FACT SHEET

Guidance on Land Treatment of Nutrients in Wastewater, With Emphasis on Nitrogen

Background

Ground water standards for the state of Washington were adopted in 1990. The goal of the standards is to maintain a high quality of ground water and to protect the existing and future beneficial uses through the reduction or elimination of contaminants discharged to the subsurface. This is achieved by: 1) requiring that all wastewater be provided with AKART (all known, available, and reasonable methods of treatment, prevention, and control) regardless of the quality of water; 2) implementation of the antidegradation policy which mandates the protection of the background water quality; and 3) human health and welfare based ground water standards that include both narrative and numeric standards.

Guidance documents have been developed to meet the goal of the standards. These include: *"Implementation Guidance for the Ground Water Quality Standards" (*Ecology, 1996*),* *"Guidelines for Preparation of Engineering Reports for Industrial Wastewater Land Application Systems"* (Ecology, 1993), and *"Design Criteria for Municipal Wastewater Land Treatment Systems for Public Health Protection"* (Washington Department of Health, 1994).

Wastewater Land Treatment Systems

The sprinkler irrigation of wastewater from both municipal and industrial sources onto crop/soil systems for biological treatment is wide spread throughout the state of Washington. The primary goal of these treatment systems is to maximize contaminant uptake by the crop and minimize contaminant leaching below the root zone to protect the beneficial uses of the ground water in the uppermost aquifer. Maximizing crop yield is not equivalent to maximizing crop uptake and is not the goal of these treatment systems.

The state's ground water standards (WAC 173-200) require that AKART be provided to all contaminants prior to their discharge or entry into the ground water. AKART is meant to be a technology-based requirement, conditioned by a judgment of reasonableness, and includes pollution prevention and best management practices. It has been defined as effluent limitations for some categories of dischargers and some pollutants. For those dischargers with no defined AKART (e.g., land treatment systems), it is determined on a case-by-case basis via information presented in an engineering report.

Land treatment systems that have been approved and permitted by Ecology (AKART) require that water and nutrients must not be applied in excess of the agronomic rate of the site's cover crop. The term agronomic rate is defined in the ground water implementation guidance (Ecology, 1996) as the *"Rate at which a viable crop can be maintained and there is minimal leaching of chemicals downwards below the root zone. Crops should be maintained for maximum nutrient uptake when used for wastewater treatment"*.

For facilities that operate year round, a critical element in meeting AKART is the management of their wastewater that is produced during the winter non-growing season. At those times when a crop is not actively growing or the growth rate is very slow at low air and soil temperatures and not able to use nutrients supplied in the wastewater, continued application will most likely exceed the agronomic rate and AKART will not be achieved. A management strategy that has been approved by Ecology (AKART) and implemented by most year around dischargers that use land treatment is the storage of wastewater in lined impoundments during the non-growing season.

As an alternative to constructing lined storage impoundments, some year around dischargers have proposed that all or part of the hydraulic holding capacity of the sprayfield soils could be used to store the wastewater during the non-growing season. Information presented in proponents engineering reports claim that wastewaters high in organic and ammonia nitrogen can be stored in the soils with minimal leaching to ground water because these are not mobile nitrogen species. In addition, cooler winter temperatures will impede the mineralization of less mobile forms of nitrogen (e.g., organic nitrogen) to nitrate and theoretically crop growth in the spring will utilize the nutrients as they are made available and will help prevent leaching to the ground water

In an effort to better define AKART for land treatment systems, especially for those that produce wastewater year around, Ecology contracted with Washington State University to conduct a literature survey on nitrogen dynamics in the soil and vadose zone, especially as it relates to the application of high organic strength wastewaters. The results of the survey were published in a report entitled, "Nitrogen use by crops and the fate of nitrogen in the soil and vadose zone" (WSU, 2000; Pub. No. 00-10-015). The majority of the literature contained in the report is from research and studies conducted outside of Washington. However, given the diversity of crop/soil systems in the state, some general principles and recommendations were developed in the report for the use of nitrogen by crops, and the fate of nitrogen in the soils and vadose zone. These include:

- The estimation of the agronomic rate for a crop must factor in all sources of nitrogen available during the growing season.
- All nitrogen applied to the soil, that is not volatilized, will eventually convert to nitrate.
- Soil nitrogen that moves below the root zone will eventually leach to the ground water as nitrate.
- Denitrification may reduce nitrate loading to ground water under some conditions, though it is of little importance in well drained soils.
- Nitrogen applied at agronomic rates will minimize the buildup of soil organic nitrogen.
- Wastes applied substantially before or after maximum crop demand may result in nitrate leaching.
- Organic wastes applied during the non-growing season will partially or totally convert to nitrate before the next growing season.
- Nitrates leached beyond the root depths of the crop to be grown during the following season will be susceptible for transport to the ground water.
- Steps should be taken to minimize movement of nitrogen below the root zone during the growing and non-growing season.

- Applying organic wastes during the non-growing season has an inherent risk in terms of leaching nitrogen to the ground water.
- The use of storage facilities to minimize waste applications during the non-growing season is a safe alternative.

Wastewater Land Treatment Systems – Guidance Development

Based on the results of the WSU literature review report, and Ecology experience with land treatment systems and their impact to ground water, a series of discussion and issue papers were written by Ecology's Water Quality Program's Hydrogeologist Workgroup. They expressed the program's concerns and issues regarding the use of soil storage of wastewater during the non-growing season, and the potential for this wastewater management strategy to impact ground water.

