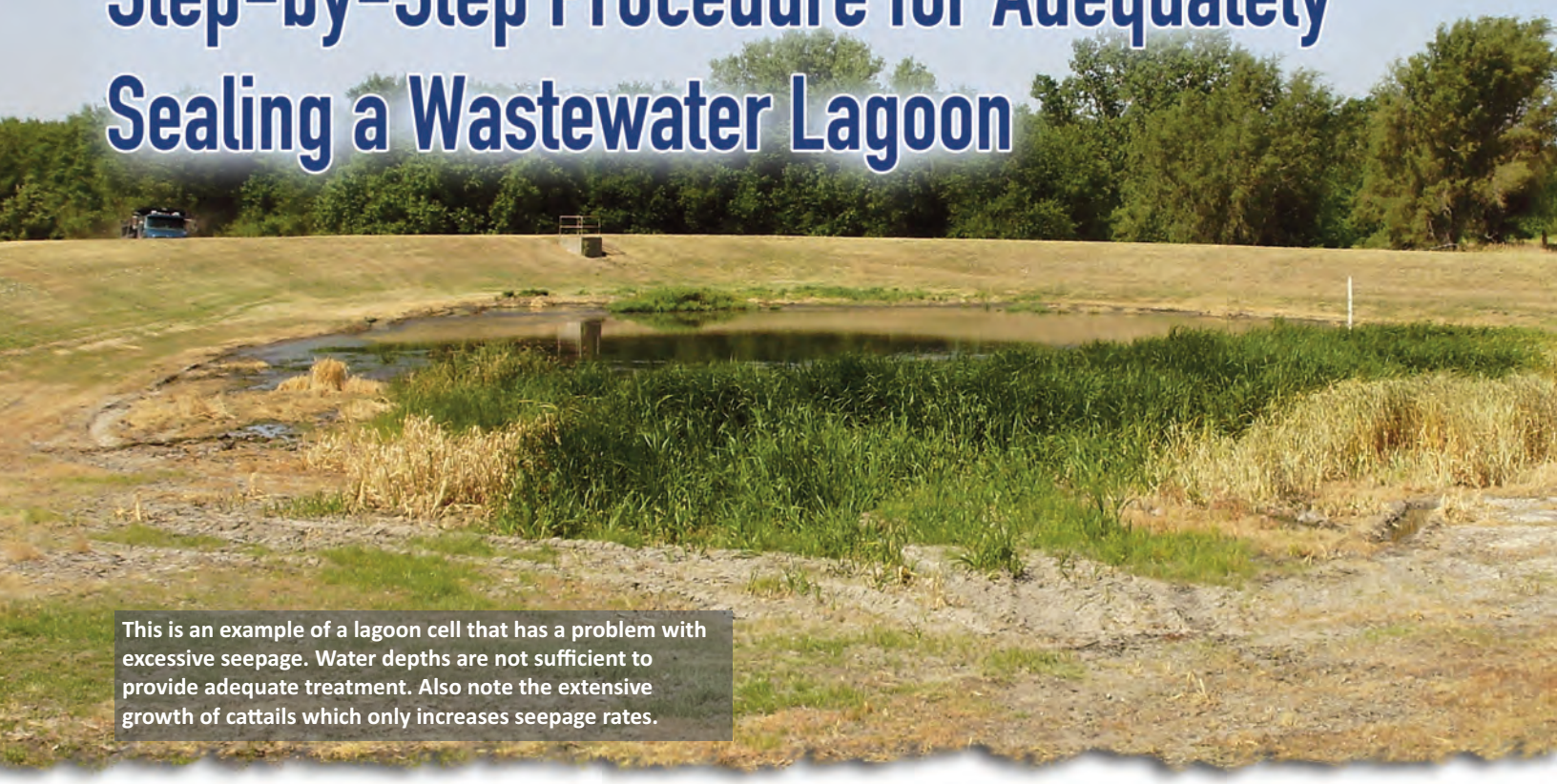
By Jeff Lamfers, KRWA Consultant

Step-by-Step Procedure for Adequately Sealing a Wastewater Lagoon



This is an example of a lagoon cell that has a problem with excessive seepage. Water depths are not sufficient to provide adequate treatment. Also note the extensive growth of cattails which only increases seepage rates.

I have been asked recently by several small wastewater system operators for assistance in sealing lagoon cells that are leaking excessively. By excessively I mean minimum water depths (2.0 to 2.5 feet) needed for adequate treatment cannot be maintained. Typically, there should be at least two feet of water in any lagoon cell in service, and more is better. In most cases, the system requesting assistance was wanting to place a second or even third cell in service because upstream cell(s) were not able to hold all flow. But in a few instances, the primary cell was leaking excessively meaning that basically the lagoon was not holding any wastewater at all. Not only does this make providing adequate treatment difficult, but the Kansas Department of Health & Environment (KDHE) also becomes concerned that the potential for contaminating groundwater is increased. I want to provide a step-by-step process for successfully sealing a lagoon cell.

First, all debris must be removed from the cell to be sealed. If such material is not removed, it makes compacting the pond bottom and inner dikes next to impossible. Debris usually includes wind-blown dust/dirt, minor amounts of sludge if the cell has ever been used in the past and usually lots of layers of vegetation that has grown over the years. It is not unusual to find anywhere from six to twelve inches of debris that needs to be removed. Some systems have been able to remove this material themselves using a grader, front-end loader and dump truck.

