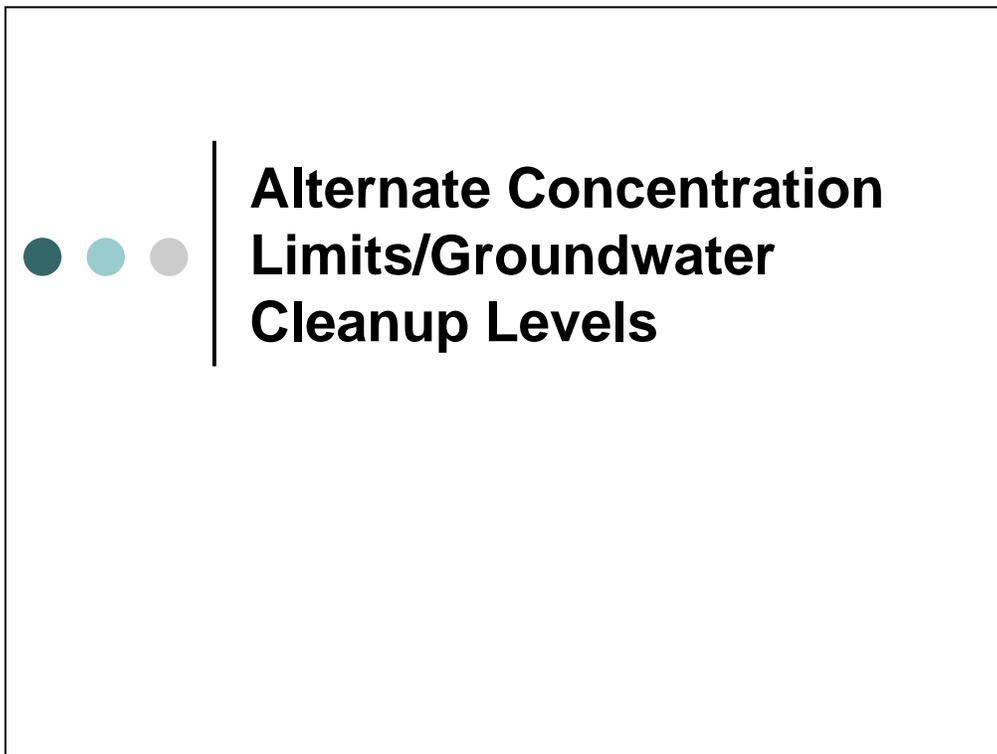


US EPA ARCHIVE DOCUMENT

A rectangular box containing three colored circles (dark teal, light teal, grey) on the left, followed by a vertical line and the text "Alternate Concentration Limits/Groundwater Cleanup Levels".

**Alternate Concentration
Limits/Groundwater
Cleanup Levels**

Title slide

● ● ● | **Alternate Concentration Limits (ACL) Terms and Definitions**

○ **40 CFR 264 Subpart F Definitions**

- Regulated Unit
- Ground Water Protection Standard (GWPS)
- Point of Compliance (POC)
- Point of Exposure (POE)
- Facility Boundary



Regulated Unit – Surface impoundment, waste pile, land treatment unit, or landfill that received waste after July 26, 1982.

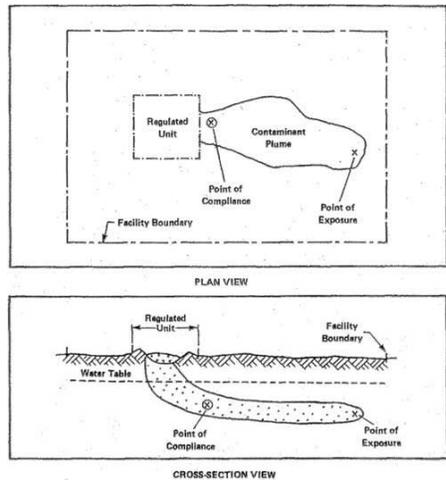
Ground Water Protection Standard – Conditions specified in the facility permit designed to protect human health and the environment. The GWPS includes: (1) the hazardous constituents that must be monitored, (2) the hazardous constituent concentration limits that must not be exceeded, (3) the point of compliance, and (4) the compliance period. GWPS are established when a release has been documented from a unit.

