Land Application of Municipal Wastewater
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# Land Application of Municipal Wastewater

## what is it and what are its potentials?

THE USE AND CONSIDERATION OF WASTEWATER application to land is increasing each year. In most instances the wastewater will be from municipal sources but industrial sources may also be included. Farmers, local government officials, and others are asking many questions about this wastewater application concept. This bulletin provides general information to help answer some of the most frequently asked questions.

### 1. What is the general concept of land application of wastewater?

Applying wastewater to agricultural land from municipal treatment plants, agricultural processing plants, and industrial sources is not new. This application has been practiced in foreign countries and in the U.S. for many years. It offers potential benefits to both the agency or industry which has wasterwater to treat and discharge and to agriculture which can use some of the water and nutrients for crop production. When wastewater is applied to the soil-plant environment, suspended solids and nutrients are filtered out; and the water is either utilized by crops or percolates to subsurface drains or to the groundwater.

### 2. Why is there increased interest in land application of wastewater?

In 1972, Congress passed amendents to the Federal Water Pollution Control Act (Public Law 92-500) which established a goal for "zero discharge" of pollutants into navigable waters by 1985. This law requires the Administrator of the U.S. Environmental Protection Agency to encourage waste treatment management which results in the recycling of potential sewage pollutants through the production of agricultural, forestry, and/or aquacultural products. As a result of this law many communities are upgrading their wastewater treatment plants. Land application of wastewater is one of the treatment alternatives which provides for recycling and is economically attractive to small rural communities. Energy costs, a continuing awareness of environmental protection, and a growing recognition among farmers of the moisture and nutrients in wastewater are also responsible for the increased interest.

### 3. What government agencies regulate land application of wastewater?

Specific regulation of wastewater application on agricultural land rests with the Water Quality Division, Michigan Department of Natural Resources. However, other levels of government may have authority over certain aspects of land application programs. Local zoning, nuisance, and health codes may influence specific projects. Efforts should be made to seek involvement of local officials and other potentially interested individuals in the development of land application projects to assure full understanding before implementation. Advice from county extension agents can be very valuable regarding individuals or groups who should be involved in the development of such projects and the decision-making process.

### 4. Is wastewater being applied now to Michigan agricultural land?

Many Michigan communities are using land application systems to meet their wastewater treatment needs. The largest system in Michigan involves wastewater to irrigate over 5,000 acres of once unproductive land in Muskegon County. Corn is the primary crop at the Muskegon County site. Other communities using systems to return wastewater to land include Colon, East Jordan, Harbor Springs, Leoni Township of Jackson County, Mackinaw City, Middleville, Roscommon, Wayland, and Belding.

The most widespread future use of land application systems for wastewater will probably be in small- to medium-sized communities with nearby established agricultural land.

### 5. Is wastewater treated before land application?

Yes, municipal wastewater generally undergoes the equivalent of secondary treatment prior to land application. Lagoon treatment and storage systems are frequently used for this purpose. Secondary treatment provides for stabilization of organic materials and partial destruction of pathogenic (disease-causing) organisms. Disinfection is required when sprinkler application methods are employed.

### 6. How is wastewater applied to land?

Usually wastewater is applied through sprinkler irrigation equipment. Municipalities which own their application sites often use solid set irrigation systems which can be completely automated. On private farmland, some type of traveling irrigation equipment more likely will be used. If fields of similar soil types can be leveled to provide uniform slopes of less than 1%, surface irrigation may be possible, using gated-pipe, or buried pipe with risers, to distribute the water across a contour. From there wastewater flows downslope until it infiltrates or reaches the end of the field. Water reaching the end of the field can be pumped back and re-introduced into the distribution system.

### 7. What nutrients and other components does wastewater contain? Are these components harmful to soil and crops?

Wastewater contains beneficial crop nutrients as well as suspended organic materials, micro-organisms, and in some cases, heavy metals. Since wastewater is extremely variable in content, one cannot be certain what it contains until tests are run. However, one inch of wastewater from a municipal treatment plant having secondary treatment might supply one acre with about 5 pounds of nitrogen, 2 pounds of phosphorus, and 4 pounds of potassium. Wastewater containing industrial wastes should be tested and expert opinion obtained prior to application on agricultural land.

### 8. What are the public health implications of applying wastewater to land?

Wastewater contains varying levels of pathogenic organisms based upon the degree of treatment provided. The danger of disease transmission can be lessened through good hygiene by those associated with the application process, avoiding unnecessary employee or public exposure to the wastewater, careful consideration of the physical aspects of the application site, and the characteristics of the wastewater. Disinfection of the wastewater prior to application when sprinkler systems are used will be necessary as a precaution.