When using a grader to remove debris, operators must be very conservative to ensure only removing debris and not the original pond bottom which may contain bentonite. Many lagoons built in the past have been sealed using bentonite. Bentonite is a clay formed by the decomposition of volcanic ash. Its greatest attribute is that upon contact with water, it absorbs water and expands as much as seven times its original volume. Once expanded, it provides a uniform barrier that is excellent for controlling downward seepage of wastewater. It is easy to visually determine if bentonite was used originally to seal a lagoon cell. It is a very light gray, almost white layer of very fine clay, usually less than six inches thick.

Keep the bentonite!

It is always a good idea before using a grader to remove debris to use a shovel or sharpshooter to dig down several inches to see if a layer of bentonite exists. If it does, you don't want to remove it. Since bentonite is an inorganic substance, it will not have broken down over the years and can still be effective in sealing a lagoon cell. So, leave it in place. You may even want to use a transit so you will know how much material to remove (or leave) so you have a lagoon cell with a relatively flat bottom when finished. If in doubt about the presence of bentonite, you might also consider

having a private lab run a soils test to determine if the type of soil present has sufficient clay to promote good compaction and minimal seepage.

When removing debris, it's important to also take care not to damage the influent line to the cell, any structures used to support this line and the concrete splash pad at the end of the influent line. The line should be marked so that it is not hit and damaged by the grader when scraping the lagoon bottom while removing debris. If a splash pad is found, it can also be used as a reference point when deciding how much debris to remove as the pad should be at the same elevation as the original pond bottom.

Once all debris has been removed, it may be advisable to lightly disturb several inches of the original pond bottom so that it can then be compacted. This should also provide a more uniform soil mixture. It may already be adequately compacted, but unlikely if lots of vegetation was allowed to grow in the cell over the years. If plants such as trees and/or cattails were allowed to grow in the cell, the bottom will need to be re-compacted as the extensive root systems of such plants can compromise the pond bottom and allow excessive seepage. I recommend using a spring-tooth harrow to break up the surface of the pond bottom. I would run both north/south and then east/west in order to break up the surface crust satisfactorily. Don't disturb the bentonite layer too much, so do not use a piece of equipment that penetrates too deeply.

The next step is to compact the soil on the pond bottom and several feet up the interior dikes. A smooth roller should be used and not a sheepsfoot. The sheepsfoot will not keep the clay or bentonite layer at a uniform depth. Some bentonite will be pushed too deep while some will remain at the original depth. So, if a smooth roller is available, that's what should be used. In order to achieve maximum compaction, most systems need to add water to the soil. This is especially true if the project is being carried out during the extreme heat of summer. Without some water, the soil (and bentonite if present) will not compact very well. So, it may be necessary to have a water truck on site in order to first spray areas to be compacted.

A grader is used to gather debris off the bottom of the lagoon cell. The debris can include wind-blown dirt and minor amounts of sludge and dead vegetation. Such material will prevent good compaction. In addition to the grader, a front-end loader and dump truck are used to remove the debris.

Soil sterilant

The next step is to add a soil sterilant to the disturbed areas so that unwanted plant growth does not become a problem once the lagoon is placed in service. The last thing anyone wants in a newly rehabilitated lagoon cell is problems with cattails, willows or other deep-rooted plants becoming established. Soil sterilants are herbicides that kill all vegetation and are formulated to last for long periods, often for ten years or more. Unlike pre-emergent herbicides which are made to control new, sprouting plants, soil sterilants control existing and future

This photo shows a lagoon cell after it has been rehabilitated to prevent excessive seepage. A staff gauge has also been installed.

growth of almost all unwanted plants. Sterilants are also persistent, remaining in active form for many years. Two of the more commonly used sterilants are Pramitol and Karmex. Roundup is not a soil sterilant. Just be careful when applying a soil sterilant, to not apply on the inner dike above the maximum water depth line. Otherwise, establishing a good grass stand on the inner dikes for that area above the water line will be very difficult.

The last steps are to install a staff gauge for measuring water depth in the cell and adding stone riprap if desired. If anchored adequately, a length of 4-inch PVC pipe filled with concrete makes a great staff gauge. But it needs to be well anchored so that it will not be pushed over by ice or wind. An inclined concrete section of the dike can also be used as a depth gauge. Wooden staff gauges are not recommended by KDHE. In either case, I would suggest marking it in three-inch (quarter-foot) increments.

While adding stone riprap is optional, I strongly encourage systems to consider it. Riprap not only prevents erosion, it also minimizes rodent burrowing problems and unwanted weed growth at the water line. Options include constructing a concrete apron or placing stone riprap not smaller than two inches in diameter or larger than five inches in diameter. Again, the soil beneath the riprap needs to be treated to prevent future weed growth. Options here include either laying plastic sheeting or landscape fabric, or spraying with a soil sterilant as discussed previously.

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Once the project is completed, begin adding wastewater to the rehabilitated cell so that a minimum two-foot water depth is attained rather quickly. This depth is needed not only for adequate treatment and to prevent odors, but to also prevent sunlight penetration to the pond bottom that could result in unwanted plant growth. At this point, it's also a good idea to conduct a seepage test to see if the cell is holding water. The seepage test must take into account evaporation and any rainfall that may occur during the test. If the aforementioned steps are followed closely, the cell should be adequately sealed and hold water for many years. If I can be of assistance with your lagoon sealing project, please feel free to contact me. I can be reached at either (913) 850-8822 or jeff@krwa.net. And I also want to encourage you to attend the Annual Conference & Exhibition next March 27 – 29 at Century II in Wichita. There will be many presentations on wastewater topics, some specific to lagoons, on the program.

Jeff Lamfers began work for KRWA in November 2008. Jeff has more than thirty years of regulatory experience in the oversight and operation of water and wastewater systems with the Kansas Department of Health and Environment. He is a graduate of the University of Kansas with a degree in Environmental Studies with an emphasis in aquatic biology.