N E T A F I M U S A

Guidelines for Using Imported Soil
for Onsite Wastewater Systems in Marginal Soil-Site Conditions

WASTEWATER DIVISION

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BACKGROUND

Increasing sources of nutrient pollution from population growth and development in the Table Rock Lake watershed of Missouri threatened water resources. The increasing population of the area from rural to a "suburban" lake side community uses onsite wastewater treatment systems. Many of these systems are often not suitable when used in concert with the small lots and thin existing soils in the region that receive and (hopefully) add additional treatment to the wastewater.

Drip irrigation was considered the best dispersal and treatment alternative for wastewater systems in the Table Rock Lake area because of drip dispersal's ability to provide aeration and microbial activity as well as being able to precisely disperse the effluent over a wider area allowing for maximum absorption by the thin soils.

As the Demonstration Project developed, it was further determined that the thin soils around the Table Rock Lake area were often not adequate for treating the wastewater, even from drip dispersal. Therefore, time-dosed drip dispersal in concert with imported soil was demonstrated to evaluate its performance. In addition to improved wastewater treatment and protection of the water quality of Table Rock Lake, the success of this design and treatment technique has helped allow for the acceptance of drip dispersal as a viable alternative to failing conventional systems in the thin soils near Table Rock Lake.

While this project worked with the dispersal of onsite wastewater into the soil, the guidelines and processes described will be the same for other types of water being used in subsurface drip irrigation in landscape irrigation. In fact, the success of drip dispersal to effectively manage effluent from onsite wastewater treatment systems in imported soils proves the ability of drip irrigation to work with higher quality water in other amended soil conditions.

This property's soil is not adequate for use as a drip dispersal area without the addition of imported soils.

Imported soils being installed in 6" lifts with tracked vehicle.

AUTHOR'S NOTE

Netafim USA thanks Dr. Randall J. Miles of the University of Missouri. The need for this paper was made clear while attending a class he presented at a Missouri Smallflows Organization Meeting. The bulk of these guidelines come from the work of Dr. Miles and his colleagues, and their expertise in soils and the creative study of the site conditions at Table Rock Lake both before and after the demonstration project have provided great insight into the ability of drip dispersal and advanced treatment to coexist in communities with poor soils where there is a high risk of environmental damage.

OVERVIEW

The primary reason for using imported soils is to increase the vertical separation from a restrictive layer. Restrictive layers are layers of soil or rock that effectively impede or stop the flow of water into the soil, potentially resulting in surfacing of the wastewater (also referred to as "effluent") and the attendant problems it can cause. Additionally, much of the bedrock in the Table Rock Lake area is highly fractured, providing a greater chance of intrusion into the groundwater and lake body.

Through the use of imported soil, the depth of the absorption field is increased to add separation from the restrictive layer, allowing the wastewater to be dispersed into and further treated by this soil before being introduced into the groundwater.

The use of imported soil requires special care, but it has been proven to be a viable solution to overcoming site limitations.

Because onsite wastewater designs are subject to state and local regulations, any regulatory specifications must be given precedence over the recommendations included here. If local regulations allow design parameters which are more liberal than those expressed in this guide, the designer should bear in mind that the conservative recommendations herein are based on actual design experience and analysis of both properly functioning and failed onsite systems. When it comes to design, Netafim takes a conservative approach.

These guidelines are not meant to replace the services of a design professional. Netafim recommends that a licensed professional be consulted for proper onsite system design and operation.

REASONS TO CONSIDER THE USE OF IMPORTED SOILS

- Limited depth to:
  - A restrictive horizon
  - Fragipan - dense, brittle subsurface soil layers that restrict water flow and root penetration
  - Bedrock - both consolidated and fractured
  - A high water table - can cause a lack of oxygen
- Limited area of suitable soil
- Small footprint of the site
- Need to increase the vertical separation for treatment and proper hydraulic loading

USE OF IMPORTED SOIL IN MARGINAL SITES

While imported soils are not the "magic bullet" to solving all of the issues caused by a site with marginal soil, they are a viable and long term solution providing many benefits. When considering importing soil, it is worth remembering that:

- Sound practices must be followed for:
  - Imported soil material
  - Preparation of the soil treatment receiving site
  - Harvesting, transporting, and placing of the imported soil material
- Aerobic pretreatment of the effluent is highly encouraged
- Dispersal as unsaturated flow is critical, thus drip dispersal
- May not be the easiest to properly install or the lowest cost alternative
- Specifications are not meant to discourage the installation and use of imported soils, rather they are intended to help ensure success

THE FIRST STEP - GET ACCURATE INFORMATION

To increase the likelihood of success, a comprehensive site inspection should be made by a soil scientist or other trained soils professional. All soils are different and they will react differently to harvesting, transport and installation. Further, important changes in the imported soil such as its hydraulic loading capabilities will occur after being harvested. As such, it must be identified and calculated before the design process is done.

