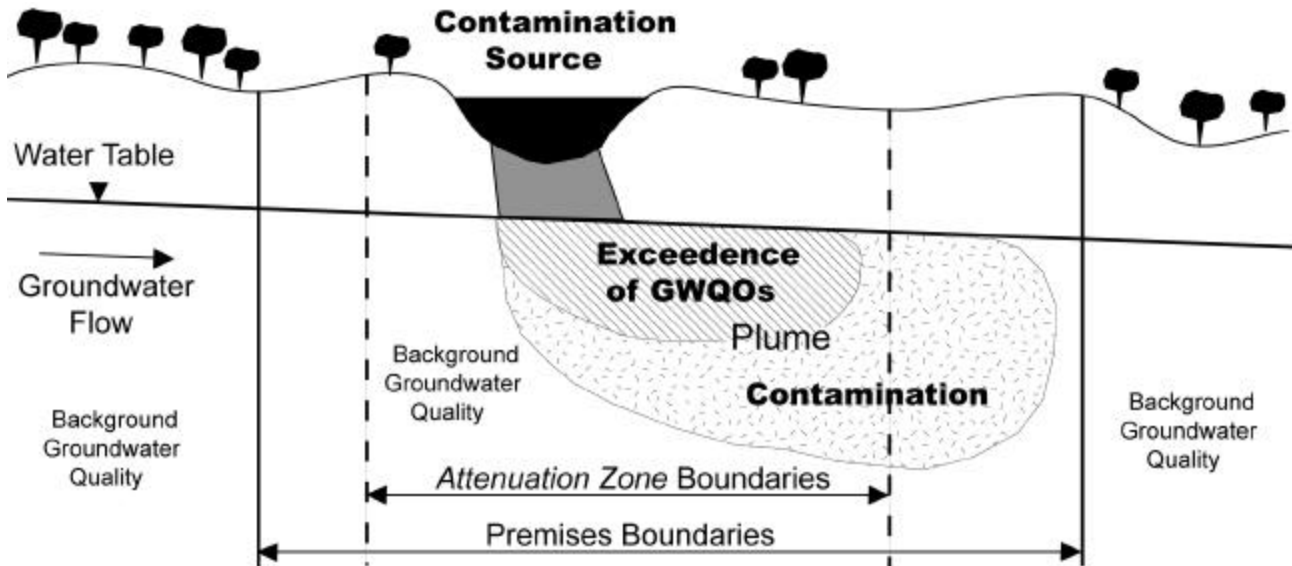


Figure 2 Acceptable Attenuation Zone scenario number 1

Figure 3 shows another acceptable scenario, where the attenuation zone boundary is located at the premises boundary (the maximum allowable extent), and contamination is migrating, but GWQOs are not exceeded, beyond the attenuation zone, and premises, boundary.