Point of Compliance – A vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated unit. The POC is the place in the uppermost aquifer where ground-water monitoring takes place and where the GWPS is set. If ACLs are established, they would be set at this location.

Point of Exposure – The point at which a potential receptor can come into contact, either now or in the future, with the contaminated ground water.

Facility Boundary – The property boundary of the facility.

ACL Terms and Definitions



This slide shows the physical locations of the regulated unit, point of compliance (POC), point of exposure (POE), and facility boundary.



GWPS Concentration Limits

- **Background Concentrations of Constituents**
 - 40 CFR §264.94(a)(1)
- **Table 1 Constituents**
 - 40 CFR §264.94(a)(2)
- **Alternate Concentration Limits (ACLs)**
 - 40 CFR §264.94(a)(3)
 - 40 CFR §264.94(b)



Three possible sets of concentration limits can be used to establish the GWPS. The regulations require that either the background concentrations, or the concentrations listed in Table 1 of 40 CFR 264.94(a)(2) be established in the facility permit as the GSPS concentration limits. However, facility owners/operators may also apply for ACLs if they can prove that the ACLs will not pose a substantial present or potential hazard to human health or the environment. Facility owners/operators typically believe that ACLs are less stringent and costly than the default parameters (e.g., MCLs). However, because they are based on less conservative assumptions, they are usually more difficult to get approved.

In general, the ACL process is slow, a large amount of data are necessary, the demonstration may be expensive, and it is very difficult to decide and agree upon the appropriate exposure scenarios. Facilities should be aware that the possibility exists that by default, MCLs may be the ACLs. Furthermore, some states may have non-degradation policies that prohibit the release of any pollutants into the ground water. These policies may prevent the use of an ACL altogether. EPA must approve the ACLs for a specific site.



How Are ACLs Determined?

- Incorporates the concept of “attenuation”
- An acceptable human-health or ecological risk value is determined for the POE. The ACL is then calculated for the POC taking into account an attenuation factor derived from the physical and chemical conditions at the facility between the POC and POE



In establishing the ACL, attenuating mechanisms may be considered only over the area between the POC and POE. If the POE is set at the POC, then no attenuation can be considered, and the POC = POE. However, if there is a considerable distance between the POC and POE, conservative estimates of attenuation can be considered when establishing the ACLs.

To derive an ACL, an acceptable human-health or ecological exposure level is established for the POE. For human-health, this typically corresponds to risk levels in the range of 10^{-4} to 10^{-6} for carcinogens, and HQ or HI values less than or equal to 1 for non-carcinogens. Site-specific conditions can be considered in establishing the appropriate initial risk levels. The amount of attenuation that takes place between the POC and POE is the “attenuation factor” (AF). The ACL (which is established at the POC) is determined by multiplying the POE risk value by the AF – in essence, it is a “back calculation.” Determining the AF is one of the most critical elements in establishing ACLs. At facilities where contaminant plumes already exist at the POE, the AF can be estimated by dividing the constituent concentration at the POC by the constituent concentration at the POE.



EPA Policy Regarding the Use of ACLs

- Ground water plumes should not increase in size or concentration above allowable health or environmental exposure levels
- Increased facility property holdings should not be used to allow a greater ACL
- ACLS should not be established so as to contaminate off-site ground water above allowable health or environmental exposure levels