Public health authorities do not advocate the use of wastewater on crops intended for human consumption in raw form because of the risk of disease transmission. While most toxic materials in wastewater have not been shown to enter the human food chain, some contaminants which may be found in wastewater have public health significance. Care should be exercised in determining whether the specific wastewater to be applied is compatible with proposed crop selections.

### 9. Will wastewater application cause offensive odors?

Wastewater odor usually results from decomposition of organic matter. The nature and intensity of such odor depends on the quantity of material and the conditions under which decomposition occurs. The term "stabilization" is used to describe the controlled decomposition of organic material in wastewater. In most cases, stabilization of the wastewater will be necessary before application in order to avoid odor nuisances.

Stabilization can be accomplished using commonly employed treatment methods such as mechanical wastewater treatment plants or stabilization lagoons. Trailing nozzles and low-level application to eliminate aerosal effects can also minimize odor potential. Virtually all nuisance odor potential can be eliminated in well-managed, fully developed programs of wastewater application to land, with proper consideration of site selection.

### 10. Will land application of wastewater pollute surface and groundwaters?

When planning and designing land application programs, careful attention must be given to the protection of lakes and streams to keep wastewater away from watercourses and thus protect the public using them for recreational and other purposes. Geological information must also be compiled and studied to make certain that wells in the area will not be contaminated.

Under good management, substances which can cause water pollution can be removed by the soil-plant environment. Application rates should be controlled to avoid runoff which would go directly into surface waters. Maintaining vigorous crop growth and harvesting crops will minimize groundwater pollution. However, the ability of the soil and plants to hold and/or remove nutrients and other substances must be considered in planning application rates in order to be sure groundwater pollution is avoided. If significant danger exists, permits for the application program will not be issued by the state agencies having jurisdiction.

### 11. What crops are best suited to wastewater utilization?

Crops grown on land where wastewater is applied should be those which can receive and utilize large amounts of water through evapo-transpiration, as well as take up high quantities of nutrients. Forage crops such as alfalfa and grasses, including ryegrass, orchard grass, reed canary grass, tall fescue and quackgrass, do well on land application sites. Corn is the most common annual crop for wastewater application sites because it will use large amounts of water and more nutrients than other annuals. Corn also has a comparatively high economic return.

Farmers who are interested in utilizing wastewater for irrigation will want to grow crops with a higher market value or greater nutritional value as livestock feed (e.g., an alfalfa-grass mixture rather than grass

alone). If the land is publicly owned, permanent cover crops such as forages may offer advantages over annual crops which may have a higher economic return (e.g., no need to till the soil and re-establish a crop each year, more complete cover for better soil erosion control and maintenance of high infiltration, etc.).

### 12. What soil types are best suited to wastewater utilization?

Wastewater application sites must be designed to (a) receive higher-than-normal quantities of water during the year and (b) renovate the wastewater as it passes through the soil profile. Coarse-textured soils (sands, loamy sands, sandy loams) have high infiltration rates and capability to percolate large amounts of water. However, these soils have limited ability to remove nutrients and other dissolved substances from wastewater. Finer-textured soils have a good ability to renovate the wastewater but take in water more slowly.

Subsurface drainage will be necessary for almost all soils to ensure that water percolation will not be restricted and thus limit wastewater applications. With suitable drainage and Michigan climate, 60 to 80 inches of wastewater per year could be applied to coarse-textured soils, in addition to normal precipitation, in most years. With medium-textured soils (loams and silt loams), 30 to 50 inches per year could probably be applied, whereas annual applications to fine-textured soils (clay loams, silty clay loams, clays) would be quite limited due to their very slow percolation.

The suitability of a given soil type depends on the rate of wastewater application which can be used and the total quantity which can be applied annually. This rate of application and total quantity applied must then be managed to achieve the desired renovation of the wastewater and to allow for periods when wastewater cannot be irrigated (e.g., during rainy weather, resting periods to insure adequate soil aeration for crops, and planting, tillage and harvesting operations).

### 13. Would a farmer encounter difficulties marketing crops and livestock produced on land where wastewater is applied?

When a program for wastewater application to cropland is developed, specific attention should be given by the originator of the waste (municipality or industry) to avoid creating any threat to the crops being grown. This may include specific control of toxic waste discharges. These measures should be clearly established between the landowner and waste originator as a part of project development. Certain crops, such as leafy vegetables which could be eaten raw, should not be grown where domestic wastewater is to be applied. The impact of the wastewater on crops cannot be disregarded, but there is currently no need to be concerned about crop or livestock marketing when the wastewater application program is properly planned and implemented.

### 14. What are the primary advantages of using wastewater for crop production? Is it economically feasible?

The primary agricultural benefit of applying wastewater to cropland is the water itself. Nutrient content of the water can improve crop yields and reduce the need for commercial fertilizers, but the real impact on production comes from the irrigation.