CHALLENGES WHEN USING IMPORTED SOIL

- The fill must be within a specific textural class range
- A lack of uniformity of the fill material, both laterally and vertically can cause:
  - Variability in texture and structure
  - A soil structure that is easy to destroy or degrade
- Unwanted compaction during the harvesting and placement process
- Subsidence (settling) can be a long term problem
- Plant residue, roots and too much organic debris in the placement area and the harvest area can provide unwanted channels for by-pass flow
- Poor quality soil material that is specified or used
- Diversity of the soil texture being used
- Soil structure that is destroyed or obliterated
- Placement that is not uniform, allowing for preferential by-pass flow
- Allowing the proper amount of time to stabilize and not subside
- The use of on-demand or gravity distribution that can cause:
  - Uneven soil trench depth, thus not providing proper distribution
  - Localized overloading of zones or pockets
- Incomplete treatment of the wastewater before dispersal - remember - the more treatment you have before dosing, the easier it will be for the soil to further treat it.

CHARACTERISTICS TO LOOK FOR IN IMPORTED SOIL

- Imported soils must possess physical characteristics that are:
  - Uniform
  - As close as possible to the original state
- The soil material must have uniform:
  - Texture
  - Structure
  - Pore space, i.e. size, connectivity and geometry. Uniformity and consistence of the soil pores is critically important

QUALITIES OF THE SOIL TO BE IMPORTED

- Sandy to loamy material must be used
- Usually <20% clay, including:
  - Sandy loam, silt loam, loam, loamy sand
  - Do not use “topsoil” or “black dirt”
  - Color does not count
- Cautions:
  - Use of platy or structureless - massive materials will not work
  - Above-ground plant growth and roots must be removed before harvesting - organic debris should be < 15%

SOIL LOADING RATE DESIGN GUIDELINES

A soil with a specific loading rate in its natural state will not have the same loading rate once it is harvested, transported and installed. For this reason it is important to minimize the changes that will take place so that the soil can perform properly once installed. In general, the best way to do that includes:

- Choose a soil that has excellent properties - sandy and loamy materials are good choices and are the most likely to maintain similar traits from their pre-harvest condition
- Harvest, transport and install the material under optimum conditions
- Use a trained professional to assist in determining what the hydraulic loading rate of the soil is before harvesting and what it is expected to be once it is harvested, transported and installed

WHAT SOIL LOADING RATE TO USE

There are differing philosophies regarding what soil loading rate to use when doing the system design. Some professionals believe that because some dispersal will occur in the natural soil, decisions on dispersal field size should be based on the loading rate of the natural soil to minimize the chance of overloading the soil. Others believe that while this makes sense in an academic sense, it is not always possible to use the loading rate of the natural soil in real-world settings, especially if it is bedrock, fragipan or other layer that makes an effective loading rate calculation impractical. In that case, it is customary to apply a calculated loading rate of the imported soil using a devaluing factor.

For example, if a sandy loam or loam soil is being used and its loading rate is 0.5 gallons per square foot per day in its pre-harvested state, it may be decided to base the calculations on a loading rate of two thirds of 0.5, or 0.33. In cases where less-than-desirable soils have to be used, the hydraulic loading rate may be up to 50% less.

Once the characteristics of the imported soil have been identified and the field is sized, it is ready to bring the soil to the project and install it.

Imported soils are put into place.

REMOVAL AND HANDLING OF SOIL DURING HARVESTING AND TRANSPORT

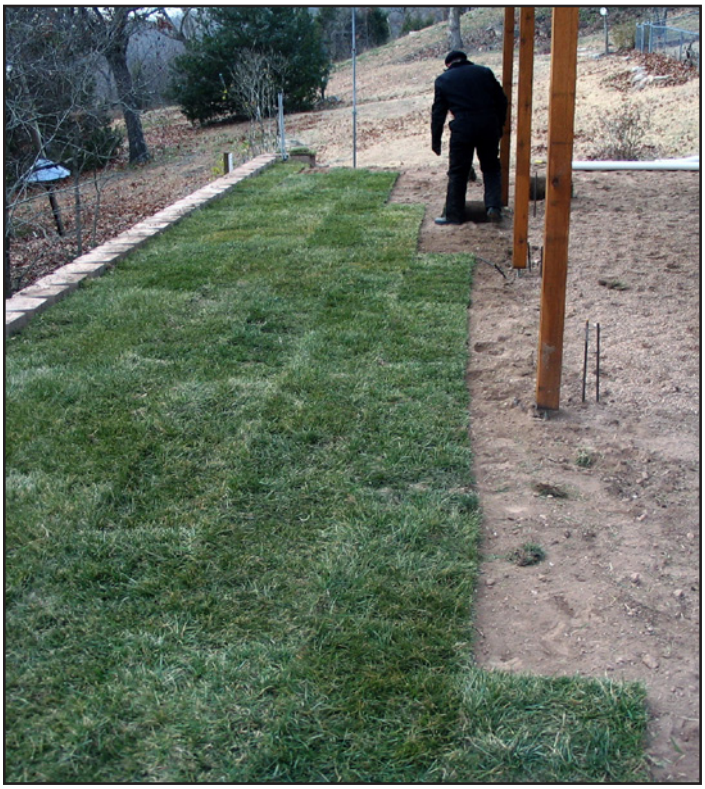
- Removal and transport of the harvested soil must be performed under DRY conditions
- If you are using soil that has been harvested previously and has been stored in a pile:
  - Remove soil by going around the base of the pile, taking soil that is the same moisture level
  - Do not dig into the center of the soil from the outside. There is too much chance of varying moisture levels (moist and dry soil tends to "ball up")
- Material at the harvest site must be as uniform as possible