3 BASIC POLICY GUIDELINES

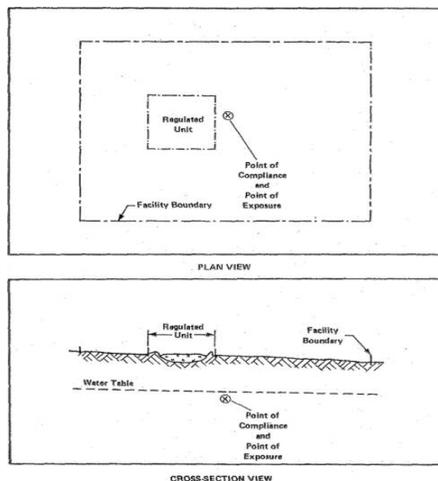
Contaminant plumes in useable ground water will not be allowed to increase in size above acceptable levels. This “no growth” policy applies to both the mass of contaminants and the size of the plume. Basically, the leading edge of the plume should not move downgradient. If necessary, source control measures should be implemented to prevent the plume from expanding.

The facility can not acquire additional property with the intent of extending the POE such that a larger AF and ACL can be established. When considering the establishment of an ACL, the permitting authority should only consider property that the facility owned at the time of initial permit application.

The facility should not establish an ACL which allows the plume to migrate and contaminate off-site groundwater above acceptable levels.



Case 1



Case 1: A regulated unit overlying useable groundwater, with no groundwater contamination detected. The POE will be assumed to be directly at the POC (downgradient edge of the waste management unit boundary) – not the property boundary. No AF will be used in setting any ACLs.

8

Case 2

The diagram consists of two parts. The top part is a 'PLAN VIEW' showing a rectangular 'Facility Boundary' (dashed line). Inside, a 'Regulated Unit' (rectangle with a circled 'X') is shown. A 'Contaminant Plume' (shaded area) extends from the regulated unit to the right. The 'Point of Compliance' is marked with a circled 'X' at the leading edge of the plume, and the 'Point of Exposure' is marked with an 'X' at the far right edge of the plume. The bottom part is a 'CROSS-SECTION VIEW' showing the 'Regulated Unit' and 'Facility Boundary' as layers above the ground. A 'Water Table' is indicated by a dashed line. The 'Contaminant Plume' is shown as a shaded area below the water table, extending from the regulated unit to the 'Point of Exposure'. The 'Point of Compliance' is marked at the leading edge of the plume.

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Case 2: A regulated unit overlying useable groundwater, with groundwater contamination detected (but contained on-site). The POE will be assumed to be the leading edge of the plume – not the property boundary. An AF can be used in establishing the ACL.

9

Case 3

PLAN VIEW

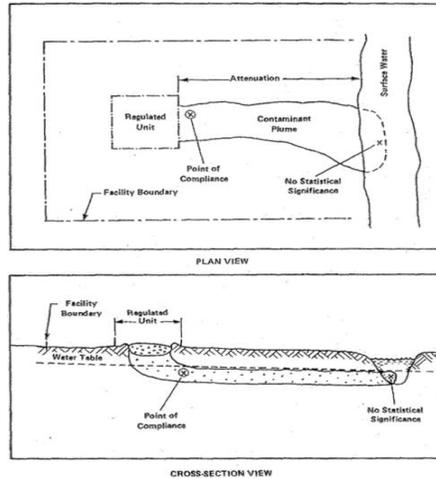
CROSS-SECTION VIEW





Case 3: A regulated unit overlying useable groundwater, with groundwater contamination detected off-site. The POE will be assumed to be at the property boundary. An AF can be used in establishing the ACL, however, attenuation can only be considered between the POC and POE (facility property boundary). At no time can the POE be beyond the original facility property boundary.