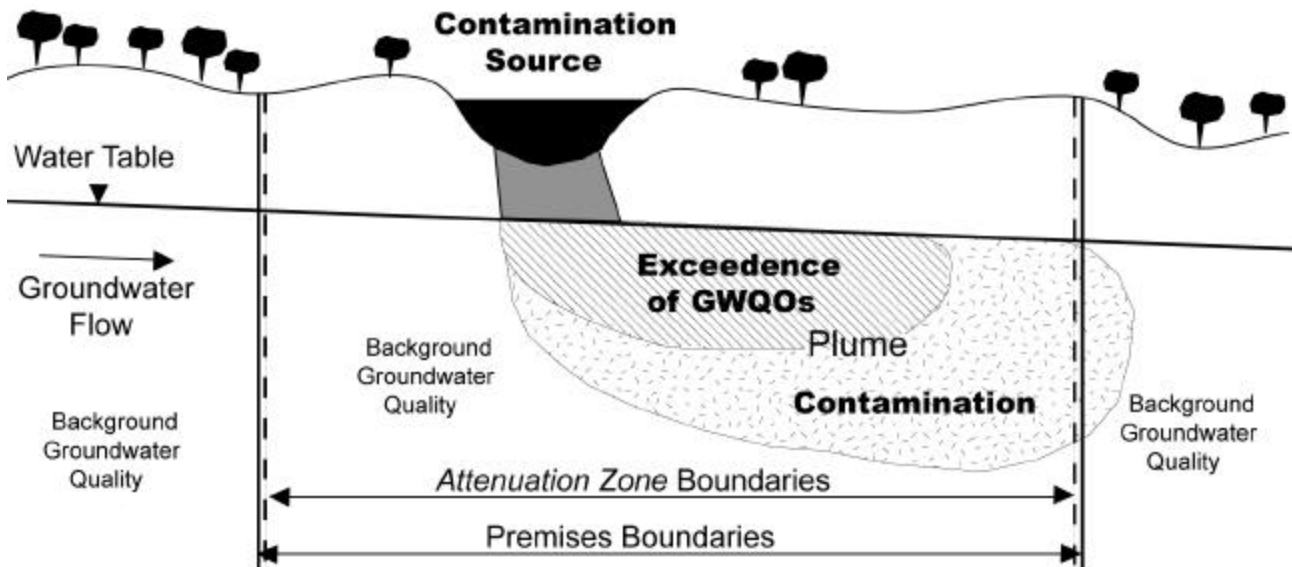


Figure 3 Acceptable Attenuation Zone scenario number 2

Figure 4 shows an unacceptable scenario, where pollution is migrating beyond the attenuation zone (and premises) boundary.

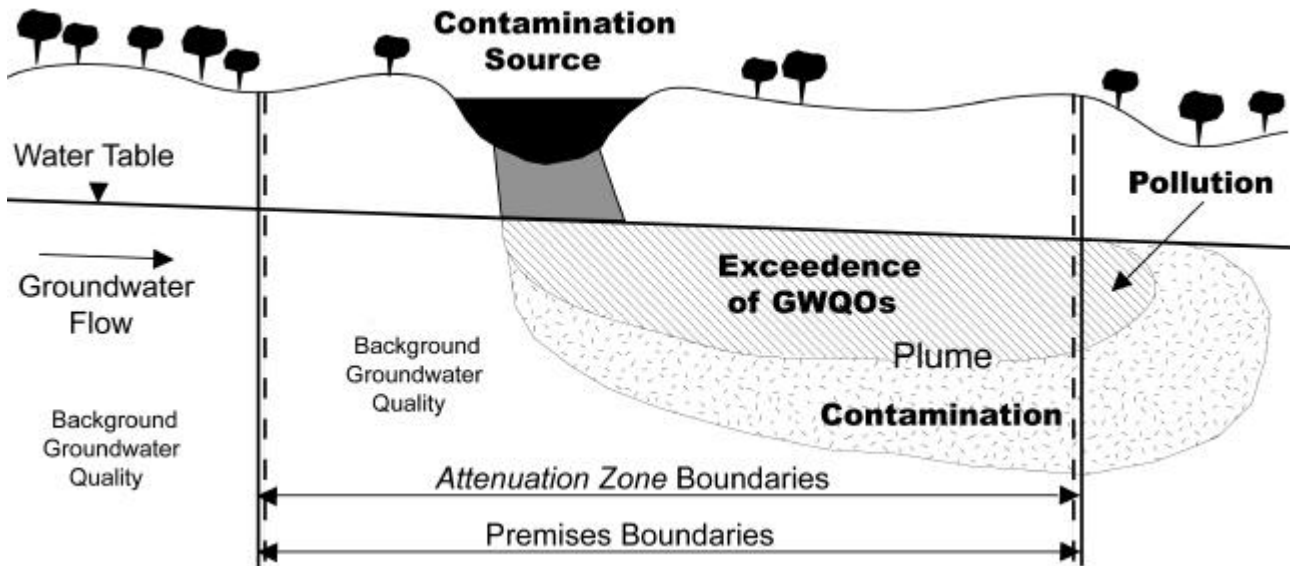


Figure 4 Unacceptable Attenuation Zone scenario

For sites where GWQOs are not met at the premises boundary, refer to Section 2.7.

2.4 Risks to Existing Beneficial Uses

The *Groundwater SEPP* requires that for an attenuation zone to be designated, EPA must be satisfied there is no unacceptable risk of detriment to an existing beneficial use, including the beneficial uses of surface waters (including outside the attenuation zone or premises boundary), that groundwater may intercept.

Investigations should first establish whether there are any existing beneficial uses of the groundwater within the vicinity of the proposed attenuation zone location (for example, irrigation, potable water supply, maintenance of ecosystems), which should include a review of the State's groundwater database to identify licensed users of water, as well as identifying any users of groundwater without licensed bores and points of surface discharge.