PLACEMENT OF IMPORTED SOIL AT THE INSTALLATION SITE

- Surface water diversions must be in place before placement. They may also be advisable as permanent fixtures to reduce surface water infiltration
- Consult a soil scientist or other trained professional if the dispersal field has a slope in excess of 15% - 20%
- All earthwork at the site must be performed under DRY conditions
- Removal of plant residue and roots from the site must be performed before placing any fill. This will help ensure that an organic layer is not created when the imported soils are placed
- Light scarification of any remaining native soil interface may be necessary, especially in very tight soils. If so:
  - Chisel/shank implements are best
  - Roto tilling the soil is not desirable
- The preferred transport method is directly from the harvest site to the new site
- Using stockpiled soil is not recommended due to the soil's variable moisture content
- To prevent the formation of a platy structure:
  - Imported soil must NOT be compacted
  - Use of a tracked vehicle is encouraged
  - If tracked vehicles are not available, equipment using high flotation tires should be used. These tires apply the vehicle's weight across a large footprint for less compaction
  - Soil should be set into place in small "lift" increments (4 - 6 inches) instead of one thick layer
- Working with a soil scientist is encouraged to help ensure that:
  - The proper specified texture is delivered
  - Damage of the soil's structure has been minimized
- Vertical separation for the dispersal and treatment field ideally should be the native soil with the fill being the cap
- If possible, allow the imported soil to settle for several days before installing the dripperline
- The area should be crowned to allow for effective surface water runoff
- Establish grassy vegetation as soon as possible - this provides erosion control and a more consistent and uniform settlement (pore space)

Netafim Bioline® is laid across the top of the soil in even rows. (Note the proximity of the dripperline to the home's foundation and doorway. Drip dispersal is family-friendly.)

A quality soil is installed across the dripperlines - whenever possible it is recommended to place soil in 4" to 6" lifts. This keeps the loading parallel to the dripperlines to avoid shifting the rows.



Sod is laid across the imported soil.

This homeowner enjoys a drip dispersal system that applies the effluent safely and evenly across the dispersal area along with an additional benefit - free irrigation water to keep the grass green.

WHEN IMPORTED SOIL MUST BE USED FOR NEARLY ALL OF THE SOIL DISPERSAL AND TREATMENT COMPONENT

- Unsaturated flow (drip dispersal) is the only way to disperse in this environment
- Construction must be performed under ideal environmental and climatic conditions
- Soil properties must clearly be specified (NOT "topsoil" or "black dirt")
- Advanced treatment should definitely be used

WHEN IN DOUBT

- Bring in soil professionals
- It is better to err on using a sandier material within the specified range
- It is better to err on harvesting, transporting, and placing the soil under dry conditions rather than moist
- Remove the few remaining roots and organic debris
- Divert all surface and subsurface water
- Place in small layer increments, not one thick layer
- No matter how "uniform" you believe the fill is placed, consider timed, pressure dosing (drip dispersal). This provides critically important unsaturated flow
- You cannot go wrong with highly treated effluent

APPLICATION OF THE FINDINGS OF THE TABLE ROCK LAKE STUDY

As this paper illustrates, much was learned about treatment and dispersal, especially in dealing with marginal soil-site receiving environments. One critical lesson learned was to use advanced treatment. This ensures that the wastewater is being treated as aggressively as possible before being sent out to the drip dispersal field. By doing so, the stress being placed on the soil is significantly reduced. The second lesson was to use time-dosed drip dispersal. This technique allows for dispersal of the effluent rather than disposal into the soil with specific rest periods between doses, and its ability to precisely dose the wastewater into the soil allows for excellent further treatment (aeration) by the soil without the fear of creating a saturated flow condition.

To learn more about the Table Rock Water Quality Onsite Wastewater Demonstration Project, please visit **www.trlwq.org/onsiteDemoproj.html**

To learn more about Netafim Wastewater products, visit **www.netafimusa.com/wastewater**

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