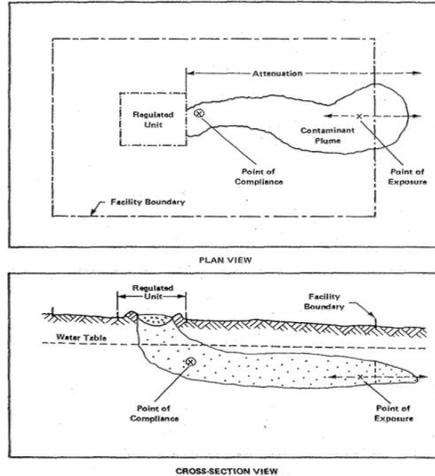
● ● ● | **Case 4**



Case 4: A regulated unit overlying useable groundwater which discharges to surface water. ACLs can be established based on the discharge to surface water if: (1) facility owns the property up to the surface water, (2) the contamination does not cause a statistically significant increase over background in the surface water, (3) the contamination will not reach and impact a receptor at an unsafe concentration before reaching surface water. Under no circumstances can the ACL be established such that the discharges to surface water cause statistically significant increases in the concentration of the contaminants in the surface water body.



Case 5



Case 5: A regulated unit overlying a non-potable aquifer with groundwater contamination detected. The POE will be established on a case-by-case basis. The ACL must be established to pose no unacceptable risk to public health or the environment. The permit applicant must demonstrate that the non-potable aquifer is isolated from any potable aquifer.

● ● ● | ACL Evaluation Criteria

○ Groundwater Criteria

- Physical and chemical characteristics of the waste
- Hydrogeological characteristics of the facility
- Quantity of ground-water flow and direction of ground-water flow
- Proximity and withdrawal rates of ground-water users
- Current and future uses of ground water



40 CFR 264.94(b) lists nine groundwater criteria which should be considered when establishing an ACL for a facility. Not all of the criteria will be required in every demonstration. The nine groundwater evaluation criteria are listed on this slide and the following slide. Detailed information on these criteria are included in the ACL Guidance document.

● ● ● ACL Evaluation Criteria

○ Groundwater Criteria (continued)

- Existing quality of ground water
- Potential for health risks caused by human exposure to waste constituents
- Potential damage to wildlife, crops, vegetation, and physical structures
- Persistence and permanence of the potential adverse effects



ACL groundwater evaluation criteria continued.

● ● ● | ACL Evaluation Criteria

○ Surface Water Criteria

- Physical and chemical characteristics of the waste
- Hydrogeological characteristics of the facility
- Quantity and quality of ground-water flow and direction of ground-water flow
- Patterns of rainfall in the region
- Proximity to surface waters



40 CFR 264.94(b) lists ten surface water criteria which should be considered when establishing an ACL for a facility. Not all of the criteria will be required in every demonstration. The ten surface water evaluation criteria are listed on this slide and the following slide. Detailed information on these criteria are included in the ACL Guidance document.



ACL Evaluation Criteria

o Surface Water Criteria (continued)

- Current and future uses of surface water
- Existing quality of surface water
- Potential for health risks caused by human exposure to waste constituents
- Potential damage to wildlife, crops, vegetation, and physical structures
- Persistence and permanence of the potential adverse effects



ACL surface water evaluation criteria continued.

Appropriate Usage of ACLs/ Regulatory Basis

o RCRA Permit Usage

- ACLs were developed to serve as GWPSs for regulated units under 40 CFR §264.94(b). As a result, they directly apply for usage in RCRA permitting cases



ACLs were developed specifically for use as a GWPS alternative to the 40 CFR 264.94(a)(2) Table 1 concentrations and the 40 CFR 264.94(a)(1) background concentrations. As a result, they are directly applicable for use in RCRA permitting cases.

Appropriate Usage of ACLs/ Regulatory Basis

- o **RCRA Corrective Action Usage**
 - ACLs do not apply to facility-wide corrective action (CA) of solid waste management units (SWMUs) under 40 CFR §264.101. However, many of the ACL concepts and approaches can be used in developing cleanup levels for site-wide CA



ACLs were developed for use at regulated units, not solid waste management units (SWMUs). Therefore, they are not directly applicable to facility-wide corrective action situations. However, the ACL concepts and approaches can be used in establishing groundwater cleanup levels (GWCLs) under corrective action scenarios (discussed below).