An issue paper entitled, "Wastewater Land Treatment Systems; Nutrient Storage in Soils" was presented to the Water Quality Program's management team (PMT) in June 2000. The paper recommended that, "AKART for land treatment systems should include agronomic application of all constituents and lined winter storage if wastewater is produced outside the growing season or in quantities in excess of crop requirements." The PMT approved the issue paper as draft guidance and asked that it be given to the Water Quality Partnership for review and public comment.

In response to PMT's request, the issue paper was re-written into a discussion paper and entitled, "Wastewater Land Treatment Systems". It was sent to the Pacific Northwest Food Processors Association for comment. A series of meetings was held (Dec. 2000; Jan. 2000; March 2001) to discuss the issue paper and the concept of using the soil water holding capacity of a land treatment site to store process wastewater during the winter months in lieu of providing lined impoundments. Comments were also submitted by the association.

Several internal iterations of the discussion paper were developed by the Hydrogeologist Workgroup in response to comments and discussions at the meetings, and Ecology experience with land treatment systems. A final draft paper entitled, "Wastewater Land Treatment Systems; Soil Storage and Nitrate Treatment" was prepared in October 2002 and was presented again to the PMT at their March 2003 meeting.

The discussion paper made the following recommendations:

1. AKART for land treatment systems is the agronomic application of all contaminants that require treatment by crop uptake and the discharge to lined storage lagoons for wastewater produced outside the growing season or in quantities in excess of crop requirements.

2. Agronomic rate as applied to land treatment systems is defined as, "*During the growing season, the rate of wastewater application that maintains a viable crop such that there is minimal leaching of contaminants below the root zone. Crops should be managed for maximum treatment of the applied wastewater*".

3. Based on "best available science" it is Ecology's position that the only approvable option is properly designed, constructed and lined lagoons for the storage of wastewater during the non-growing season. The hydraulic capacity of the land application site soils is not considered by Ecology an alternative to the use of storage lagoons.

4. Total Dissolved Solids (TDS) is not effectively treated by the land application process at the concentrations of most permitted wastewaters. Therefore Ecology expects that maximum pollution prevention measures will be applied to all wastewater streams prior to wastewater application to the land surface.

5. Land application sites should be designed following the Ecology guidance in the Bibliography.

6. Ownership of cropland used for land treatment by a municipality or industry is recommended but not required. However, any cropland which accepts wastewater from a municipality or industry is considered a component of the wastewater treatment system and is subject to regulation. Under this circumstance, the landowner accepts the premise that the treatment of wastewater using these lands and the crops raised on them is not considered an agricultural activity, but rather a treatment process. It is generally held that maximizing crop yield is not equivalent to maximizing crop uptake.

The PMT gave conditional approval of the overall concept of the paper, but believed it needed some revisions to address the concern that the blanket prohibition of using soil storage during the non-growing season could be considered rulemaking. PMT asked that the document be revised and brought back for approval.

<u>Wastewater Land Treatment Systems – Draft Guidance</u>

The PMT approved discussion paper was reviewed by the program's Hydrogeologist Workgroup. Some editorial changes were made and the discussion paper became a draft guidance document entitled, "Guidance on Land Treatment of Nutrients in Wastewater." The new guidance concluded, in part, that:

- Nitrogen applied to land in the form of ammonia or organic nitrogen will convert to nitrate during the non-growing season, and will leach out of the soils and migrate to the ground water.
- Applying wastewater to the land during the non-growing season does not reliably protect the ground water and therefore does not meet the AKART requirement.

The draft guidance document was presented to the PMT on April 20, 2004, where it was agreed to move ahead with the draft guidance and include it in Ecology's *"Guidelines for preparation of Engineering Reports for Industrial Land Application Systems"*.

The draft guidance was given and presented to the Northwest Food Processors Association's Environmental Affairs Committee during their May 2004 meeting. Comments were received in a

letter dated June 7, 2004. A main concern was that the draft language did not allow for site specific alternatives to the current approved AKART for land treatment systems, and therefore did not allow any flexibility in the application of the guidance.

Wastewater Land Treatment Systems – Final Guidance

In response to the comments received from the NWFPA, the draft guidance was reviewed by the program's Hydrgeologist's Workgroup. Several important changes were made:

1. The title of the guidance was changed to reflect its focus on nitrogen; "Guidance on Land Treatment of Nutrients in Wastewater, With Emphasis on Nitrogen".
2. Site specific demonstrations of innovative plans to manage wastewater during the non growing season will be considered by Ecology. Approval of these plans will depend on their achieving nitrogen treatment equivalent in effectiveness for protecting the ground water as the current approved AKART.

The final guidance was adopted and issued in November 2004. It is available online at: www.ecy.wa.gov/biblio/0410081.html.

References Cited

Washington Department of Ecology. 1993. Guidelines for Preparation of Engineering Reports for Industrial Wastewater Land Application Systems. Publication #93-36.

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Washington Department of Health. 1994. Design Criteria for Municipal Wastewater Land Treatment Systems for Public Health Protection.

Washington State University. 2000. Nitrogen Use by Crops and the Fate of Nitrogen in the Soil and Vadose Zone. Publication #00-10-015.