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

All risks to identified users, surface water ecosystems (marine and fresh) and other surface water beneficial uses (that is, those protected by SEPPs) must be assessed according to their relative sensitivity.

It is also important to consider deeper aquifers and their sensitivity to any contamination. Assessment of the resultant levels of risk must also consider any aquifer interconnectivity.

2.5 High Permeability and Low Attenuation

Permeability is defined as 'the ability of a porous or fractured medium to transmit a fluid'. The permeability of a medium or geological

material/aquifer is generally governed by the size of and the degree to which openings, such as pore spaces and fractures, are interconnected.

Geological materials that have high permeability include gravels, sands, sandstones, highly fractured rock, and cavernous limestone.

Due to the increased transport risk posed by a high permeability medium, an attenuation zone will not be allowed in an area demonstrating these characteristics.

Geological materials with high permeability are generally expected to demonstrate low attenuation properties. A geological material's permeability and attenuation properties need to be assessed and confirmed as part of a hydrogeological assessment (refer to Section 3).

Where a premises is impacting on groundwater quality in aquifers with high permeability or low attenuation properties, it is particularly important that the owner/occupier investigate the extent of groundwater pollution and its impacts on beneficial uses, with the view to clean-up and manage polluted groundwater. In such an instance, EPA may require the owner to clean up groundwater pollution to protect beneficial uses.

2.6 Groundwater Protection Zones

The Groundwater SEPP defines a **groundwater protection zone** as any area which:

'...has groundwater of special environmental significance or vulnerability, or requires more stringent controls to protect groundwater than are otherwise prescribed by this policy...'

The intent of this provision is to prohibit some potentially polluting activities in areas of particular importance, for example, recharge areas of high quality aquifers, karst limestone aquifers, groundwater springs areas and aquifers which discharge to particularly sensitive surface water ecosystems.

Activities that may lead to pollution of groundwater and hence to a proposal to establish an attenuation zone should not be located in any area which has special environmental significance or vulnerability with respect to groundwater. For further information, refer to the siting requirements of the EPA publication 788, Siting, Design, Operation and Rehabilitation of Landfills.

A Hydrogeological assessment should identify areas of high groundwater significance, including groundwater protection zones. See section 3 for further information on hydrogeological assessments.

2.7 Groundwater Pollution at Sites Unable to Meet Attenuation Zone Prerequisites

A prerequisite for the designation of an attenuation zone, at a site with existing groundwater pollution, is that pollution must not have migrated beyond the premises boundary. Where this has occurred the owner/occupier may be required to investigate the extent of groundwater pollution and its impacts on beneficial uses, with the view to clean-up and management of polluted groundwater. In such an instance, EPA may require the owner to clean up groundwater pollution to protect beneficial uses.

3. PREPARING A PROPOSAL FOR AN ATTENUATION ZONE

The designation of an attenuation zone by EPA depends on provision of sufficient information by a proponent, licensee or recipient of a notice:

- demonstrating the prerequisites for attenuation zones are met; and
- defining the particulars of the specific site.

This section provides guidance for the preparation of attenuation zone proposals. Figure 5 is a flow-chart designed to aid in the preparation of an attenuation zone proposal.

Any proposal for an attenuation zone must include a **hydrogeological assessment**, addressing:

- geological/hydrogeological setting;
- groundwater quality at, and in the vicinity of, the site;
- beneficial uses to be protected (as designated within the SEPP *Groundwaters of Victoria*) and likelihood of groundwater use in the vicinity of the premises;
- groundwater flow direction and rate;
- permeability properties of the aquifer(s);
- attenuation properties in the aquifer(s);
- identification of background groundwater quality;
- all existing ecological and human receptors (for example, bore users, freshwater ecosystems); and
- whether the proposed attenuation zone is within a groundwater protection zone.

Hydrogeological assessments should be undertaken and prepared by an experienced and qualified hydrogeologist.

For a proposed activity a thorough assessment of the prerequisites should occur early in the planning phase and for existing activities this should commence without delay.

For licensed activities, EPA will evaluate the application of an attenuation zone at the time of licence review.

3.1 Proposal Prerequisites

Any proposal for an attenuation zone must clearly demonstrate to EPA that all prerequisites have been met and include detailed information about the proposed attenuation zone.