Appropriate Usage of ACLs/ Regulatory Basis

o Superfund (CERCLA) Usage

- Per CERCLA Section 121(d)(2)(B)(ii), ACLs may be established as ARARs under 3 conditions:
 - Contaminated ground water discharges to surface water
 - The discharge of contaminated ground water to surface water does not result in “statistically significant” increases of contaminants in the surface water
 - Enforceable measures can be implemented to prevent human consumption of the contaminated ground water



ACLs were developed for use at RCRA regulated units, not CERCLA site cleanups. However, CERCLA Section 121(d)(2)(B)(ii) specifically states that ACLs may be used as applicable or relevant and appropriate requirements (ARARs) under three conditions:

- (1) The contaminated groundwater discharges to surface water;
- (2) The discharge of the groundwater to the surface water does not result in statistically significant increases of contaminants in the surface water; and
- (3) Enforceable measures (e.g., institutional controls) can be implemented to prevent human consumption of the contaminated groundwater.

Appropriate Usage of ACLs/ Regulatory Basis

- **Superfund (CERCLA) Usage (continued)**
 - ACLs may be useful under the above conditions for addressing ground water contamination where it is impracticable or impossible to achieve the existing GWPS based on the Superfund remedy selection balancing criteria, and the ACLs can be shown to be protective of human health and the environment



ACLs are appropriate only where cleanup to ARARs is impracticable, based on an analysis using the Superfund remedy selection (balancing and modifying) criteria.

Where an ACL is established, an ARAR waiver is not necessary.

Where an ARAR is waived due to a technical impracticability (TI), there is no need to establish a CERCLA ACL.

Ground Water Cleanup Levels (GWCLs) Terms and Definitions

- Facility specific chemical concentrations in ground water that define the ground water cleanup objectives for final remedies. They provide clear numerical targets that stakeholders can use to measure the success of ground water cleanup actions
- Based on the maximum beneficial use to ensure that ground water is cleaned up to levels that protect human health and the environment, both now and in the future



RCRA ground water cleanup levels (GWCLs) are facility-specific chemical concentrations in ground water that define the cleanup objectives for final remedies. In other words, a cleanup remedy will be considered successful when the contaminant concentrations in the groundwater are equal to, or less than, the GWCLs. Since they GWCLs are specific concentration values, they can be used to measure the success of the cleanup action.

GWCLs should be based on the maximum beneficial use of the groundwater. This ensures they will be protective of human health and the environment.



Derivation of GWCLs

- **Use existing cleanup standards (e.g. drinking water standards - MCLs) when available**
- **If existing standards are not available, develop risk-based cleanup levels**
 - For carcinogens: 10^{-4} to 10^{-6} risk range
 - For non-carcinogens: Hazard Quotient or Hazard Index less than or equal to 1



The default GWCLs should be existing – promulgated standards (e.g., the Safe Drinking Water Act maximum contaminant levels [MCLs]).

Where default groundwater standards are not available, site-specific cleanup levels can be based on risk-based criteria. For human-health, this typically corresponds to risk levels in the range of 10^{-4} to 10^{-6} for carcinogens, and HQ or HI values less than or equal to 1 for non-carcinogens. Site-specific conditions can be considered in establishing the appropriate initial risk levels.

It should be noted that the approach to developing GWCLs (starting with appropriate risk-based values) is very similar to the approach used in establishing ACLs.



Lack of Necessity for GWCLs

- **GWCLs may not be necessary under certain circumstances:**
 - Contaminated ground water is within a non-drinking water aquifer
 - Ground water has no current or foreseeable beneficial use
 - Does not discharge to surface water or a drinking water aquifer at levels of concern
 - Does not cause exposure through cross-media transfer
- **However, ground water monitoring may still be required to ensure these conditions do not change over time**



Occasionally, GWCLs may not be necessary. Several scenarios where this may be the case include:

- (1) Where the contaminated groundwater is located within a non-drinking water aquifer;
- (2) Where the groundwater has no current, or foreseeable future beneficial use (i.e., for drinking, recreation, irrigation, etc.);
- (3) Where the contaminated groundwater does not discharge to surface water or a drinking water aquifer; and
- (4) Where the contaminated groundwater does not cause exposure to human or ecological receptors through cross-media transfer (i.e., volatile organic compounds in groundwater partitioning to the gaseous phase resulting in inhalation hazards).