Plants and soil organisms act as a living filter to cleanse the water before it percolates to the groundwater table. Estimates indicate that this natural process can remove 75 to 90% of the nutrients, and it alleviates some of the demand on surface waters for dilution of the wastewater. Thus, land application can be a useful way for treating community wastewater.

Wastewater application to cropland can be economically feasible for the farmer with appropriate crop selection, proper management, and suitable costs. Land is the treatment system. The attractiveness of this system to a community may be diminished if an adequate amount of land with suitable soil types is not available reasonably close to the community.

### 15. Can wastewater application be adapted to private agriculture?

Yes. Various agreements between community and farmer can be adapted, depending on the particular situation.

### 16. What are the possible institutional arrangements between communities and farmers to utilize wastewater?

There are several alternatives. These include:

#### Purchase and Leaseback

Under this option the wastewater treatment authority buys the land and leases it to another party for farming operations. The lessee may be the previous landowner or a third party such as a management firm. Maintenance costs, which are usually borne by the authority, could possibly be passed on to the lessee. Alternatively, the community might hire a manager.

#### Purchase and Resale on Condition

This involves the public purchase of land and its subsequent resale for private use as limited by the deed. This is a means of insuring that land acquired by a public body shall be properly transferred so that development and use will conform with public land use objectives.

The purchase-resale option enables a wastewater authority to obtain rights to land without making a long-term capital investment. The conditions important to the operation of the wastewater treatment process can be prescribed in the resale conditions.

### Negative Easements

This option involves the acquisition of only that portion of the total "bundle of rights" to land necessary to meet specific objectives. This conveyance is called a development or "negative" easement. A farmer granting an easement is able to maintain ownership while relinquishing certain rights in exchange for negotiable compensation. For example, a wastewater authority may purchase an easement to transmit and apply wastewater to cropland for a certain annual fee. Various arrangements for compensation are possible.

### Contractual Agreements

This arrangement insures access to land without any transfers of real property rights. Many agreements can be arranged between the farmer and community. The terms of the agreement are specified in the contract and can cover construction of the application and drainage system, application rates, cropping practices and cost-sharing for maintenance and operation of the system.

### Wastewater Cooperative

Special cooperatives for land treatment are an alternative to the two-party contractual agreements. Basically this would involve a group of farmers dealing collectively with the wastewater management authority to provide more satisfactory arrangements for collection and application of wastewater.

Selection among these, and perhaps other institutional options, depends on the circumstances unique to each land treatment system. From the community standpoint, the various arrangements imply tradeoffs between dollar cost and control of the system. If the community wants complete control, it has to put up all of the capital. The farmer, on the otherhand, wants to maintain sufficient management discretion to keep his farm competitive, while avoiding as much of the system cost as he can. There is clearly room for negotiation. Nevertheless, the community must select an option that will provide it enough control over sufficient land area to service its long-term needs and also to maintain an overall responsibility for the land application program.

## 17. What adjacent land uses are compatible with land application of wastewater?

Application sites selected should not be adjacent to high population areas or recreational facilities to avoid negative public reactions. The most compatible adjacent land uses are those involving low population, predominantly rural in character, where use of the site is not in sharp contract to adjacent land uses, It should not be necessary to conceal the site from public view, but neither should the public feel concerned by the site.

## 18. What research is being conducted to provide information on land application of wastewater?

Many universities across the country are researching the application of wastewater on agricultural land. The most prominent project is one at Pennsylvania State University which has been active for many years in evaluating land application of wastewater to both forest and cropland. The U. S. Environmental Protection Agency and the U.S. Army Corps of Engineers have active programs to evaluate wastewater application. In Michigan, research related to wastewater application is being conducted at the Muskegon County Wastewater System. Also, Michigan State University has a part of its research farm devoted to ponds and land application sites for research on methods of utilizing wastewater from the East Lansing municipal treatment plant.

## 19. Where can one obtain more information on land application of wastewater?

Several excellent sources are available. These include the following:

Department of Natural Resources, Stevens T. Mason Building
P.O. Box 30028, Lansing, Michigan 48909

Department of Agriculture, Lewis Cass Building
P.O. Box 30017, Lansing, Michigan 48909

Public Affairs Division, Michigan Farm Bureau
P.O. Box 30960, Lansing, Michigan 48909

Department of Public Health, 3500 N. Logan
P.O. Box 30035, Lansing, Michigan 48909

Cooperative Extension Service, MSU
East Lansing, Michigan 48824

Other sources are county or district health departments, county extension offices, and officials of communities presently operating wastewater application systems utilizing land.

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