The prerequisites to be met are:

1. The proposed activity is one of the four set out in section 2.1.
2. All practicable measures have been taken to prevent groundwater pollution. This can be demonstrated by comparison of the site specific designed management practices with best practice for the activity. Where management is not in accordance with best practice, the proponent should clearly demonstrate why it is not practicable to do so (see section 2.2 for further information on practicability).
3. That GWQOs are/will be met at the premises boundary. For existing activities, existing (past and current) data should be provided, and for proposed activities, modelling should be undertaken using site specific information. For all beneficial uses (excluding 'maintenance of

ecosystems'), GWQOs apply at any point in the aquifer from which groundwater can be abstracted via a bore. Therefore there is a requirement that these GWQOs be met at the attenuation zone boundary. For the beneficial use 'maintenance of ecosystems', however, GWQOs apply at the point of discharge to the surface water (not at the attenuation zone boundary). The proposal must demonstrate that groundwater leaving the zone will meet the applicable *SEPP Waters of Victoria* requirements at the point of discharge.

4. That there are no unacceptable risks to any existing beneficial uses (refer to section 2.4).
The application should identify existing groundwater use, or groundwater discharge to surface waters, in the vicinity of the site. Where a beneficial use is present, there is a need to conduct a risk assessment, to determine if the risks are unacceptable.
5. That the site has neither high permeability or low attenuation properties (refer to section 2.5).
This should be addressed as part of the hydrogeological assessment.
6. That the premises is not within a groundwater protection zone (refer to section 2.6).