Even if GWCLs are not necessary, it may be necessary to continue groundwater monitoring to ensure that these conditions do not change in the future.

Methods for Developing ACLs/ GWCLs

- Manual calculation methods - use of various equations (e.g. ASTM Soil Leaching, SAM, Domenico) to manually derive cross-media transfer and attenuation factors, and resulting ACLs/GWCLs
- Commercial Software – e.g. ASTM RCBA Tool Kit



ACLs and GWCLs can be determined several different ways. They can be manually calculated using appropriate equations. For example, various soil leaching models/equations (e.g., ASTM, Soil Attenuation Model [SAM], VLEACH, SESOIL) and vapor partitioning equations can be used to estimate the contaminant mass that will leach through the unsaturated zone to the groundwater, and volatilize to the surface air, respectively. Variations of the Domenico equation can be used to calculate the concentration of contaminant that will arrive in the groundwater at a downgradient point considering advection, dispersion, retardation (sorption), and biodegradation. Attenuation factors can be estimated using site specific hydrogeologic parameters for site without groundwater plumes, or by dividing the constituent concentration at the POC by the concentration at the POE at sites with contaminant plumes.

Commercial software packages are also available to calculate ACLs and GWCLs. For example, the *ASTM RCBA Tool Kit* (Groundwater Services, Inc.) can be run in backwards mode to calculate an ACL or GWCL at the contaminant source considering an initial risk-based concentration at the POE.

Pitfalls in Developing ACLs/GWCLs and Other Concerns

- Lack of appropriate documentation
- Inappropriate site-specific parameters (e.g., hydraulic conductivity, porosity, fraction organic carbon, dispersivity, contaminant half-lives)
- Different risk-based criteria
- Use of software not approved/endorsed by the Region or State



- (1) Often, facilities fail to provide sufficient information to support the ACL/GWCL demonstration. In particular, underlying assumptions are often omitted.
- (2) The derivation of site-specific hydrogeologic parameters is critical to determining realistic attenuation factors and resulting ACLs/GWCLs. For example, an overestimation of the f_{oc} and transverse dispersivity, and an underestimation of the contaminant half-life could result in an overestimation of the attenuation factor for the groundwater plume. This would result in an underestimation of the potential impact to receptors at the POE. All site-specific hydrogeologic parameters used as input to the equations/models should be verified for accuracy.
- (3) Risk-based criteria commonly vary from state to state or region to region. For example, the ambient surface water quality criteria in some states may only be protective of aquatic life, whereas in other states, the criteria may be protective of both aquatic and benthic organisms. If the criteria are not protective of the benthic species, a more stringent criteria may be necessary. This may be a concern where groundwater discharges to surface water.
- (4) Facilities commonly use software (e.g., RBCA Tool Kit) to determine ACLs/GWCLs. These software packages may, or may not, be approved/endorsed for use in the Region/State.

Pitfalls in Developing ACLs/GWCLs and Other Concerns (continued)

- Biological breakdown products and synergistic effects
- Exposure pathways
- Others?



- (5) ACL/GWCL derivations should consider the adverse effects of biological breakdown products of the primary constituents (e.g., DCE from TCE). Likewise, the demonstrations should consider the synergistic effects of the different contaminant compounds on human and ecological receptors.
- (6) ACL/GWCL demonstrations should consider all exposure pathways (including vapor intrusion for VOCs). Many facilities ignore this pathway as a potential health risk and loss of contaminant mass.
- (7) Should an exceedance of the protective risk-based number at the POE trigger corrective action if the ACL is not exceeded at the POC?