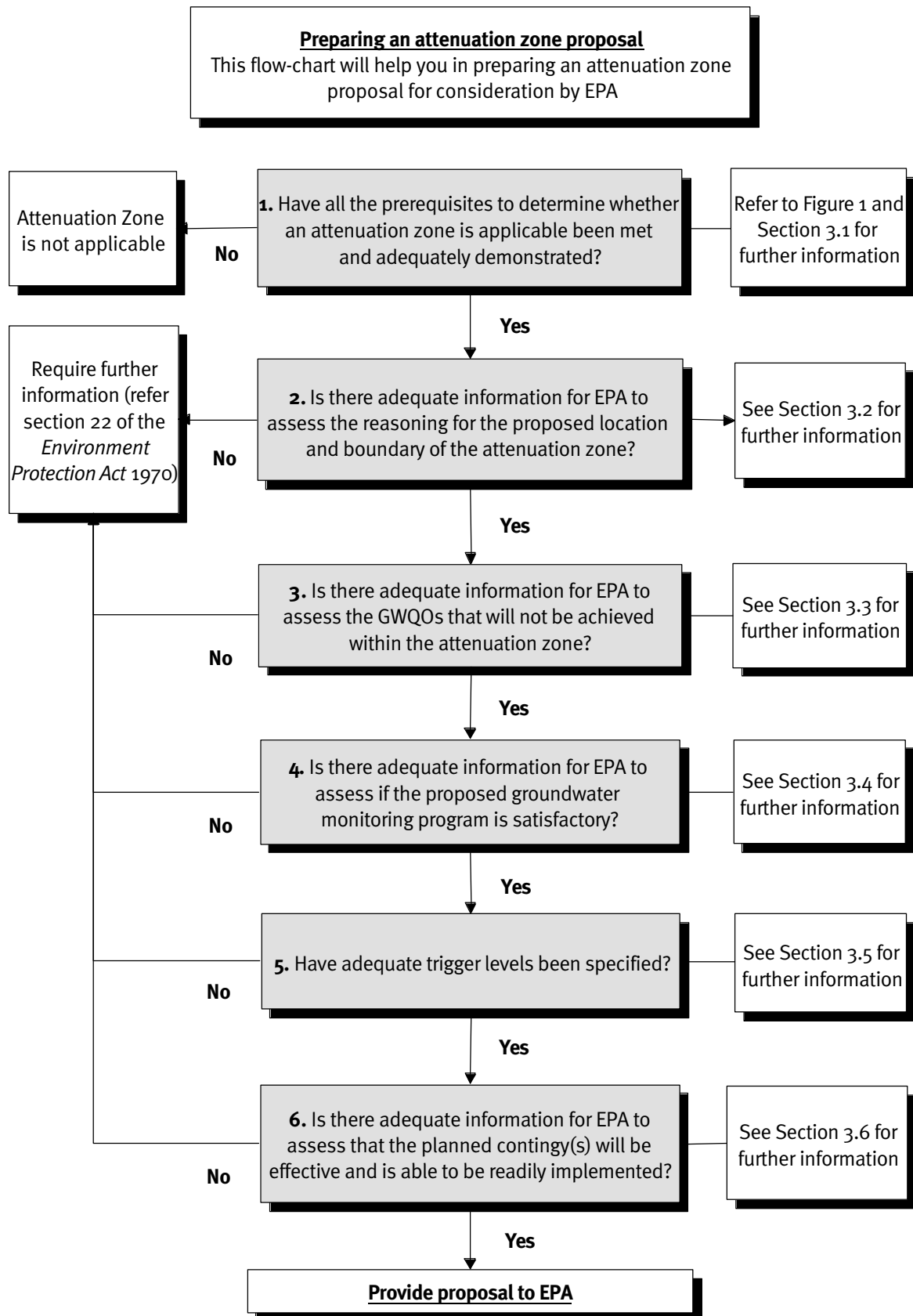


Figure 5: Flow-chart for preparing an attenuation zone proposal

3.2 Determining the Extent of an Attenuation Zone

A proponent must define the extent of the attenuation zone which they are proposing, and include detailed justification for the proposed extent (and demonstration that the attenuation zone is as small as possible). The proposed location and boundaries of the attenuation zone, and the premises boundary, must be displayed in a survey plan or map, and defined in all three dimensions (that is, including depth).

For an **existing** activity, once it is clear that GWQOs are met at the premises boundary, a proponent must determine the extent of any existing groundwater contamination. It is also necessary to estimate the future migration of groundwater contamination, taking into consideration both present and future environmental management of the activity. The extent of the zone to be proposed should then be established according to where certain GWQOs are not, or will not be, met over a nominal time frame. It is imperative that the area into which groundwater contaminants migrate be absolutely minimised in addition to ensuring pollution does not progress beyond the zone's boundary.

For a **proposed** activity, a thorough environmental investigation is necessary in the planning stage to determine the likely nature and extent of any impacts the activity may have on groundwater quality. Information should be provided as part of a works approval. Where necessary, EPA may require further information. Where an attenuation zone is required, the investigation should also contribute to determining the proposed extent of the zone. Further options for minimising contamination likely

to result from the activity should be investigated and the best practice option identified.

While a proponent may propose the extent of an attenuation zone, only EPA can designate an attenuation zone.

3.3 GWQOs Not to be Met in the Attenuation Zone

The proponent must identify the groundwater quality objectives that will not be met within the proposed attenuation zone. This information should be generated as part of the hydrogeological assessment.

3.4 Groundwater Monitoring Program

In order to verify the performance requirements of an attenuation zone are met, and ensure the early detection of unexpected (and undesirable) breaches of GWQOs beyond a zone, the proponent must demonstrate an adequate groundwater monitoring program, which should:

- include locations of sampling points;
- indicate the frequency of monitoring;
- monitor the spatial and temporal variation in pollutant distribution;
- verify that GWQOs are met at the boundary of the attenuation zone;
- verify the extent of plume(s), including contamination outside the zone;
- detect new releases of contaminants; and
- detect changes in environmental conditions (for example, hydrogeologic, geochemical and microbiological).

Monitoring must be in accordance with EPA Publication 669 *Groundwater Sampling Guidelines*.

3.5 Trigger Levels

The proponent must include 'trigger levels', which indicate if the GWQOs are not being, or will not be, met at the zones boundary. These 'triggers' indicate:

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

Where trigger levels are exceeded a contingency plan (see section 3.6) will be implemented that can effectively reduce groundwater pollution to ensure GWQOs continue to be met at the zones boundary.

3.6 Contingency Plans

The proponent must provide an acceptable contingency plan, as required in the *Groundwater SEPP*, which will be implemented in the event of trigger levels (see section 3.5) being exceeded. It must outline abatement arrangements that consist of at least one option, that will be both effective and fully serviceable at the time the attenuation zone is designated.

An attenuation zone proposal should contain the analysis and review undertaken of the various contingency plan options.

3.7 Submit to EPA

Once a proposal for an attenuation zone is complete, it should be submitted to the relevant EPA

Office. See contact details at the end of this document.

3.8 Decision by EPA

Following receipt and review (possibly including requests for additional information) of a proposal, EPA will make a decision as to designating an attenuation zone.

This may include amending an existing licence or issue of a works approval or notice.

EPA will maintain and make publicly available a list of all designated attenuation zones.

EPA CONTACT DETAILS

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